PG&E's Mandatory TOU Rate Education and Outreach Assessment

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Executive Summary

PG&E's institution of mandatory TOU pricing for small and medium business (SMB) customers and small agricultural customers is the first wide scale implementation of mandatory time varying pricing in the U.S. for customers of that size. The rate transition is designed to factor in when customers consume power in addition to how much they consume in determining their bill; leading to a closer alignment between the prices customers face and the cost of supplying power. The transition required efforts to ensure customers were aware of the transition, understood TOU pricing conceptually, knew how the shift affected them personally and, if they elected to do so, were able to develop a concrete plan to change their peak period consumption.

PG&E implemented an outreach and education campaign designed to increase awareness and improve understanding of TOU rates. The education campaign had three main components:

- **Outbound phased mail** designed to build customer awareness and knowledge as the TOU transition neared;

- **Person-to-person outreach** for select customers that were either among the 10% most highly impacted or in traditionally hard-to-reach customer groups; and

- **Always on education materials** available to customers at any time throughout the year (e.g., earned media, online content, webinars, etc.) and designed to provide resources to customers looking for more information.

This study was designed to quantify the impact of PG&E's education campaign and the effectiveness of the campaign's main components:

- Were SMB customers aware of the transition to mandatory TOU rates?

- Did customers understand TOU rates?

- Did they know of and understand options available to help them manage the transition to TOU?

- What was the relative effectiveness of different outreach efforts?

- Did the level of education and outreach influence customer demand response?

The staggered roll out of mandatory TOU rates at PG&E provided a unique opportunity to compare side-by-side cohorts of customers who transitioned to TOU rates in November 2013, customers who had been on the rate since November 2012 (which was helpful for measuring retention/decay), and a control group of customers who had not received outbound PG&E education and outreach materials. Overall, Nexant surveyed 2,302 small and medium businesses customers to assess levels of awareness and understanding of TOU rates.[1] Within each of the three cohorts, we oversampled customers eligible for person-to-person outreach and customers immediately below the eligibility cutoff.

Overall Findings

- PG&E's outreach and education campaign increased the share of customers who could correctly identify their rate. In total, 48% and 43% of customers who transitioned to TOU in November

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[1] Small agricultural customers were not included in the survey to measure awareness and understanding of TOU rates because they were on a different transition schedule.

2013 and November 2012 were able to correctly identify their rate. In contrast, only 16% of control group customers were able to accurately identify their rate. The majority of customers in the control group, 51%, replied they did not know if their current rate was a TOU rate, CPP rate or a flat rate.

- The education campaign also led to increased awareness of the rate transition and of TOU rates in general. Self-reported awareness of the rate transition was between three to four times higher among customers who were contacted by PG&E.

- Understanding of options available to manage bills under TOU is higher among customers who were sent PG&E outbound education materials. All metrics indicate that customers who received PG&E outbound materials were better at identifying concrete steps to manage their bills.

- While some of the results suggest decay in awareness and understanding of TOU a year after the transition, those differences are not statistically significant.

- Customers who received PG&E outbound education are better informed about TOU rate impacts, but a gap remains between the perceived and real effects of TOU rates on customer bills. A substantial share of customers assume that the TOU transition will lead to significantly higher bills; when in practice, less than 1% of customers would have experienced bill increases larger than 3.5% even if they did not change their behavior.

- In response to TOU rates, customers mainly adjusted their thermostats or performed manual actions to reduce their power consumption.

Effectiveness of Education Campaign Components

- Phased mail tactics were highly effective and led to statistically significant changes in customer awareness and understanding of TOU rates. They account for nearly all of the overall effect.

- Person-to-person outreach does not lead to detectable gains over and above those attained by phased mail tactics alone.

- It was not possible to asses if person-to-person outreach contributed to the low rate of complaints (4 out of 360,000+ customers) regarding the transitions to mandatory TOU.

- For the 2012 and 2013 transitions to mandatory TOU, PG&E spent $48.90 per customer on education and outreach. The majority of expenses were associated with person-to-person outreach, which costs $118.10 per customer, and was only directed at a subset of customers. In contrast, phased mail tactics were directed at all customers transitioning to TOU at a cost of $10.25 per customer.

- In comparison to phased mail tactics, person-to-person outreach required 25 times more funding to attain a similar change in customer awareness and comprehension of TOU. The return on investment was calculated based on two main factors: per customer costs and the effect of the education and outreach component. To assess effectiveness, we calculated the amount of expenditures per customer required to achieve a 1% increase in TOU comprehension (which includes awareness, understanding of TOU rates, and understanding of options to manage the rate transition).

Behavioral Changes

- Successful education and outreach does not guarantee changes in behavior; but reductions in peak demand indicate that customers were aware of TOU, understood when to reduce demand, and that some of them elected to do so.

- Customers clearly reduced peak loads because of TOU rates. In total, they reduced demand by 45.6 MW on PG&E's five highest system loads days and reduced demand by 33.7 MW for the average summer weekday. Small, medium, and agricultural business reduced demand by 3.7%, 3.9%, and 13.8%, respectively, during typical summer weekday peak periods. Relative to the strength of the TOU price signal, the reductions attained are large compared to the literature on TOU price response from small and medium non-residential customers.[2]

- Customers not only reduced demand during peak periods, but reduced consumption in each rate period. The reductions were largest when prices were higher and smallest when prices were lower. The annual energy savings from the implementation of TOU rates totaled 178.9 GWh per year for the customers who transitioned in the evaluation period.[3] To put this in perspective, this amounts to half of the total energy savings (353 GWh) expected for all of PG&E's energy efficiency commercial programs over the 2013–2014 period.[4]

- The shift in customer loads coincided with the implementation of TOU. Customers began to reduce demand around the time they transitioned, after receiving several communications from PG&E informing them of the transition.

- Customers who received person-to-person outreach did not reduce demand more so than customers who only received phased mail. This finding is consistent with the findings that person-to-person outreach did not lead to detectable gains in awareness and understanding of TOU over and above those attained by phased mail tactics alone.

Recommendations

- Limit use of person-to-person outreach to customers whose bill would increase by more than 5% if they do not change their behavior when they transition to TOU.

- Study the influence of incremental communications regarding TOU on demand reduction persistence and/or improvements.

- Send annual or bi-annual reminders of TOU rates and the benefits of peak reduction.

- Estimate the effect of changes in rates and rate policies through controlled tests and phased roll-outs rather than after-the-fact analysis.

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[2] The *2013 Evaluation of PG&E's Mandatory TOU Rates for Small and Medium Non-residential Customers*, filed on April 1, 2014 as part of CPUC Rulemaking 13-09-011 (2013 OIR) contains a review of prior SMB TOU pricing studies in Appendix A. The report can be downloaded at http://apps.pge.com/regulation/search.aspx. It also contains additional detail about the demand reductions and energy savings and impact evaluation methodology.

[3] The estimates for TOU energy savings from agricultural rates are for summer months only. The energy savings estimates could not be estimated for the remainder of the year due to the highly seasonal nature of agricultural loads.

[4] See CPUC Fact Sheet: http://www.cpuc.ca.gov/NR/rdonlyres/BB0D11D4-E6AA-471B-A5BA-8A70A18B4ECB/0/201314CommercialFactSheet.pdf

1 Introduction and Purpose of Study

Nearly all small and medium business (SMB) customers across the U.S. pay a flat price and do not have an incentive to consider the pattern of their energy consumption behavior, nor are they aware of the extent to which consumption patterns drive utility energy and infrastructure costs. While TOU rates are offered to SMB customers in many utilities, customers must request such rates and, without extensive marketing, enrollments have been low.

PG&E's institution of mandatory TOU pricing for small and medium business customers and small agricultural customers is the first wide scale implementation of mandatory time varying pricing in the U.S. for customers of that size.[5] The rate transition is designed to factor in when customers consume power in addition to how much they consume in determining their bill; leading to a closer alignment between the prices customers face and the cost of supplying power. The implementation was made possible as a result of PG&E's installation of SmartMeter[TM] technology, which allow for utilities to measure customer consumption by time-of-day.

An important prerequisite for realizing the benefits from TOU pricing is that customers must be aware they are on such a rate and also understand how TOU pricing affects their bills. The transition required efforts to ensure customers were aware of the transition, understood TOU pricing conceptually, knew how the shift affected them personally and, if they elected to do so, were able to develop a concrete plan to change their peak period consumption. As part of the transition to mandatory TOU rates for small and medium-sized business customers, PG&E implemented an outreach and education campaign designed to increase awareness and improve understanding of the new rate. This report summarizes the impact and effectiveness of PG&E's campaign.

PG&E's implementation of TOU rates was staggered as a result of the eligibility requirement set forth in the Dynamic Pricing decision (D.10-02-032.), producing three distinct cohorts. Business customers transition to TOU around November. Customers on Agricultural rates transition in March. The staggered roll out of mandatory TOU rates at PG&E provided a unique opportunity to compare side-by-side customers who recently transitioned to TOU rates, customers who had been on the rate for a year (which was helpful for measuring retention decay), and a control group of customers who had not received outbound PG&E education and outreach material. In addition, PG&E targeted specific customers for person-to-person outreach. These groups include hard-to-reach customers and the 10% of customers most likely to experience higher bills. This allowed Nexant to measure the impact of different outreach components and to understand how effectively different components performed.

Because of the transition dates for businesses and agricultural customers differed, the survey to measure customer awareness and understanding of TOU rates was targeted at small and medium businesses, which account for over 90% of service accounts that transitioned to mandatory TOU. However, when possible, we report behavioral changes by small agricultural customers in addition to

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[5] Mandatory TOU rates have been implemented for medium customers on a mandatory basis, most notably by San Diego Gas & Electric (20 kW and up) in the 1980s and for United Illuminating Company in 2005. However, TOU rates have not been implemented in the U.S. on a mandatory basis for small business accounts. There is, however, precedent for mandatory TOU rates for SMB outside of the U.S., most notably in Ontario, Canada, and Italy.

those from small and medium businesses. All behavioral changes reported in this study are limited to customers who transitioned to TOU rates by the summer of 2013.[6]

1.1   Summary of PG&E's Education and Outreach Efforts

A key objective of PG&E's education effort was to empower customers to make informed decisions. Decisions about whether or not to modify behavior were left up to customers and were outside of PG&E's control. On their own, successful education efforts do not guarantee changes in customer behavior since customers might fully understand TOU rates but elect not to modify their behavior.

PG&E's outreach employed three distinct approaches to reach customers:

1. **Phased mail tactics** were outbound and reached customers on a periodic basis, based on where the customer was in the education and awareness cycle. These outbound communications began in the spring prior to the customer's November transition date. As the transition date neared, the education materials emphasized personal implications of TOU rates and concrete steps to reduce peak demand. Ninety days prior to the transition, customers received a custom bill comparison to help them understand how TOU rates would affect them personally. They also received 60-day and 30-day notices immediately prior to implementation. Shortly after their transition date, customers received a welcome package informing them that the TOU rate transition had been implemented. They also received a reminder of the seasonal rate change as customers neared their first summer on TOU and additional information about tips and tools. In total, PG&E sent nine direct mail letters or postcards and four bill inserts to customers who transitioned to TOU in November 2012. Six of the letters/postcards and four of the bill inserts were delivered prior or during the transition. PG&E sent the November 2013 cohort eight direct mail pieces and four bill inserts. The main difference is that PG&E sent the customized bill comparison twice to the November 2012 cohort but only sent the bill comparison once to the November 2013 cohort. However, the surveys to measure TOU awareness and understanding were conducted in December 2013 and January 2014, before customers in the November 2013 cohort had received the final two mail pieces and two bill inserts designed to alert customers of the transition from winter to summer rates. Figure 1-1 summarizes the phased mail contacts in 2012 and 2013,[7] and reflects the phased mail PG&E had sent to customers in each cohort by the time the survey was implemented.

2. **Person-to-person outreach** focused on the 10% most highly impacted customers as well as traditionally hard-to-reach customer groups. Like the phased tactics, this outreach was outbound and targeted towards customers who were scheduled to transition to TOU in the same year. Most person-to-person outreach activities occurred in the summer prior to when a specific customer was scheduled to transition to TOU. In 2012, PG&E representatives attempted to reach customers three times. If they were unable to establish personal contact, customers were sent a distinct education packet through first class mail to ensure confirmed delivery of the TOU educational material. In 2013, PG&E was required to conduct person-to-

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[6] For more detail about demand reductions and energy savings, please see the *2013 Evaluation of PG&E's Mandatory TOU Rates for Small and Medium Non-residential Customers*, submitted to the CPUC on April 1, 2014, as part of R1309011.

[7] Additional details regarding can be found in the December 2012 and December 2013 Time Varying Pricing Quarterly Presentations filed with the California Public Utilities Commission, in compliance with D.10-02-032.

person outreach with each eligible customer, even if more than three contact attempts were needed.

3. **Always on tactics** were available to customers at any time throughout the year. These tactics included earned media, online content, webinars (live and recorded), TOU education videos, booths at industry conferences, etc. While *always on* tactics were available to all customers regardless of their transition date, they were designed to provide resources to customers looking for more information about the transition to TOU rates. Except for earned media, customers have to proactively locate and view online tools and videos; unlike the phased and person-to-person efforts, which were outbound and targeted at customer nearing the transition.

The assessment focuses on the incremental effects of outbound education efforts (i.e., phased tactics and person-to-person outreach). Variation on the degree of education and outreach efforts is critical for assessing the effectiveness of outreach campaigns. If all customers receive the same messages, via the same channels, with similar attempts to contact customers, it is not possible to separate the effectiveness of distinct marketing efforts. Variation in phased and person-to-person outreach occurred due to PG&E's staggered implementation of mandatory TOU and because person-to-person outreach was targeted at a subset of the population. In contrast, always on tactics were available to all customers, making it difficult to assess their effect. Moreover, always on tactics were ancillary; designed to provide additional resources for customers who were aware of TOU rates and wanted more details.

Figure 1-1: Summary of 2012–2013 Phased Mail Outreach

Cohort	Calendar Year	Type of Communication	Jan	Feb	Mar	April	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Nov 2012 Transition Group	2012	Direct Mail					Time Matters postcard		My Energy letter	Rate Comparison #1	Tools letter 60-Day Letter	Rate Comparison #2 (30-Day Letter) / TOU reminder postcard		Welcome
		Bill Insert		TVP announcement					Time Matters	My Energy			Tools	
	2013	Direct Mail				Seasonal Rate Change			Tips/Tools					
		Bill Insert					Seasonal Rate Change			Tips/Tools				
Nov 2013 Transition Group	2013	Direct Mail			Time Matters		Getting Ready			Rate Comparison #1	60-Day Letter	30-Day Letter		Welcome (Jan 2014)
		Bill Insert		Time Matters		Getting Ready							Transition Reminder	

1.2   Description of TOU Rates

Table 1-1 describes the PG&E mandatory TOU rate and the otherwise applicable flat pricing options. By design, the rates are designed to be revenue neutral, meaning that on average, customer revenue collected by PG&E does not change assuming no change in electricity use. In practice, customers can reduce their bills by deciding when to consume power. TOU rates provide customers an incentive to consume power more efficiently and to either reduce consumption during periods when prices are highest or shift consumption to lower priced periods.

Customers transitioned to three different TOU rates depending on their size and whether or not they were designated as an agricultural account. The difference in summer peak period prices (12 to 6 PM) between the mandatory TOU and flat prices is modest for small business customers, ranging between 8% and 9%. For agricultural accounts, the incentive to reduce shift consumption was stronger due to a 45% change in summer peak period prices (12 to 6 PM). The peak period price changes were accompanied by corresponding price reductions during off-peak and weekend hours. While the emphasis was on electricity use during peak summer afternoon hours, the part-peak prices for small and medium business customers were very similar to the peak period prices.

Table 1-1: Mandatory Time of Use Rates

Rate class	Day Type	Period	Summer (May to October)			Winter (Nov to April)		
			TOU	Flat Rate	Ratio (TOU/Flat)	TOU	Flat Rate	Ratio (TOU/Flat)
			(¢/kWh)	(¢/kWh)	%	(¢/kWh)	(¢/kWh)	%
Small (A1)	Weekdays	12:00 to 8:30 AM	20.0	21.4	94%	14.2	15.0	95%
		8:30 AM to 12:00 PM	22.4		105%	15.9	15.0	106%
		12 to 6 PM	23.1		108%	15.9	15.0	106%
		6:00 to 9:30 PM	22.4		105%	15.9	15.0	106%
		9:30 PM to 12 AM	20.0		94%	14.2	15.0	95%
	Weekends and holidays		20.0		94%	14.2	15.0	95%
Medium (A10)	Weekdays	12:00 to 8:30 AM	13.2	14.4	91%	9.8	10.7	92%
		8:30 AM to 12:00 PM	15.2		106%	11.6	10.7	108%
		12 to 6 PM	15.9		110%	11.6	10.7	108%
		6 to 9:30 PM	15.2		106%	11.6	10.7	108%
		9:30 PM to 12 AM	13.2		91%	9.8	10.7	92%
	Weekends and holidays		13.2		91%	9.8	10.7	92%
Agricultural (AG1 to AG4)	Weekdays	12:00 to 8:30 AM	14.6	22.2	66%	12.5	17.3	72%
		8:30 AM to 12:00 PM	14.6		66%	15.2	17.3	87%
		12 to 6 PM	32.6		147%	15.2	17.3	87%
		6 to 9:30 PM	14.6		66%	15.2	17.3	87%
		9:30 PM to 12 AM	14.6		66%	12.5	17.3	72%
	Weekends and holidays		14.6		66%	12.5	17.3	72%

1.3   Research Questions

The study was designed to concretely and comprehensively assess the effectiveness of PG&E's education and outreach efforts:

- Were SMB customers aware of the transition to mandatory TOU rates?

- Did customers understand TOU rates?

- Did they know of and understand options available to help them manage the transition to TOU?

- What was the relative effectiveness of different outreach efforts?

- Did the level of education and outreach influence customer demand response?

1.4   Performance Metrics

Prior to PG&E's implementation of the education campaign, PG&E and the California Public Utilities Commission (CPUC) agreed upon several metrics to assess the effectiveness of the campaign. These metrics focus on customer awareness and understanding of TOU rates, their understanding of actions they could take to help manage the transition, and behavioral changes (the primary research questions).

Behavioral changes in consumption patterns are considered a secondary indicator of success since they were not within PG&E's control. As noted earlier, a campaign objective was to empower customers to make informed decisions; the decision about whether or not to modify behavior were left up to customers. Although outside of PG&E's control, reductions in peak demand indicate that customers are aware of TOU, understand when to reduce demand, and some of them elected to do so. On the other hand, lack of detectable reductions does not mean customers were unaware of TOU rates. Table 1-2 summarizes the performance metrics.

Table 1-2: Performance Metrics

Category			Performance Metric	Section/Pages
Primary Performance Metrics	Awareness and understanding of TOU rates	1	Change in awareness of mandatory TOU	Section 3.1 Pages 19 and 21
		2	Change in the ability to identify TOU summer peak period	Section 3.1 Pages 20,21
		3	Change in ability to identify winter part-peak period	Section 3.1 Pages 20, 21
		4	Change in the ability to identify transition date	Section 3.1 Pages 20, 21
		5	Understanding that flat rates are no longer available	Section 3.1 Pages 20-21
		6	Change in ability to understand impacts of TOU on their bills	Section 3.2 Pages 22-24
	Understanding of options to help them manage the transition	7	Change in understanding that they can lower bills by reducing energy and by changing their demand consumption pattern	Section 3.1 Pages 19,21
		8	Change in ability to identify options available to them to manage bills	Section 3.3 Pages 24, 25
		9	Change in knowledge about where to get more information on energy efficiency and DR programs	Section 3.1 Pages 20,21
Secondary Indicators (Behavioral)		10	Change in load shape during peak periods before and after outreach efforts	Section 5.1 Pages 32-36
		11	Degree to which changes in load shape coincide with implementation to TOU and education and outreach materials	Section 5.2 Pages 36-38
		12	Comparison of demand reductions, if any, between survey respondents who report high awareness and understanding of TOU and customers that reported either low awareness or limited understanding of the rate	Section 5.3 Pages 39-40
		13	Comparison of demand reductions based on the bill impacts communicated to customers as part of education efforts	Section 5.5 Pages 42-45

1.5 Structure of Report

The remainder of this report is divided into six sections. Section 2 summarizes the methodology, including the survey sample design, how changes in awareness and understanding were measured, and validation that the control group was comparable to the customers who received PG&E's outbound education and outreach. Section 3 details the overall impact of PG&E's education campaign on TOU awareness and knowledge. Section 4 documents the effect of individual campaign components. Section 5 discusses behavioral evidence of customer response to TOU. Section 6 documents the costs and return on investment of individual campaign components. We conclude with recommendations.

2   Methodology

Measuring customers' awareness and understanding of TOU rates required conducting a survey. In order to draw causal conclusions, it was necessary to survey both customers who already transitioned to TOU as well as a control group that was nearly identical to customers who transitioned except for their exposure to PG&E outbound education and outreach efforts.

The best candidates for a control group were customers scheduled to transition to TOU in November 2014 who had not received any of the outreach materials. The treatment group was broken down into two distinct groups: customers who were transitioned to TOU in November 2012 and those who transitioned in November 2013. Designing the survey for these three groups and administering it in December 2013 and January 2014 allowed for comparisons that are useful for determining not only the impact of the outreach campaign, but also whether the retention of information decayed over the course of a year.

Because the rate is mandatory, customers do not self-select. Any differences are observable and the mechanism that led to them – geographic patterns of meter installation along meter routes – is known. This allowed Nexant to use propensity score matching to ensure the groups recruited to complete the surveys were similar; except for differences in the timing of education and outreach efforts. Propensity score matching is a statistical technique that allows us to consolidate information from multiple parameters into a single attribute and match customers based on that "score."

2.1   Sample Design

The survey was implemented in December 2013 through January 2014 via phone and internet. Customers were sent a pre-announcement letter informing them of the survey and inviting them to complete the survey online. This was followed by email reminders and telephone calls.

Table 2-1 summarizes the sample design that was employed and shows the response rates for each cell of the study. Based on CPUC guidance, the top 10% most impacted customers – those with bill increases over 2% (absent any change in behavior) – were targeted for person-to-person outreach. To assess if person-to-person outreach led to a deeper understanding of TOU rates and higher awareness of options for managing the rate transition, we oversampled customers immediately above and below the most impacted cutoff.

Overall, 2,302 completed surveys were returned and were available for analysis. In total, 12.9% of customers recruited for the survey completed it. The response rates for the three main groups (customers who transitioned in November 2013, customers who transitioned in November 2012, and the control group) were similar at 12.0%, 13.0%, and 13.7%. Within each of the three cohorts, customers in the Most Impacted category and the Immediately Below the Threshold category – the two categories that were oversampled – had higher response rates than other customers. These customers were recruited more heavily because there were fewer of them and the quotas for these groups were higher.

Table 2-1: Summary of Sample Design

Year	Group	Surveys Mailed	Quota	Completes	Response Rate	% of Quota Met
Nov 2012 Transition	Most Impacted	2,186	300	328	15.0%	109.3%
	Immediately Below Threshold	1,451	200	202	13.9%	101.0%
	Other Customers	1,988	200	201	10.1%	100.5%
	All Customers	5,625	700	731	13.0%	104.4%
Nov 2013 Transition	Most Impacted	2,493	300	324	13.0%	108.0%
	Immediately Below Threshold	1,478	200	234	15.8%	117.0%
	Other Customers	2,367	200	205	8.7%	102.5%
	All Customers	6,338	700	763	12.0%	109.0%
Control Group	Most Impacted	2,114	349	351	16.6%	100.6%
	Immediately Below Threshold	1,681	251	253	15.1%	100.8%
	Other Customers	2,083	200	204	9.8%	102.0%
	All Customers	5,878	800	808	13.7%	101.0%
TOTAL		**17,841**	**2,200**	**2,302**	**12.9%**	**104.6%**

Larger sample sizes are necessary in order to detect meaningful differences. If sample sizes are too small, it is not possible to distinguish meaningful differences from random noise. The ability to detect meaningful differences between the two groups depends both on the sample size and the proportion of customers who, for example, state they are aware of TOU rates. Figure 2-1 presents the relationship between sample size and a 95% margin of error. The margin of error represents differences that are not statistically significant. For example, given a 10% margin of error, a difference between 50% and 40% awareness could not be distinguished from random noise due to the size of the sample. As the sample size increases, smaller differences between the treatment and control group become statistically significant – that is, they can be distinguished from random noise. The sample size reflects the size for each of the control and TOU groups. For example, a sample size of 500 implies 500 TOU and 500 control group customers, for a total of 1,000 customers. The graph also shows the sample sizes for two different proportions. The further customer responses such as awareness rates deviate from 50%, the easier it becomes to distinguish differences from random noise.[8]

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[8] This is due to the equation for standard errors for proportion, which is described by the following formula: $se = \sqrt{\frac{p \cdot (1-p)}{n}}$ where p is the proportion and n is the sample size.

Figure 2-1: Ability to Detect Differences by Sample Size
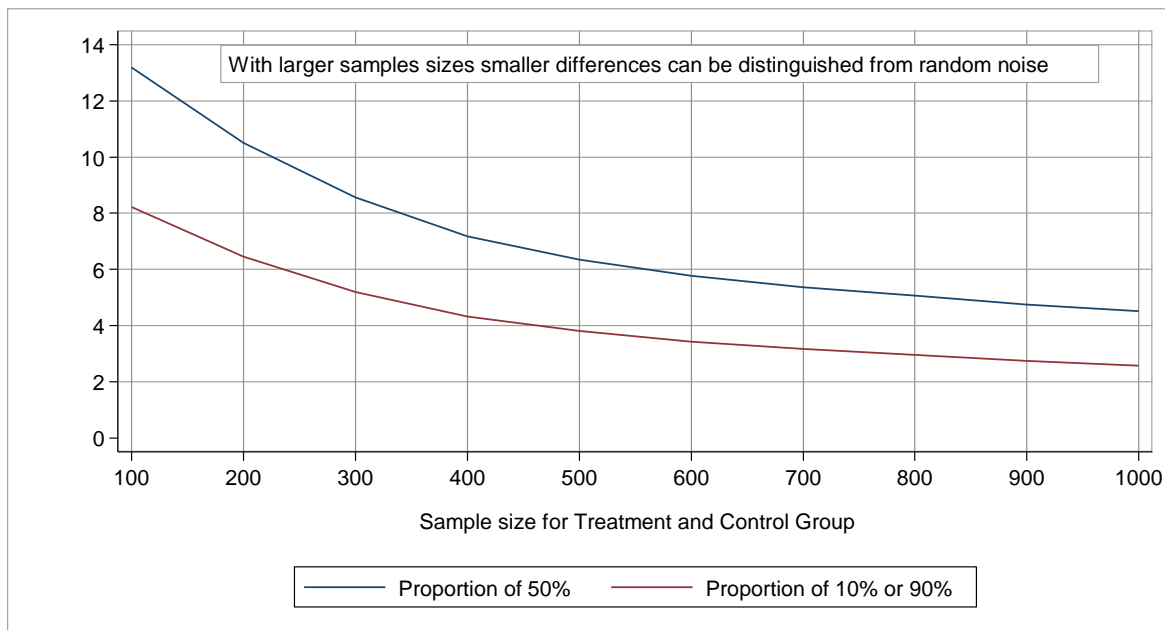
Sample sizes for each group targeted in the survey are in the range of 700 to 800 customers, which allows for differences in awareness and education of as small as 3 to 6% between treatment and control groups to be detected. However, when subsets of the population are analyzed – e.g., the analysis to assess the incremental effect of person-to-person outreach – the sample sizes are smaller.

2.2 Comparison of Treatment and Control Group Characteristics

A valuable first step in the analysis is to ensure that the process used to create the control group was able to successfully produce treatment and control groups that differ only in whether or not they received the treatment. If the control group is well-matched, then there should not be any differences in characteristics that may be related to energy consumption or the awareness and understanding of TOU rates. A good way to check this is to compare survey responses for questions related to firm characteristics across the three groups and test for statistically significant differences. Several characteristics are available from the survey, including satisfaction with PG&E, industry codes, revenue, number of employees, and energy costs.

Figures 2-2 and 2-3 show the distributions of the afore-mentioned characteristics for each study group. Examining the graphs shows that these distributions are very similar and that there do not appear to be any large differences. This assertion is supported by the results of formal hypothesis tests that are presented in Table 2-2. With the exception of annual revenue, the study groups do not show significant differences for any of the firm characteristics.[9]

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[9] Taking a closer look at the distributions for annual revenue, it is likely that the significant result is being driven by the share of firms with revenues of $200,000 to $500,000. The study groups are very similar across the remaining revenue bins.

Figure 2-2: Distributions of Firm Characteristics for Study Groups
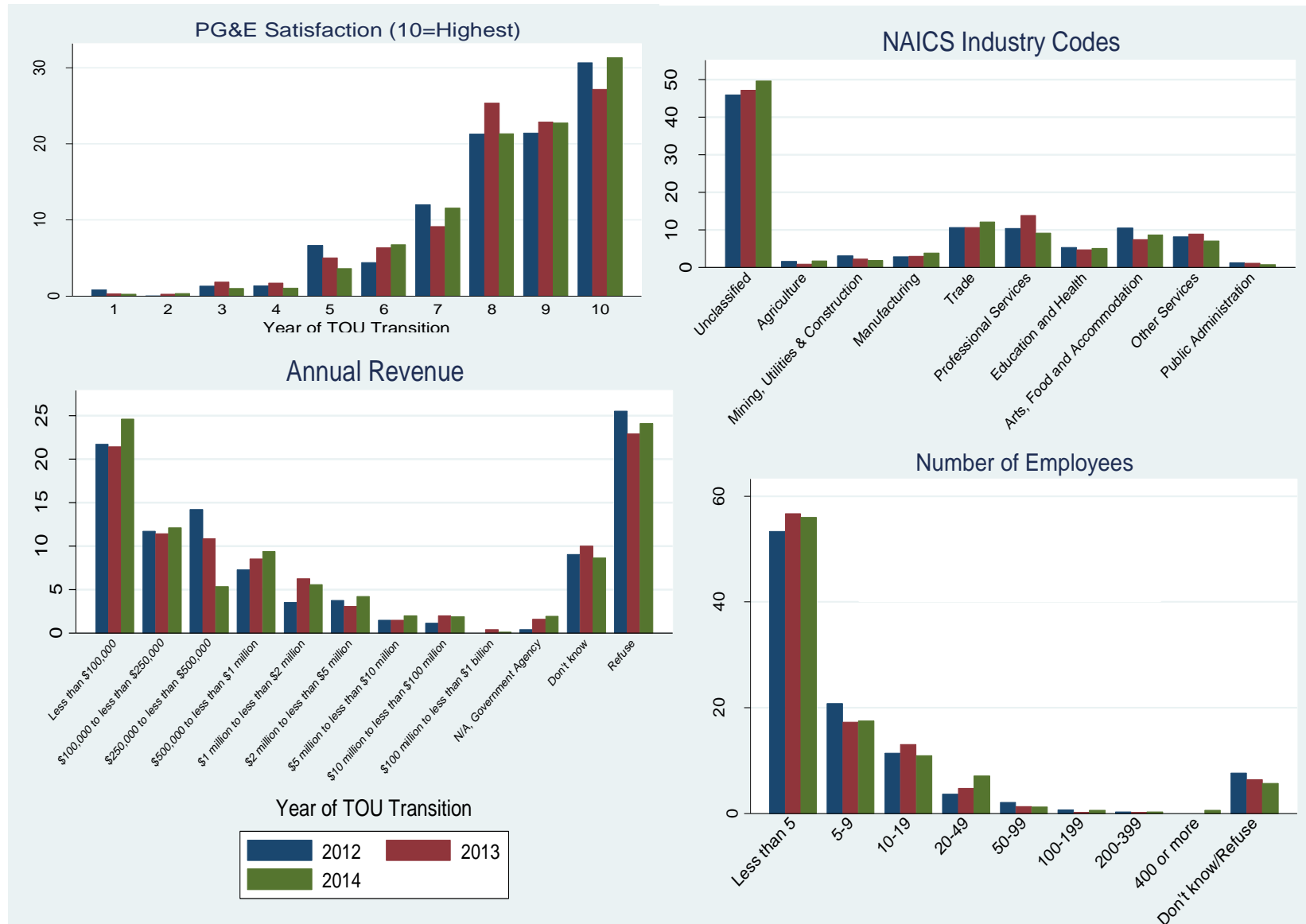
Figure 2-3: Distributions of Energy Costs for Different Study Groups
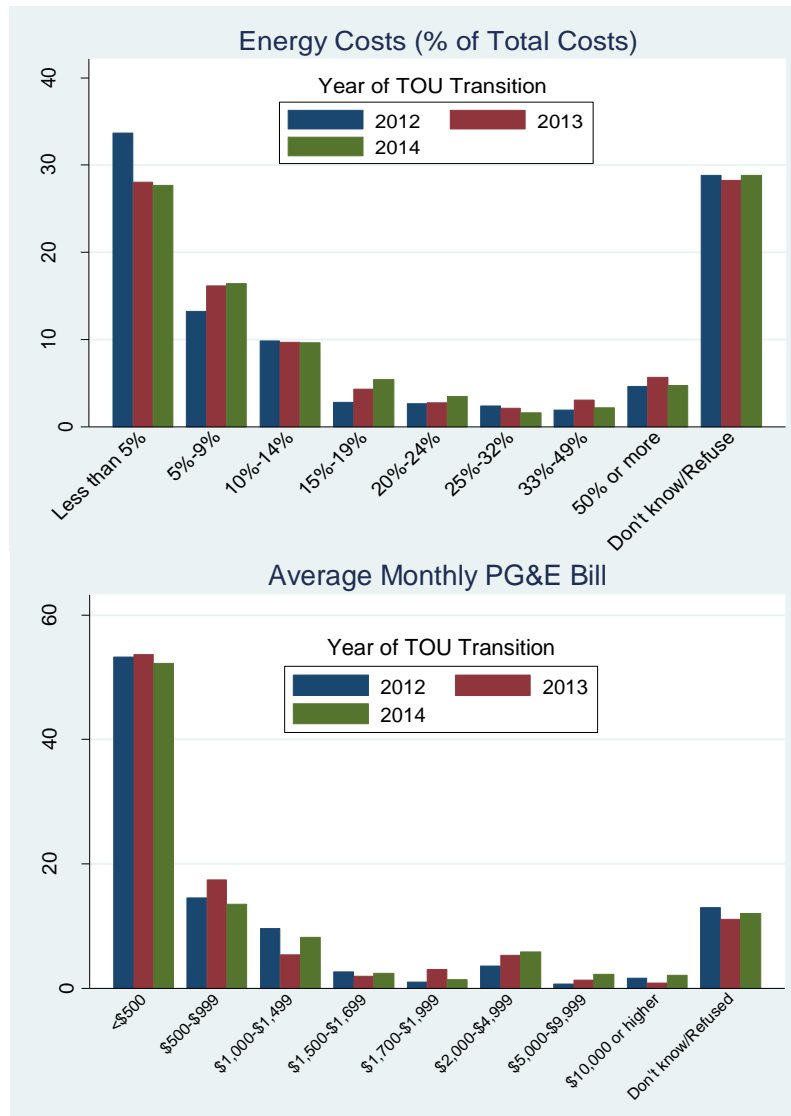
Table 2-2: Tests for Differences in Firm Characteristics between Study Groups

Characteristic	Value of test statistic	p-value
PG&E Satisfaction	0.98	0.48
NAICS code	0.78	0.72
Number of Employees	1.16	0.29
Annual Revenue	1.63	0.03*
Energy Costs	0.76	0.73
Avg. Monthly Energy Bill	1.35	0.16

* = Significant at 5%

One area where a difference between the study groups was expected is location. Customers were assigned to their TOU transition groups based on when their SmartMeter™ was installed. Because there were geographic patterns to the rollout of smart meters, there will also be geographic differences between study groups. The most important implication of geographic differences is that customers in different study groups are likely to live in different climate zones. Since climate and weather are important drivers of energy consumption, these differences must be accounted for when performing the analysis.

All of PG&E's customers are assigned to climate zones and mapped to 1 of 25 weather stations in PG&E territory. Figure 2-4 compares the distribution of heat intensity, as measured by cooling degree days (base 60°F) over the course of the 2012 May to October period. Table 2-3 compares the average customer heat intensity (CDD) for the three study groups.

As expected, there are noticeable geographic differences between the three study groups. A larger share of the 2012 respondents were located in hotter parts of PG&E's territory. The difference in average CDD between the control and 2013 transition groups is not statistically significant (p. value=0.855). However, there were statistically significant differences between the control group and the 2012 population (p. value=0.01) and between the 2012 and 2013 groups. Throughout the analysis, sample weights are used to adjust for these differences in climate.

Figure 2-4: Distribution of Study Group by Summer Heat Intensity
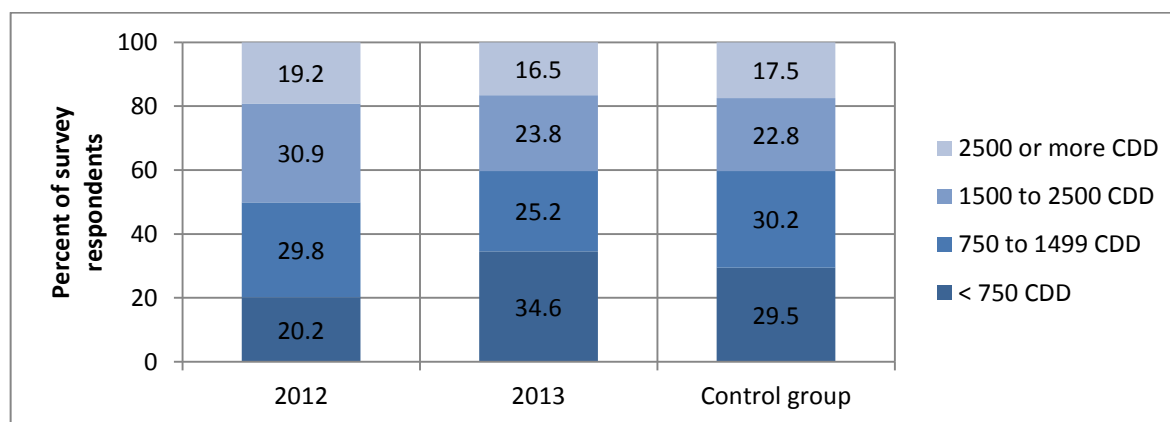
Table 2-3: Comparison of Heat Intensity (Before Corrections)

Comparison	Study group	n	Avg. CDD	se	p-val
Control group v. 2012	Control group	805	1503.7	41.6	
	2012	741	1681.6	41.1	
	Difference		**-177.9**	**58.5**	**0.001**
Control group v. 2013	Control group	805	1503.7	41.6	
	2013	754	1440.8	42.6	
	Difference		**62.9**	**59.5**	**0.855**
2013 v. 2012	2013	754	1440.8	42.6	
	2012	741	1681.6	41.1	
	Difference		**-240.8**	**59.2**	**0.000**

3   Overall Impact of Outreach and Education

The overall impact of the outreach and education was estimated by analyzing responses to survey questions about the awareness and understanding of TOU rates. Surveys were sent out to all three study groups and oversampled customers falling into the 10% Most Impacted category by design. Survey weights were used to take into account both the oversampling and the differences in climate between the three groups. Responses to each question were analyzed using tests for the equality of the proportions across each group. Specifically, three comparisons were made:

1.   2012 transition group vs. the control group;

2.   2013 transition group vs. the control group; and

3.   2012 transition group vs. 2013 transition group.

The first two comparisons provide measures of the impact of the outreach and education campaign in each year, while the third tests for any decay in awareness or understanding that may have occurred from 2012–2013.

3.1   Results

Table 3-1 shows both summaries of the results for each question that was analyzed as well as the results of the tests of proportions for each comparison of interest.

PG&E's outreach and education campaign increased the share of customers who could correctly identify their rate. In total, 48% of customers who transitioned to TOU in November 2013 were able to correctly identify their rate; the remainder either stated they did not know what rate they were on (33%) or identified the incorrect rate structure (19%). The response by customers who had transitioned to TOU in November 2012, a year prior to the survey, was similar: 43% of them were able to correctly identify they were on a TOU rate, 35% stated they did not know what rate they were on, and 22% identified the wrong rate. In contrast, the response among control group customers was markedly different: 16% were able to accurately identify their current rate (flat pricing), 51% replied they did not know what rate they were on, and 33% identified the wrong rate (with 27% of the 33% incorrectly believing they were on a TOU rate).   The education campaign nearly tripled customers' awareness of their actual rate. This was accomplished by decreasing the share of customers who stated they did not know what rate they were on and by increasing the accuracy of the rate customers identified.

Self-reported awareness of the rate transition was also between three to four times higher among customers who PG&E had contacted. Only 17% of customers in the control group reported being aware that their rate would change to a TOU rate. In contrast, 67% and 45% of customers that recently transitioned or transitioned a year earlier, respectively, reported that PG&E had informed them of their transition to TOU rates.

The campaign also led to statistically significant increases in understanding of TOU rates. Customers were presented several questions regarding the structure of TOU rates, the timing of peak periods and the rate transition to assess their level of understanding. Customers who had been sent outbound education materials by PG&E had statistically significant higher levels of understanding than the control group across nearly all metrics. They were better able to identify the number of summer rate periods

and peak window; they better understood that flat rates would no longer be available and were being phased out for all California Investor Owned Utilities (IOUs); and they comprehended they could lower bills by changing when they used power and by reducing consumption.

The campaign also led to results that are more difficult to interpret for two metrics – the difference between actual and customer identified transition dates (metric #4) and share of survey respondents that stated PG&E provided them information regarding how to manage their bill with TOU. To be clear, customers exposed to PG&E education materials more accurately identified their transition date and better recalled PG&E communications about how to manage the transition to TOU. Moreover, the differences were statistically significant. Customers who transitioned in November 2013 identified the date of their transition to TOU approximately right; customers who transitioned to TOU a year prior, in November 2013, on average stated their transition occurred during the summer; and customers in the control group thought their transition was taking place at the time of the survey.

The education campaign did not lead to a higher understanding of winter TOU rates. Responses were similar for customers that were and were not sent TOU education materials by PG&E. However, this finding is not surprising – none of the PG&E education materials highlighted winter TOU rates. In fact, it confirms the validity of the methods used. When PG&E did not conduct education on the topic, no differences in knowledge were found. The education campaign also did not influence customer perceptions about TOU bill impacts. We discuss this finding in more detail later.

Lastly, the results suggest decay in awareness and understanding of TOU a year after the transition, but those differences are not statistically significant.

Table 3-1: Summary of Overall Impact of Outreach and Education

Category		Performance Metric	Survey component	Average			2012 v. Control Group		2013 v. Control Group		Decay 2012 v. 2013	
				Nov 2012 Transition (n=741)	Recently Transitioned (n=754)	Control Group (n=805)	Diff	±95% CI	Diff	±95% CI	Diff	±95% CI
Awareness	1	Change in awareness of mandatory TOU	Correctly identified their current rate	43%	48%	16%	27%	4%	32%	4%	-5%	5%
			Heard or knew about TOU rates	77%	82%	64%	12%	5%	18%	4%	-6%	4%
			Stated PG&E informed them that their rate would change to TOU	45%	67%	17%	28%	4%	50%	4%	-23%	5%
Understanding of TOU rates	2	Change in the ability to identify TOU summer peak period	Could identify the number of summer rate periods	34%	35%	21%	13%	4%	14%	4%	-1%	5%
			Could identify the summer peak hours	66%	69%	57%	9%	5%	12%	5%	-3%	5%
	3	Change in ability to identify winter part-peak period	Could identify the number of winter rate periods	30%	35%	31%	-1%	5%	4%	5%	-5%	5%
			Could identify the winter peak hours	17%	13%	15%	2%	4%	-3%	3%	4%	4%
	4	Change in the ability to identify transition date	Difference between actual and customer identified transition date (months)	5.75	0.90	-11.97	17.72	2.28	12.87	1.85	4.85	1.45
	5	Understanding that flat rates are no longer available	Knew that flat rates would be completely phased out for business customers in California	32%	45%	14%	18%	4%	31%	4%	-13%	5%
			Understood they no longer would be able to return to flat rates	31%	45%	45%	-14%	5%	-1%	5%	-13%	5%
	6	Change in ability to understand impacts of TOU on their bills	Self-identified impact on bill	Categorical measure (See section 3.2)								
Understanding of options to help them manage the TOU transition	7	Change in understanding that they can lower bills by reducing energy and by changing their demand consumption pattern	Understood they could save by minimizing their use during summer peak hours	81%	86%	69%	12%	4%	17%	4%	-5%	4%
	8	Change in ability to identify options available to them to manage bills	Compare distribution what customers stated they could do to manage bills	Categorical measure (See section 3.3)								
	9	Change in knowledge about where to get more information on energy efficiency and DR programs	Share that stated PG&E provided them information regarding how to manage their bill	49%	27%	20%	30%	5%	8%	4%	22%	5%

3.2   Perceived and Actual Effect of TOU on Electricity Bills

A key element of TOU education was a custom bill comparison provided to customers approximately 90 days prior to their transition date. It compared what their bill would have been had they been on the TOU rate instead of flat pricing for the year prior to the transition. That is, rather than simply provide customers general information about the rate change, PG&E also gave them information about how mandatory TOU rates affected them personally if they did not change their energy consumption patterns.

As part of the survey, we assessed how customer perceptions about TOU bill impacts differed between customers who received the custom bill comparison and the control group. Figure 3-1 summarizes the comparison. The difference in the distribution of responses between customers who did and did not receive the bill comparison is statistically significant. Overall, 38% of control group customers reported they did not know what the bill impacts would be, which is substantially higher than what was observed among customers who received the bill comparisons. In addition, a higher share of customers who did not receive the bill comparison expected TOU rates to result in what they described as a significant increase in their bills. Another notable finding is that perceptions regarding bill impacts were not different between customers who recently transitioned (and had almost no experience with TOU) and customers who transitioned a year earlier.

Figure 3-1: Perceptions of TOU Effect on Electricity Bill
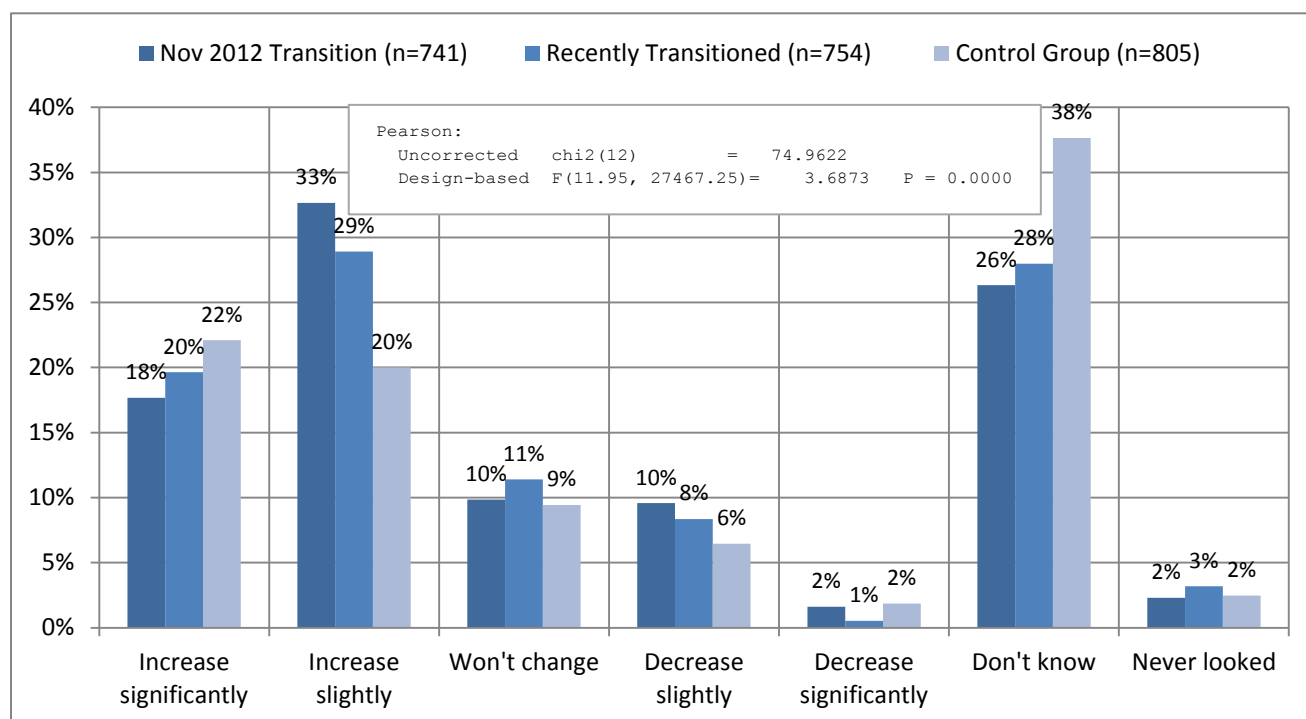
Table 3-2 compares how survey respondents perceived TOU bill impacts against the bill comparisons sent to the customers (which assumed customers did not change behavior). Customers self-reported bill impacts had no apparent relationship with the actual bill impacts shared with customers as part of PG&E's education and outreach campaign. Nearly half of the customers who benefited from the rate,

even if they did not change behavior (structural winners), believed TOU increased their bills. The reverse is also true. Nearly half of customers who did not benefit unless they changed their behavior (structural losers), actually believed TOU decreased their bill. To put this in context, on average, customers who perceived TOU rates led to significant increases in their bill, on average, would have experienced a $0.30 bill change for a $100.00 bill. Although the education campaign increased awareness of the bill impacts from TOU, there remains a substantial gap between how customers' perceive TOU bill impacts and reality.

Table 3-2: Perception of TOU Bill Impacts Versus Actual Bill Impacts

Cohort	Self-reported bill impact	N	% Bill Change Shared in Customized Bill Comparisons						
			Avg.	S.D.	p5	p25	Median	p75	p95
Nov 2012	Increase significantly	131	0.3%	2.1%	-1.9%	-0.8%	0.0%	1.3%	2.7%
	Increase slightly	242	0.3%	1.5%	-2.5%	-0.5%	0.3%	1.3%	2.6%
	Won't change	73	-0.2%	1.3%	-1.8%	-1.0%	-0.1%	0.5%	2.4%
	Decrease slightly	71	0.0%	1.2%	-1.6%	-0.8%	0.0%	0.8%	2.3%
	Decrease significantly	12	0.2%	1.1%	-1.5%	-0.3%	0.1%	0.8%	2.4%
	Don't know	195	0.1%	1.4%	-1.8%	-0.7%	-0.1%	0.9%	2.5%
	Never looked	17	0.2%	1.5%	-1.6%	-0.6%	-0.5%	1.1%	3.1%
	ALL	**741**	**0.2%**	**1.5%**	**-2.1%**	**-0.7%**	**0.0%**	**1.0%**	**2.6%**
Nov 2013	Increase significantly	148	0.3%	1.7%	-2.5%	-0.9%	0.3%	1.4%	3.2%
	Increase slightly	218	0.2%	1.7%	-2.6%	-0.9%	0.2%	1.3%	2.8%
	Won't change	86	0.0%	1.4%	-2.3%	-1.1%	0.0%	1.0%	2.5%
	Decrease slightly	63	-0.1%	1.3%	-1.8%	-1.1%	-0.3%	0.8%	2.1%
	Decrease significantly	4	0.2%	1.2%	-0.6%	-0.6%	-0.1%	-0.1%	2.0%
	Don't know	211	0.0%	1.4%	-2.2%	-0.8%	0.0%	1.0%	2.3%
	Never looked	24	0.2%	1.2%	-2.0%	-0.7%	-0.2%	1.3%	2.3%
	ALL	**754**	**0.1%**	**1.5%**	**-2.3%**	**-0.9%**	**0.0%**	**1.1%**	**2.6%**

As a reference point, Figure 3-2 presents the distribution of bill impacts, absent changes in behavior, for the entire population of SMB customers who transitioned to mandatory TOU in November 2012 and November 2013. Over 90% of customers would have experienced less than a 2% change in bills absent any changes in behavior. In practice, they also had the opportunity to reduce their bills by adjusting when they consumed power. Less than 1% of customers would have experienced bill increases larger than 3.5% absent changes in behavior.

Figure 3-2: Actual TOU Effect on Electricity Bills Assuming No Change in Behavior
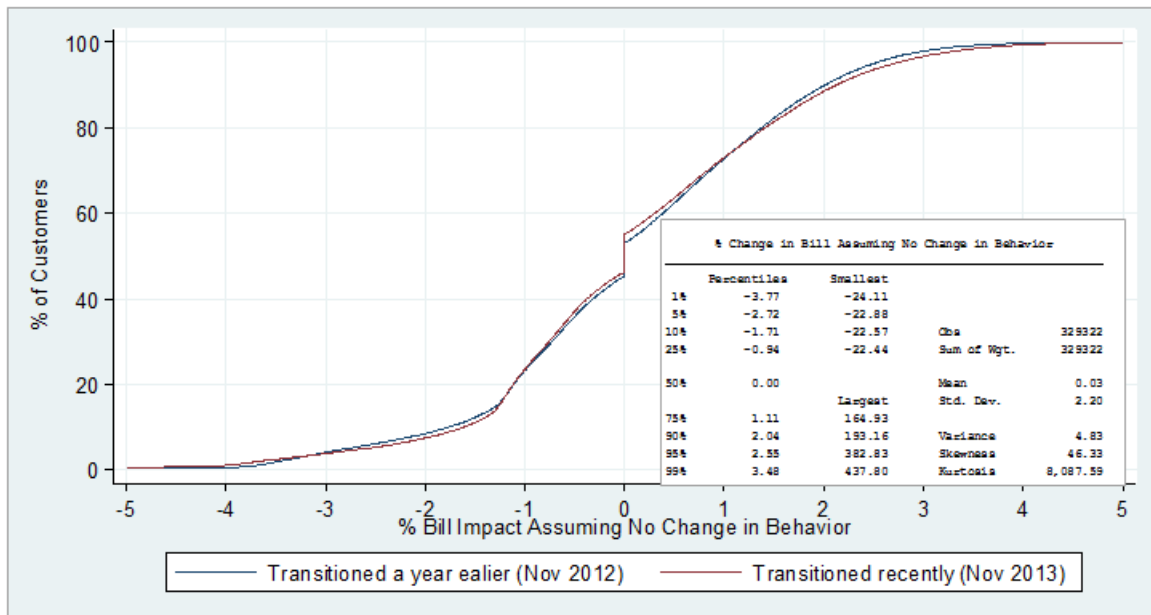
3.3 Stated Actions Taken Because of the TOU Transition

Another important topic is understating what actions customers took or said they would take in response to TOU rates. Figure 3-3 summarizes actions customers said they took due to the switch from a flat rate to TOU rates.

Several observations are noteworthy:

- Customers who had experienced TOU rates during the summer (November 2012 cohort) were more likely to state they had adjusted their thermostat than either customers who transitioned to TOU in November 2013 or the control group (which had not transitioned to TOU at all). Since neither group had experienced a summer with TOU, the similarity of their response is not surprising.

- Customers who received PG&E's education and outreach materials were more likely to identify manual actions they could take to shift or reduce their peak load.

- Customers in the control group and those who recently transitioned to TOU were less likely to have taken actions to reduce demand.

- Some customers who had not yet received communications about their forthcoming transition to TOU (control group) indicated they had taken actions because of TOU. It is possible that they mistakenly believed they were on TOU rates, inferred the transition was coming (perhaps based on earlier survey questions), or misunderstood the question. The control group allowed us to net out the baseline response from the effect of PG&E's campaign.

Figure 3-3: Stated Actions Taken Because of the Switch from Flat Rates to TOU
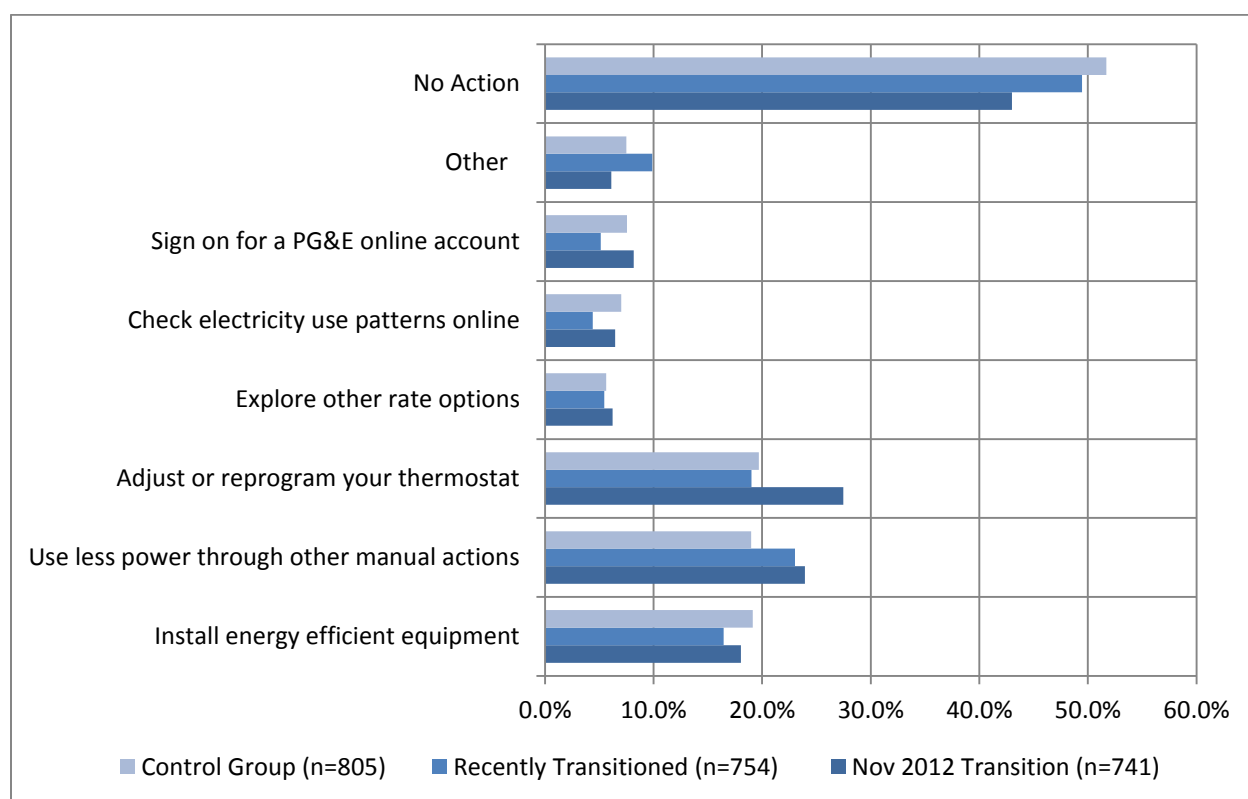
3.4   Conclusions

- PG&E's outreach and education campaign increased the share of customers who could correctly identify their rate. In total, 48% and 43% of customers who transitioned to TOU in November 2012 and November 2013 were able to correctly identify their rate. In contrast, only 16% of control group customers were able to accurately identify their rate.

- The education campaign also led to increased awareness of the rate transition and of TOU rates in general. Self-reported awareness of the rate transition was between three to four times higher among customers who PG&E had contacted.

- Customers who were exposed to PG&E outbound education were: better able to identify the number of summer rate periods and peak window; they better understood that flat rates would no longer be available and were being phased out for all California Investor Owned Utilities (IOUs); and they comprehended they could lower bills by changing when they used power and by reducing consumption.

- Understanding of options available to manage bills under TOU is higher among customers who sent PG&E outbound education materials. All metrics indicate that customers who received PG&E outbound materials better understood concrete steps to manage their bills.

- While some of the results suggest decay in awareness and understanding of TOU a year after the transition, those differences are not statistically significant.

- Customers who received PG&E outbound education are better informed about TOU rate impacts, but a gap remains between the perceived and real effects of TOU rates on customer

bills. Customers self-reported bill impacts had no apparent relationship with the actual bill impacts shared with customers as part of PG&E's education and outreach campaign. On average, customers who perceived TOU rates led to significant increases in their bill, on average, would have experienced a $0.30 bill change for a $100.00 bill. Although the education campaign increased awareness of the bill impacts from TOU, there remains a substantial gap between how customers' perceive TOU bill impacts and reality. In practice, less than 1% of customers would have experienced bill increases larger than 3.5% even if they did not change behavior.

- In response to TOU rates, customers mainly adjusted their thermostats or used less power by undertaking manual actions.

4 Effects of Specific Outreach Components

An important question is how education campaigns can be improved. Were specific methods more or less effective? Should person-to-person outreach be expanded, maintained at the same level, or scaled back? These questions are relevant because PG&E is still transitioning SMB customers to mandatory TOU; and both SCE and SDG&E are also scheduled to implement mandatory TOU amongst this segment. In addition, some of the lessons learned from the transition to mandatory TOU are relevant to the implementation of default Peak Day Pricing among SMB customers.

There are limitations to comparison, however. It was not possible to quantify the effect of individual education pieces – e.g., the initial notice, billing analysis (90-days), 60-day notice, 30-day notice, welcome package, and summer preparedness letter – because all customers who transitioned to TOU received the same education materials. What could be done, however, is determine the effect of phased outreach tactics and incremental effect of person-to-person outreach. What was the effect of phased mail tactics alone? Did the additional step of person-to-person outreach lead to higher awareness and understanding than those attained by phased mail tactics alone? These questions are critical because person-to-person outreach is expensive in comparison to approaches that rely on direct mail. The goal is to strike the right balance between these two approaches so rate payer funds are used in the most effective manner possible.

4.1 Phased Mail Tactics Alone

The effect of phased mail tactics was estimated using a simple comparison of proportions between control and treatment groups that were nearly identical except for their exposure to PG&E's outbound TOU education materials. This is the same procedure as was used to estimate overall effects, except that we excluded responses from customers who were eligible to receive person-to-person outreach.

Table 4-1 summarizes the effect of the phased mail tactics. The presentation is similar to that of the overall impacts of the education campaign (Table 3-1) and the results are similar both in terms of magnitude and significance. It accounts for most of the overall effect of the education campaign because it reached all customers who transitioned. The primary difference between the overall and phased mail tactic alone results is that there were more instances of statistically significant decay a year after the transition.

Table 4-1: Impact of Phased Outreach

Category		Performance Metric	Survey component	Average			2012 v. Control Group		2013 v. Control Group		Decay 2012 v. 2013	
				Nov 2012 Transition (n=411)	Recently Transitioned (n=443)	Control Group (n=486)	Diff	±95% CI	Diff	±95% CI	Diff	±95% CI
Awareness	1	Change in awareness of mandatory TOU	Correctly identified their current rate	42%	47%	16%	27%	5%	32%	5%	-5%	5%
			Heard or knew about TOU rates	76%	82%	64%	11%	5%	17%	5%	-6%	4%
			Stated PG&E informed them that their rate would change to TOU	43%	67%	17%	26%	5%	50%	5%	-24%	5%
Understanding of TOU rates	2	Change in the ability to identify TOU summer peak period	Could identify the number of summer rate periods	35%	35%	21%	14%	5%	14%	5%	0%	5%
			Could identify the summer peak hours	65%	68%	57%	8%	5%	12%	5%	-3%	5%
	3	Change in ability to identify winter part-peak period	Could identify the number of winter rate periods	30%	34%	31%	-1%	5%	4%	5%	-5%	5%
			Could identify the winter peak hours	18%	13%	16%	2%	4%	-3%	4%	5%	4%
	4	Change in the ability to identify transition date	Difference between actual and customer identified transition date (months)	5.30	0.77	-13.19	18.49	3.41	13.96	2.52	4.53	2.47
	5	Understanding that flat rates are no longer available	Knew that flat rates would be completely phased out for business customers in California	31%	44%	15%	17%	4%	30%	5%	-13%	5%
			Understood they no longer would be able to return to flat rates	27%	42%	46%	-20%	6%	-5%	6%	-15%	6%
	6	Change in ability to understand impacts of TOU on their bills	Self-identified impact on bill	Categorical measure								
Understanding of options to help them manage the TOU transition	7	Change in understanding that they can lower bills by reducing energy and by changing their demand consumption pattern	Understood they could save by minimizing their use during summer peak hours	81%	85%	69%	12%	5%	16%	4%	-4%	4%
	8	Change in ability to identify options available to them to manage bills	Compare distribution what customers stated they could do to manage bills	Categorical measure								
	9	Change in knowledge about where to get more information on energy efficiency and DR programs	Share that stated PG&E provided them information regarding how to manage their bill	50%	24%	21%	29%	6%	3%	5%	26%	6%

4.2   Person-to-person Outreach

The final inquiry of interest using the survey data was to estimate the incremental impact of person-to-person outreach on awareness and understanding. Are customers who received person-to-person outreach more aware of TOU rates, do they understand them better than customers who only received phased mail?

One way to estimate the incremental effect of person-to-person outreach is by comparing customers who are eligible and ineligible for person-to-person outreach. The same type of comparison is also made for a control group. The purpose of doing so is to identify any pre-existing differences between eligible and ineligible customers and net them out. Technically, this is a difference-in-differences estimate. This technique is illustrated visually in Figure 4-1. The first step in this procedure is to calculate the differences in awareness and understanding between who were and were not eligible for person-to-person outreach. This is done for both the treatment and control group. The difference between customers who are and are not eligible for person-to-person outreach in the control group represents the natural, or pre-existing difference. Since this pre-existing difference is not due to the person-to-person outreach (no one in the control group received outreach materials), it is netted out of the change observed in the treatment group.

Figure 4-1: Illustration of Difference-in-differences Estimation
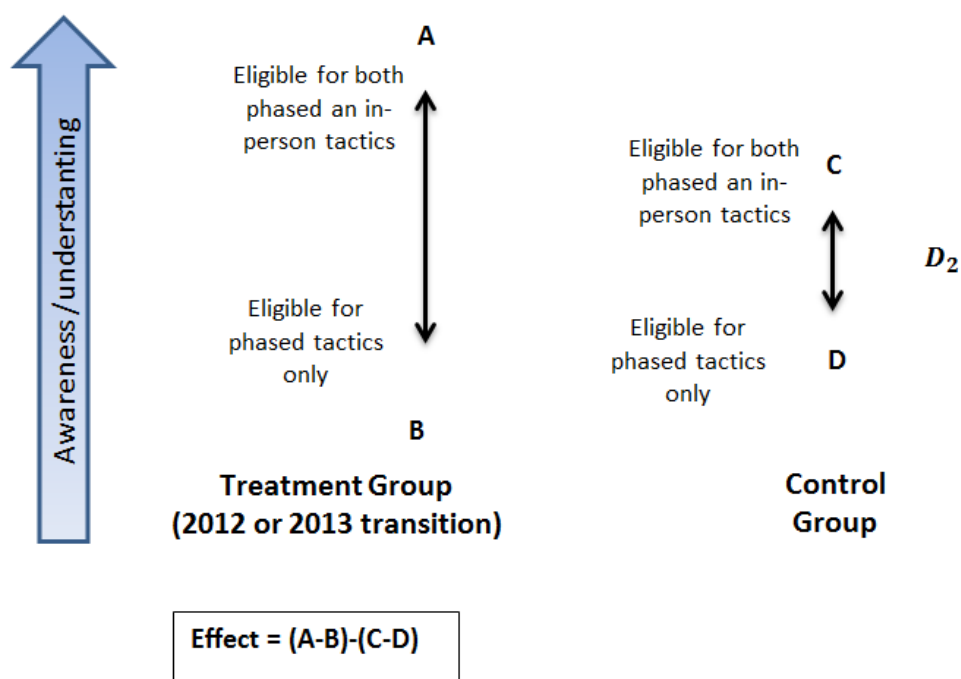
Table 4-2 shows the incremental effect of in-person outreach alongside the effect of phased outreach from Table 4-1. A side-by-side comparison of the two shows that in-person outreach had a small (typically less than 10%) and generally insignificant impact on TOU awareness and understanding above and beyond what was achieved through phased outreach.

Table 4-2: Incremental Effect of Person-to-person Outreach

Category		Performance Metric	Survey component	Impact of Phased Outreach		Incremental Effect of Person-to-person Outreach	
				2012	2013	2012	2013
Awareness	1	Change in awareness of mandatory TOU	Correctly identified their current rate	26.6%	31.7%	2.6%	4.3%
			Heard or knew about TOU rates	11.4%	17.2%	6.2%	5.5%
			Stated PG&E informed them that their rate would change to TOU	26.2%	49.6%	14.1%	6.9%
Understanding of TOU rates	2	Change in the ability to identify TOU summer peak period	Could identify the number of summer rate periods	13.9%	14.3%	-8.7%	-2.1%
			Could identify the summer peak hours	8.2%	11.6%	8.0%	5.8%
	3	Change in ability to identify winter part-peak period	Could identify the number of winter rate periods	-1.3%	3.7%	2.2%	1.9%
			Could identify the winter peak hours	2.0%	-3.0%	-3.2%	5.1%
	4	Change in the ability to identify transition date	Difference between actual and customer identified transition date (months)	18.49	13.96	-3.60	-3.58
	5	Understanding that flat rates are no longer available	Knew that flat rates would be completely phased out for business customers in California	16.6%	29.6%	9.3%	9.3%
			Understood they no longer would be able to return to flat rates	-19.8%	-4.5%	13.0%	10.0%
	6	Change in ability to understand impacts of TOU on their bills	Self-identified impact on bill	Categorical measure			
Understanding of options to help them manage the TOU transition	7	Change in understanding that they can lower bills by reducing energy and by changing their demand consumption pattern	Understood they could save by minimizing their use during summer peak hours	12.0%	16.3%	4.0%	5.9%
	8	Change in ability to identify options available to them to manage bills	Compare distribution what customers stated they could do to manage bills	Categorical measure			
	9	Change in knowledge about where to get more information on energy efficiency and DR programs	Share that stated PG&E provided them information regarding how to manage their bill	29.0%	2.5%	-1.0%	12.4%

With few exceptions, person-to-person outreach did not lead to detectable gains over and above those attained by phased mail tactics alone. The additional cost of person-to-person outreach does not provide detectable additional benefits. This does not mean person-to-person outreach does not work. Absent any other education efforts, person-to-person outreach would likely boost awareness and knowledge of TOU rates. To use an analogy, taking Medicine A and Medicine B is not more effective than taking Medicine A alone.

By reaching out personally to the 10% of the most impacted customers, person-to-person outreach could have very well helped dissuade customer protest. However, its role, if any, could not be isolated after-the-fact. However, the rate of complaints arising from PG&E's implementation of mandatory TOU was very low. Out of over 360,000 SMB customers that PG&E transitioned to mandatory TOU rates, only 4 complaints escalated beyond the initial phone representative – 2 were identified internally by PG&E and 2 complaints were submitted to the CPUC.

4.3   Conclusions

- Phased mail tactics were highly effective and led to statistically significant changes in customer awareness and understanding of TOU rates. They account for nearly all of the overall effect.

- Person-to-person outreach does not lead to detectable gains over and above those attained by phased mail tactics alone.

- It is not possible to ascertain the degree to which person-to-person outreach to most impacted customers contributed the low rate of complaints (4 out of 360,000+ customers) regarding the transitions to mandatory TOU.

5 Behavioral Changes

The campaign's goal was to empower customers to make informed decisions. Because decisions about whether or not to modify behavior are made by customers (and outside PG&E's control), changes in behavior are a secondary, supplementary indicator of success. Education and outreach is a pre-requisite for TOU peak demand reductions. Reductions in peak demand indicate that customers were aware of TOU, understood when to reduce demand, and that some of them elected to do so. Successful education and outreach does not guarantee changes in behavior; but reductions in peak demand do not occur without an awareness and basic understanding of TOU rates.

In this section, we address four main behavioral questions:

- Did customers change their loads due to implementation of TOU rates?

- How closely did the change in loads correspond with the transition to mandatory TOU?

- Did customers who reported a higher awareness and understanding of TOU deliver larger demand reductions?

- Did person-to-person outreach lead to incremental demand reductions?

- Were percent demand reductions related to bill impacts communicated to customers?

The analysis of behavioral change is limited to SMB accounts that transitioned to TOU in November 2012 and agricultural pumps that transitioned to TOU in March 2013. A more comprehensive analysis of how customers changed their electricity due to mandatory TOU is presented in the *2013 Evaluation of PG&E's Mandatory TOU Rates for Small and Medium Non-residential Customers.*[10] It includes additional details about the methodology used for analysis and comparison between customers who transitioned to TOU and the respective control groups.

5.1 Did customers change their loads due to implementation of TOU rates?

Customers reduced demand during periods when TOU prices were highest because of the transition to TOU. Table 5-1 summarizes the change loads due to PG&E's implementation of mandatory TOU rates for each rate period. Relative to the strength of the TOU prices, the reductions attained are among the largest reduction measured from TOU rates. The reductions were highest among agricultural accounts, which had the largest change in peak prices compared to flat rates.

Small (A1) and medium (A10) rates were higher from 8:30 AM to 9:30 AM in both winter and summer months. While there was a difference between part-peak and peak hours (12 to 6 PM) over the summer, the difference was small, less than 1¢. Agricultural rates had two rate periods for summer and winter months, peak (12 to 6 PM) and off-peak.

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[10] The report was files as part of CPUC Rulemaking 13-09-011 (2013 OIR) and can be found at http://apps.pge.com/regulation/search.aspx

Table 5-1: Estimated Demand Reductions and Energy Savings by Rate Class, Season, Day Type and Rate Period

TOU Rate	Season	Day Type	Rate Period	Price (¢/kWh)	Aggregate Impacts			Per Customer Impacts		
					% Reduction	Demand Reduction (MW)	Energy Savings (GWh)	Demand Reduction (kW)	95% CI Lower Bound	95% CI Upper Bound
Small Business (A1) 220,000 service accounts	Summer	Weekdays	Peak	23.1	3.7%	23.4	18.1	0.11	0.10	0.11
			Part-peak	22.4	3.7%	17.6	15.9	0.08	0.08	0.08
			Off-peak	20.0	2.0%	6.2	8.7	0.03	0.03	0.03
		Weekends & Holidays	Off-peak	20.0	2.4%	8.6	11.3	0.04	0.03	0.04
	Non-Summer	Weekdays	Part-peak	15.9	5.3%	25.5	41.1	0.12	0.11	0.12
			Off-peak	14.2	3.4%	10.0	13.6	0.05	0.04	0.05
		Weekends & Holidays	Off-peak	14.2	3.5%	10.7	14.6	0.05	0.04	0.05
Medium Business (A10) 5,200 service accounts	Summer	Weekdays	Peak	15.9	3.9%	6.4	5.0	1.19	1.12	1.25
			Part-peak	15.2	4.5%	6.2	5.6	1.15	1.10	1.20
			Off-peak	13.2	4.2%	3.7	5.2	0.68	0.64	0.71
		Weekends & Holidays	Off-peak	13.2	4.4%	4.6	6.1	0.86	0.79	0.92
	Non-Summer	Weekdays	Part-peak	11.6	4.9%	5.6	9.0	1.04	0.99	1.08
			Off-peak	9.8	7.3%	5.7	7.8	1.06	1.02	1.09
		Weekends & Holidays	Off-peak	9.8	6.5%	5.3	7.2	0.98	0.92	1.04
Agricultural (AG1 to AG4) 17,800 service accounts	Summer	Weekdays	Peak	32.6	13.8%	3.9	3.0	0.22	0.20	0.24
			Off-peak	14.6	8.6%	2.1	4.9	0.12	0.10	0.14
		Weekends & Holidays	Off-Peak	14.6	5.1%	1.2	1.6	0.07	0.04	0.10

Summer peak (12-6 pm) demand reduction (MW) - All customers   33.7

Annual energy savings (GWh) - All customers   178.9

Customers not only reduced demand during peak periods, but reduced consumption in each rate period. All of the reductions were statistically significant, as can be seen by the fact the 95% confidence intervals do not overlap zero. The reduction patterns generally followed the pattern of TOU prices. Generally, they were largest when prices were higher and smallest when prices were lower.[11] The annual energy savings from the implementation of TOU rates totaled 178.9 GWh per year, or 4.0% of usage, for the customers who transitioned in the evaluation period.[12] To put this in perspective, this amounts to half of the total energy savings (353 GWh) expected in all of PG&E's energy efficiency commercial programs over the 2013 to 2014 period.[13] A key question is whether energy savings will persist, decay, or grow. Studying the long-term effect of TOU rates on peak demand and energy savings is highly recommended.

Figure 5-1 compares summer load shapes for small, medium, and agricultural customers before and after the TOU implementation. Figure 5-2 makes a similar comparison for winter load shapes. In each case, the TOU customer loads (blue line) are compared to the control group (red line). Prior to the implementation of mandatory TOU, load patterns of treatment and control group customers are very similar. Both groups consumed power in the same manner when both groups were on flat rates. When TOU rates are implemented, a change in the electricity consumption patterns takes place. Customers who transition to TOU rates start to consume less power than those who remained on flat rates. For all rates, customers not only shifted their consumption away from the peak period but also reduced overall demand.

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[11] There are a few exceptions. Small business reductions on average weekdays in winter part-peak period were larger than reductions during summer peak hours. In addition, medium business reductions for the summer part-peak period appear larger than reductions during peak hours. These differences are not statistically significant, however. They do not represent a pattern since the outcome could have been due to random chance given the sample sizes and the small differences in impacts. In addition, the percent change in prices for those time period is very similar (see Table 3-1), so substantial differences in the response should not be expected.

[12] The estimates for TOU energy savings from agricultural rates are for summer months only. The energy savings estimates could not be estimated for the remainder of the year due to the highly seasonal nature of agricultural loads.

[13] See CPUC Fact Sheet: http://www.cpuc.ca.gov/NR/rdonlyres/BB0D11D4-E6AA-471B-A5BA-8A70A18B4ECB/0/201314CommercialFactSheet.pdf

Figure 5-1: Summer Weekday Load Shapes Before and After TOU Implementation
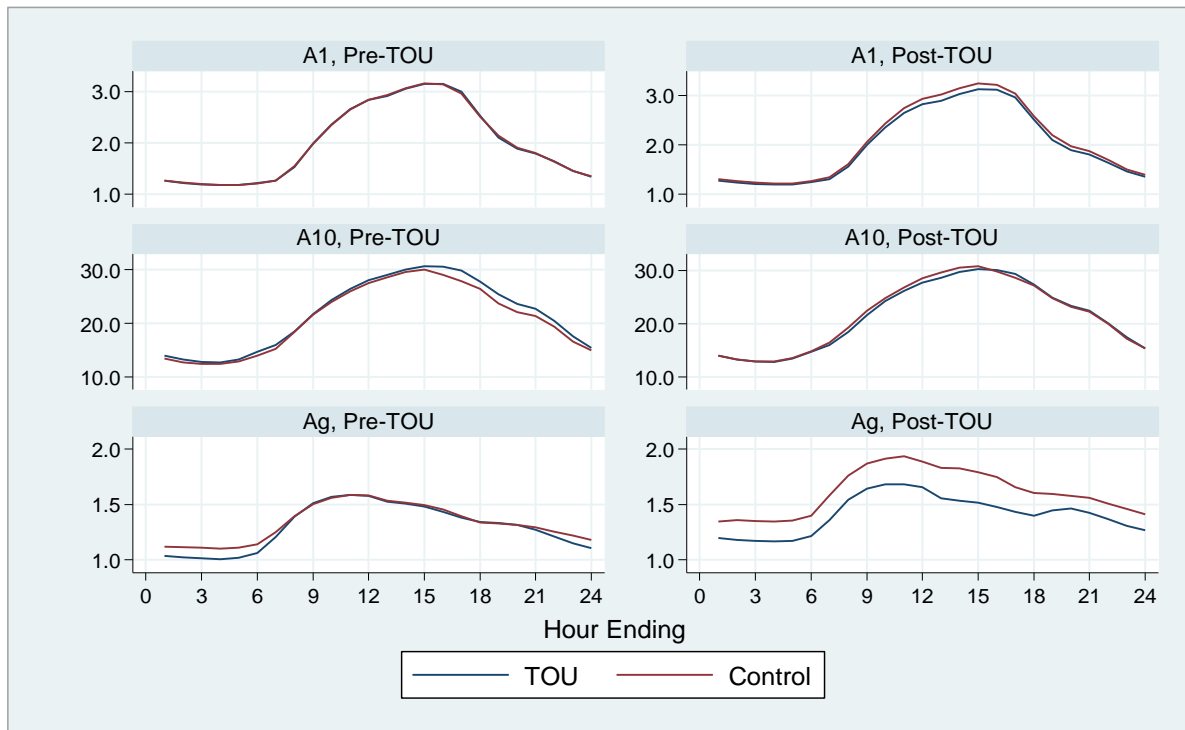
Figure 5-2: Winter Weekday Load Shapes Before and After TOU Implementation
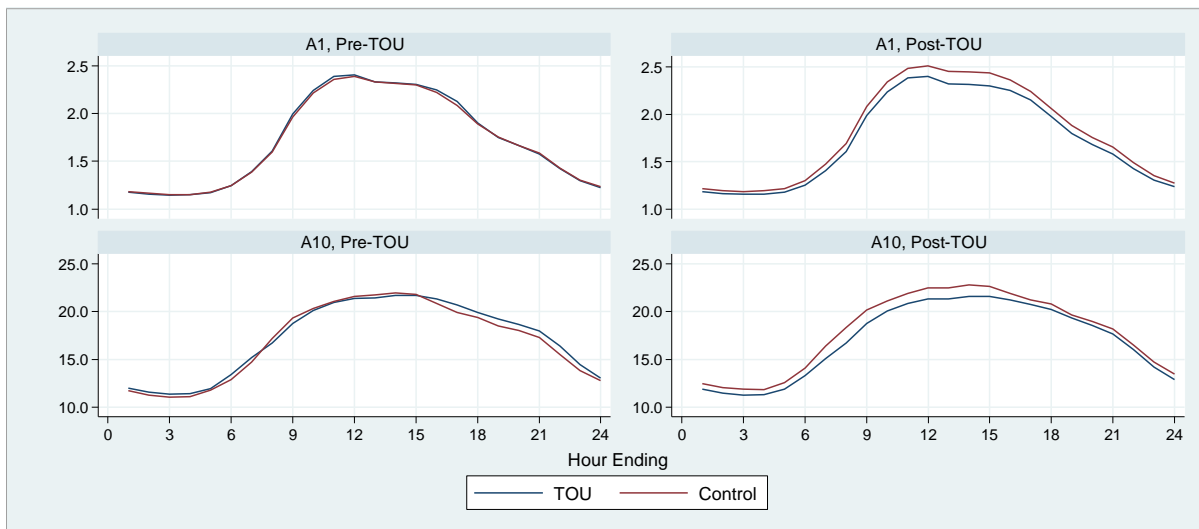
Figure 5-3 shows the difference between the treatment and control group customers for individual summer days as a function of weather both before and after TOU implementation. When both groups are on flat rates (blue dots), the difference between the two groups is centered on zero, indicating similar behavior on average.[14] With TOU rates in place (green diamonds), there is a clear difference

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[14] The exception is medium customers. They had larger pre-existing differences due to control group sample size limitations.

between customers on TOU rates and those that remained on flat rates – namely, TOU customer loads are lower. The impact is the difference between the two trends (the difference-in-differences).

**Figure 5-3: Difference between TOU and Control Group
Before and After TOU Implementation as a Function of Weather**
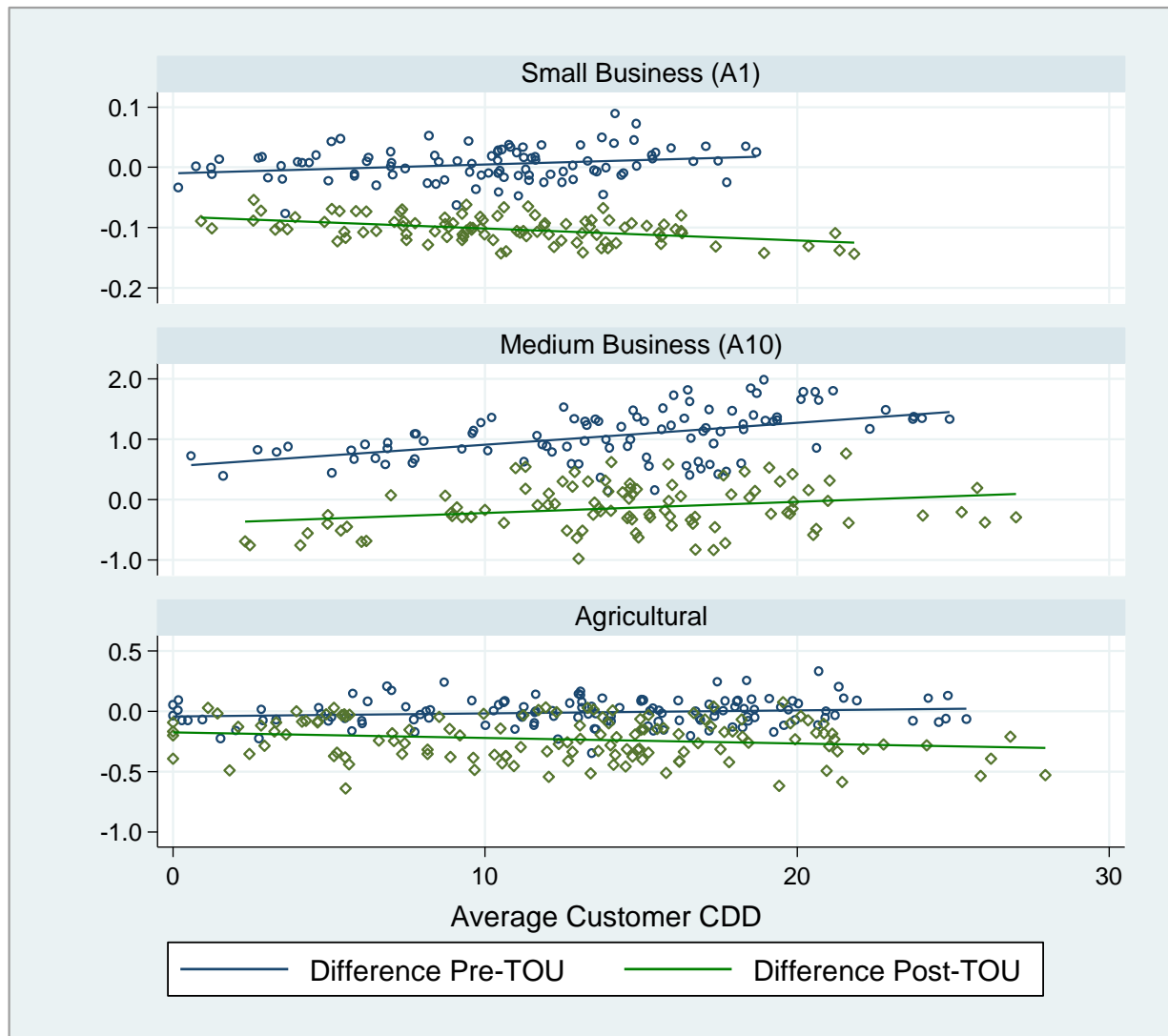
5.2 How closely did the change in loads correspond with the transition to mandatory TOU?

The shift in customer loads coincided with the implementation of TOU. Figure 5-4 shows demand patterns for the TOU and control groups in the months immediately prior, during, and after the transition to mandatory TOU. It is based on small businesses, which account for 90% of customers who transitioned to TOU. Prior to the implementation of mandatory TOU, the electricity demand patterns for the treatment and control group are nearly identical. When the TOU implementation begins, the

loads begin to diverge, as TOU customers start to consume less power than those who remained on flat rates. Once the implementation is complete, the reductions in demand by TOU customers continue.

Figure 5-4: TOU and Control Groups Loads in Months Before, During, and After Implementation
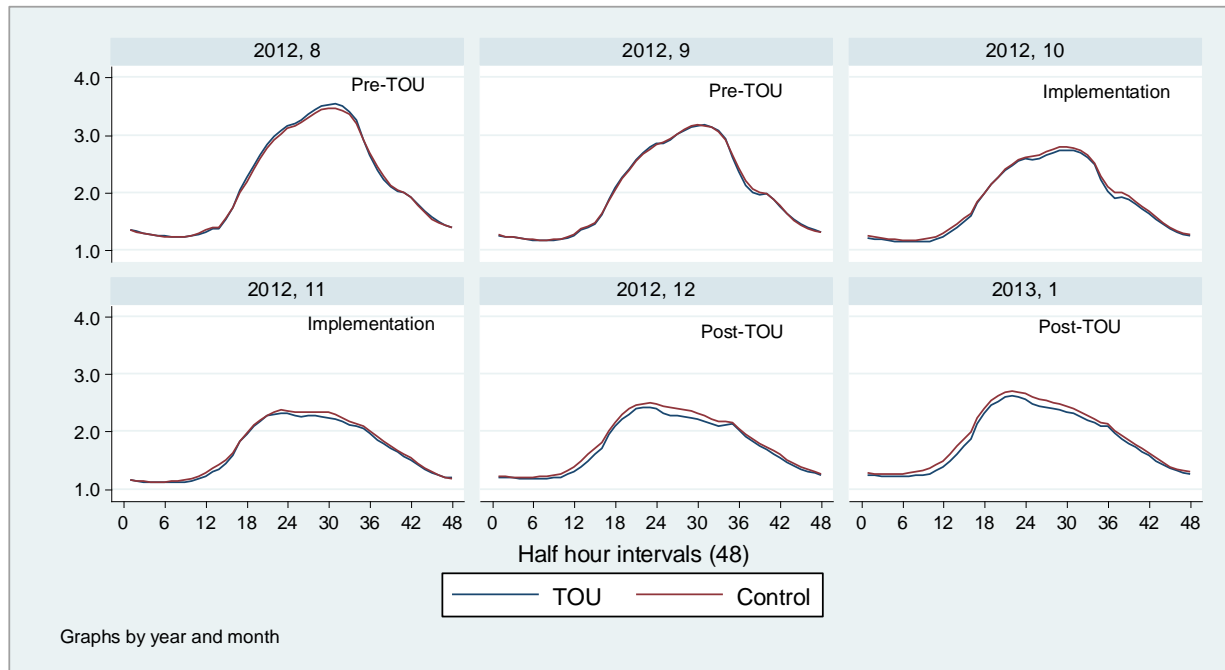
Figure 5-5 shows how changes in loads relate to the TOU transition dates and to PG&E's phased mail communications. The transition dates varied by customer due to differences in billing cycles. In all cases there is a notable reduction in TOU customer loads approximately when they began to receive the 30-day notice, which reminded customers the transition to TOU was imminent. The pattern is most clear for small business and small agricultural customers who make up over 97% of customers transitioned. The pattern is less clear for medium customers due to pre-existing differences between the group that transitioned to TOU and the control group. As noted in the impact evaluation of PG&E non-residential TOU rates, the medium customer results were based on a smaller sample size and fewer control group candidates, leading to a poorer control group in comparison to other segments. As a consequence, the estimated impacts rely more heavily on the difference-in-differences correction and modeling of energy demand.

Figure 5-5: Timing of Small Business Response and PG&E Phased Communications

Nexant
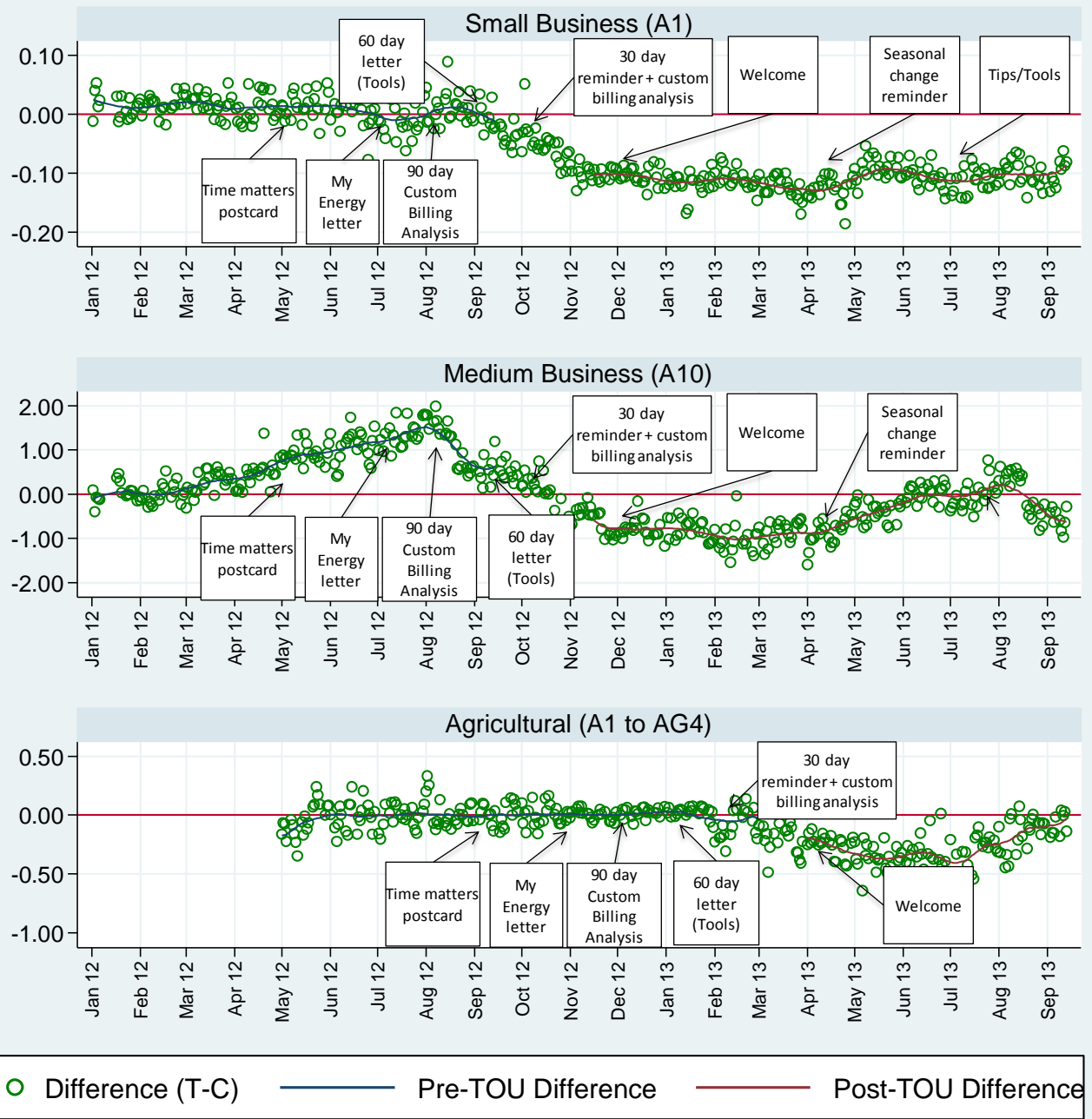
5.3   Did customers who reported higher awareness and understanding of TOU deliver larger demand reductions?

An important question is whether or not customers who were knowledgeable of the TOU transition actually delivered larger demand reductions. The assessment was limited to 732 customers who transitioned in November 2012 and participated in the survey. The analysis focused on four metrics that reflected awareness and understanding of TOU rates:

- Could customers correctly identify they were on a TOU rate (awareness)?

- Did they state they had heard of TOU rates (awareness)?

- Could customers identify the time period when electricity is most expensive in the summer (understanding)?

- Did they understand they could save by minimizing their use during summer peak hours (understanding)?

Because the assessment incorporated survey responses, the sample used for the analysis was far smaller than the samples used for the impact evaluations (less than one tenth in size). We estimated demand reductions delivered during peak hours (12 to 6 PM) during the 2013 summer for customers who could and could not correctly identify if they were on a TOU rate and for customers who did and did not claim to have heard of TOU rates. The results are inconclusive due to the small sample size.

Table 5-2 and Figure 5-6 summarize the results. We are unable to conclusively distinguish the estimated reductions from random noise; that is, the estimates are not statistically significant. We are also unable to determine if customers who were aware of TOU or understood it better outperformed customers who were less aware or misunderstood the TOU rate. This can be seen clearly in Figure 5-5, where the 95% confidence intervals overlap for different sets of customers and all of the estimates overlap zero, regardless of whether they correctly identified their rate or whether they heard of TOU.

The demand reductions were estimated using smart meter data from the summers before and after TOU implementation – 2012 and 2013, respectively – and a matched control group. Technically, demand reductions were estimated through a difference-in-differences panel regressions with fixed effects and time effects, using a control group developed via propensity score matching. In total, suitable control group matches were found for 685 of the 732 (94%) survey participants who experienced a full summer on TOU. If TOU led to reductions in demand, we should have seen a change among customers that transitioned to TOU but no similar change for customers that remained on flat pricing (the control group). Appendix B provides more details regarding the analysis methodology, including comparisons of the TOU and control groups, the specification of the regression models, and detailed regression output.

Table 5-2: Awareness and Demand Reductions (Survey Participants in November 2012 TOU Cohort)

Group		Accts	Avg. Customer				95% Confidence Band	
			Load without DR	Load with DR	Reduction	% Reduction	Lower bound	Upper bound
Correctly identified they were on a TOU rate	Yes	297	4.08	3.61	0.47	11.6%	-0.8%	24.0%
	No	388	4.11	3.98	0.13	3.3%	-1.7%	8.2%
Stated they heard of TOU	Yes	523	3.62	3.51	0.11	3.1%	-2.1%	8.2%
	No	162	4.89	4.82	0.07	1.5%	-3.5%	6.5%
Could identify summer peak hours	Yes	434	3.62	3.56	0.06	1.7%	-3.3%	6.7%
	No	251	4.45	4.26	0.18	4.2%	-2.4%	10.7%
Understood they could save by reducing during summer peak hours	Yes	561	3.65	3.53	0.11	3.1%	-1.7%	7.9%
	No	124	5.14	5.10	0.05	0.9%	-5.1%	6.9%

Figure 5-6: Awareness and Demand Reductions with 95% Confidence Interval
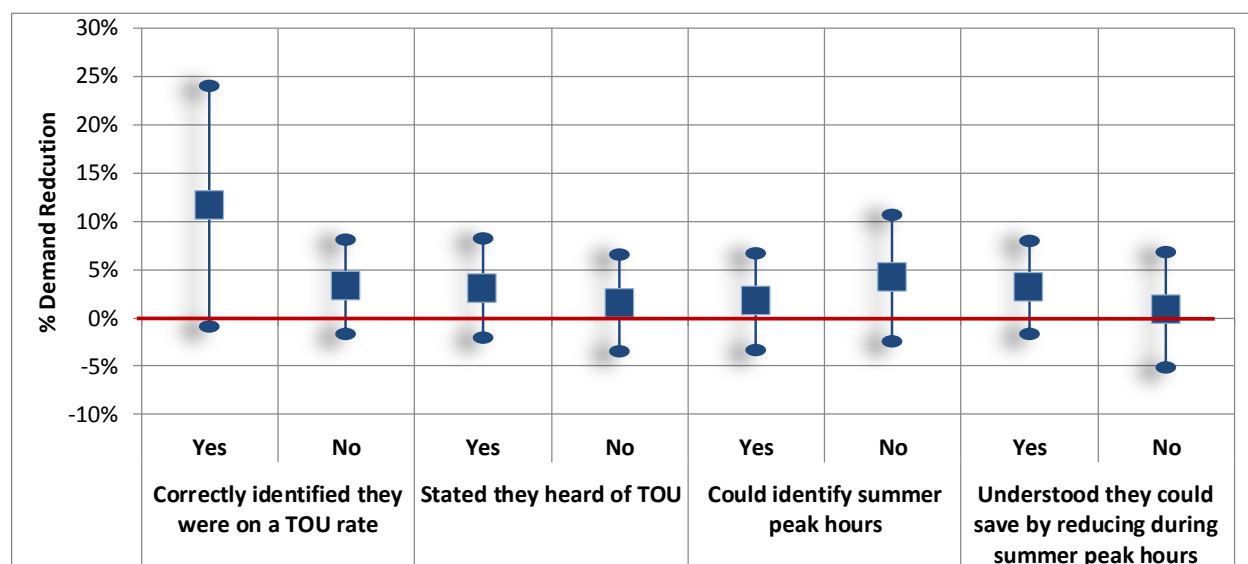
5.4   Did person-to-person outreach lead to incremental demand reductions?

Customers who received person-to-person outreach did not reduce demand more so than customers who only received phased mail. This finding is consistent with the findings that person-to-person

outreach did not lead to detectable gains in awareness and understanding of TOU over and above those attained by phased mail tactics alone.

The cutoff for the most impacted customers produces a unique localized experiment. As noted above, customers immediately below the cutoff are very similar to those immediately above the cutoff. This allows a comparison of customers immediately above and below the cut-off – who were and were not targeted for person-to-person outreach – to determine if their load behavior is different. If the person-to-person outreach led to a sufficiently large behavioral change, we should observe a distinct change at the breakpoint in electricity use – a discontinuity in the linear pattern.

This technique is known as regression discontinuity analysis. It makes use of the localized experiment created by comparing outcome variables related to peak electricity usage in the area of the breakpoint. The results are analyzed using regressions, but they are more easily understood visually, which is done in Figure 5-7 and Figure 5-8. Data points before and after the breakpoint are shown in different colors and the graphs show very little change in peak loads and usage at the point where customers become eligible for person-to-person outreach indicating that the additional impacts of person-to-person outreach on peak usage behavior are minimal. If a large impact existed, there would be a noticeable break in the data at the cutoff for person-to-person outreach eligibility. There is no noticeable break, however. Customers that received person-to-person outreach do not consume less kW during peak hours and the share of total consumption that occurs on-peak is the same.

Figure 5-7: Average Summer Weekday Load During Peak Hours for Customers Near Person-to-person Outreach Threshold
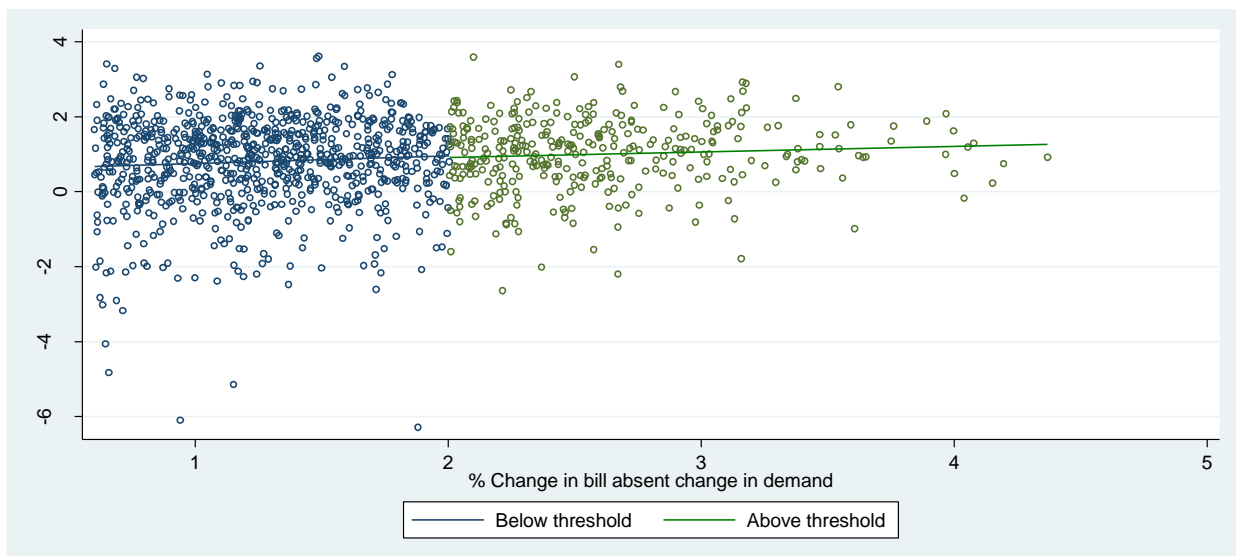
Figure 5-8: Share of Summer Weekday Usage During Peak Hours for Customers Near Person-to-person Outreach Threshold
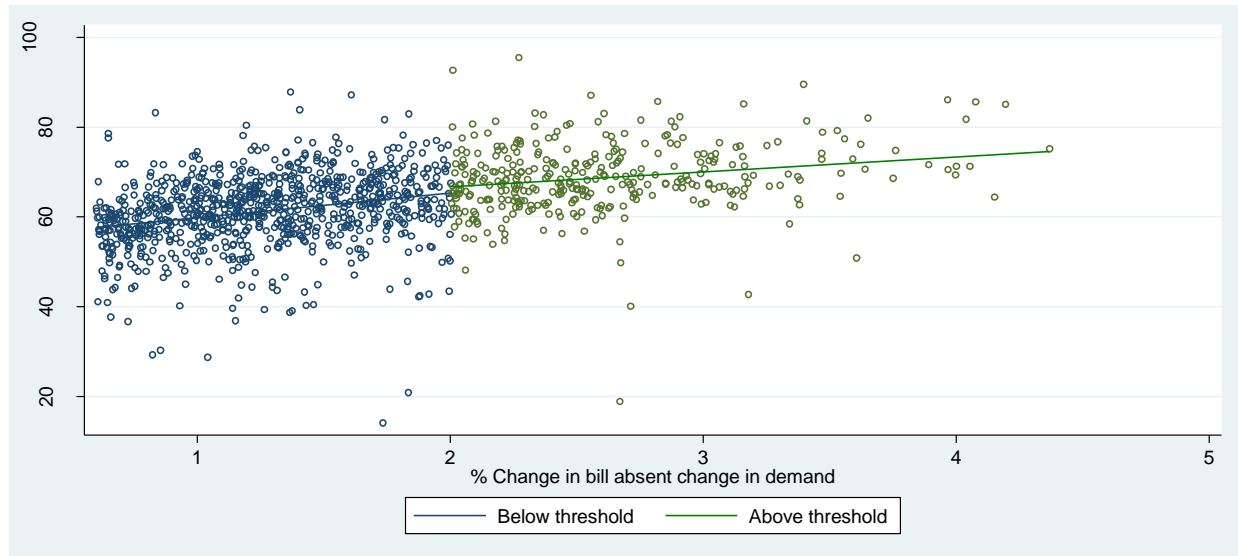
The data was also analyzed via a regression discontinuity model and results are presented separately for small (A1) and medium (A10) businesses in Table 5-3. The data analyzed in each case was average summer weekday load (kW) and the average share of weekday consumption that occurs on peak. If person-to-person outreach led to a decrease in demand or on peak usage over and above that of phased mail, the coefficient for person-to-person outreach would be negative and significant.

Table 5-3: Regression Discontinuity Results for Effect of In-Person Outreach

Variable	A1 Customers (n=1,197)			A10 Customers (n=246)		
	Coefficient	Std. Err.	p-value	Coefficient	Std. Err.	p-value
Avg. Summer Weekday Load (kW)						
In-Person Outreach	0.08	0.47	0.87	16.86	9.69	0.08
% Increase in Bill	0.14	0.29	0.63	0.83	4.03	0.84
% of Summer Weekday Usage during Peak Hours						
In-Person Outreach	1.22	0.87	0.16	-5.56	2.13	0.01
% Increase in Bill	4.63	0.54	0.00	4.95	0.89	0.00

5.5   Did the magnitude of bill impacts communicated to customers relate to the magnitude of demand reductions?

An important issue in the context of policy decisions about time-varying rates is concerns about customer bill impacts. While time varying pricing has many benefits, altering hourly prices can change customer bills even if they do not change their behavior because they remove cross-subsidies

embedded in flat pricing. Depending on their pre-existing demand consumption patterns, some customers would experience a higher bill and other customers would experience a bill decrease even if they did nothing. This occurs even though rates are designed to collect the same amount of revenue from the average customer, assuming no change in behavior. Based on economic theory, customers that experience lower electricity costs because of the shift should increase energy use while customers who experience higher costs should decrease consumption. The key question is whether actual customer behavior matches theory. As part of PG&E's TOU education and outreach campaign, customers who transitioned to TOU rates in November 2012 were sent customized bill comparisons twice – that is, they were provided information about bill impacts absent changes in behavior rather than having to assess on their own how TOU rates would affect them.

Two important questions about customer structural bill impacts and demand reductions are:

- Do structural winners – that is, customers who will see bill reductions on a time-varying rate even if they don't change their behavior – respond to the new price signals and reduce usage during peak periods when prices are high? Or are they free-riders?

- Do structural losers – that is, customers who will see bill increases on a time-varying rate if they don't change their behavior – reduce use during peak periods enough to benefit or mitigate the impact of the transition to TOU rates?

Figure 5-9 summarizes the typical customer percent reductions based on the structural bill impacts (absent changes in loads) communicated to customers. The top panel summarizes the change in demand during 2013 summer peak periods, lasting from 12 to 6 PM. The bottom panel summarizes the change in demand during the winter part-peak period, lasting from 8:30 AM to 9:30 PM. The results reflect the typical demand reductions by structural bill impact category, weighing all customers, large and small, equally. [15] The reductions were statistically significant for all groups analyzed, as can be seen by fact that the 95% confidence interval do not overlap zero. Since the relationship between structural bill impacts and demand reductions was not analyzed as part of PG&E's impact evaluation, Appendix C provides more detail about the regression models an includes the regression output.

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[15] The typical percent reductions are not the same as program impacts because they weight all customers equally, rather than assign more weight to larger customers. This is a function of the fact that the model used to estimate reductions used as the dependent variable the natural log of demand and employed a difference-in-differences panel regression with fixed effects. The combination of logs and fixed effects normalizes the data so that larger customers do not dominate the weighting. The benefit of this model is that reflects how the typical customer responded. Appendix C provides more details about the models estimated and includes the regression output.

Figure 5-9: Structural Bill Impacts and Typical Customer Price Response with 95% Confidence Intervals

Average Summer Weekday Peak Period (12-6 pm)

	(1) Decrease of 2% or more	(2) Decrease of 1-2%	(3) Decrease of 0-1%	(4) Increase of 0-1%	(5) Increase of 1-2%	(6) Increase of 2% or more
■ Average	-22.2%	-6.3%	-7.1%	-2.8%	-1.6%	-2.6%
— Lower	-23.3%	-7.0%	-7.6%	-3.4%	-2.3%	-3.6%
— Upper	-21.2%	-5.5%	-6.6%	-2.1%	-1.0%	-1.7%

Average Winter Weekday Part-Peak Period (8:30 am to 9:30 pm)

	(1) Decrease of 2% or more	(2) Decrease of 1-2%	(3) Decrease of 0-1%	(4) Increase of 0-1%	(5) Increase of 1-2%	(6) Increase of 2% or more
■ Average	-3.9%	-10.6%	-5.4%	-8.5%	-6.5%	-12.6%
— Lower	-4.9%	-11.3%	-5.9%	-9.1%	-7.1%	-13.4%
— Upper	-3.0%	-9.9%	-4.9%	-7.9%	-5.9%	-11.8%

The results are not causal – we cannot conclude the bill impacts communicated to customers led to smaller or large percent reductions – but the trends, or lack of them, are informative nonetheless. Customers who would have experienced bill decreases absent changes in behavior, structural winners, were not free riders. In fact, the largest structural winners reduced a larger share of their loads during summer months than other customers, though they are typically smaller accounts. Customers who would have experienced higher bills if they did not change their demand behavior, structural losers, also reduced demand. Considering that less than 1% of customers would have experienced structural bill

impacts greater than 3.5%, customers were able to reduce demand enough to benefit or mitigate the impacts of transitioning to TOU.

5.6   Conclusions

- Successful education and outreach does not guarantee changes in behavior; but reductions in peak demand indicate that customers were aware of TOU, understood when to reduce demand, and that some of them elected to do so.

- Customers clearly reduced peak loads because of TOU rates. Small, medium, and agricultural business' reduced demand by 3.7%, 3.9%, and 13.8% during summer weekday peak periods. Relative to the strength of the TOU price signal, the reductions attained are among the largest reductions measured from TOU rates.

- Customers not only reduced demand during peak periods, but reduced consumption in each rate period. The reductions were largest when prices were higher and smallest when prices were lower. The annual energy savings from the implementation of TOU rates totaled 178.9 GWh per year for the customers who transitioned in the evaluation period.[16] To put this in perspective, this amounts to half of total energy savings (353 GWh) expected for all of PG&E's energy efficiency commercial programs over the 2013 to 2014 period.[17]

- The shift in customer loads coincided with the implementation of TOU. Customers reduced demand around the time they transitioned, after receiving several communications from PG&E informing them of the transition.

- It was not possible to determine if customers who reported higher awareness of TOU delivered larger demand reductions. By necessity, this assessment had to rely only on survey respondents who had experienced TOU rates for a full summer. The sample sizes were simply too small to draw any conclusions.

- Customers who received person-to-person outreach did not reduce demand more so than customers who only received phased mail. This finding is consistent with the findings that person-to-person outreach did not lead to detectable gains in awareness and understanding of TOU over and above those attained by phased mail tactics alone.

- Customers who would have experienced bill decreases absent changes in behavior, structural winners, were not free riders. In fact, the largest structural winners reduced a larger share of their loads during summer months than other customers, though they are typically smaller accounts. Customers who would have experienced higher bills if they did not change their demand behavior, structural losers, also reduced demand. Considering that less than 1% of customers would have experienced structural bill impacts greater than 3.5%, customers were able to reduce demand enough to benefit or mitigate the impacts of transitioning to TOU.

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[16] The estimates for TOU energy savings from agricultural rates are for summer months only. The energy savings estimates could not be estimated for the remainder of the year due to the highly seasonal nature of agricultural loads.

[17] See CPUC Fact Sheet: http://www.cpuc.ca.gov/NR/rdonlyres/BB0D11D4-E6AA-471B-A5BA-8A70A18B4ECB/0/201314CommercialFactSheet.pdf

6   Costs and Return on Investment

A key goal of this study was to identify which educational approach produced the best return on investment. The return on investment is based on two main factors: per customer costs and the impact of specific education and outreach components. This allows us to measure the dollars spent per customer to achieve a one percent change in, for example, awareness.

The assessment is limited to quantifying the incremental effect of the phased outreach and the incremental effect of person-to-person outreach. What could not be done, however, was to quantify the effect of individual education pieces – e.g., the initial notice, billing analysis (90-days), 60-day notice, 30-day notice. Since all customers who transitioned to TOU received the same education materials, it was not possible to assess the effectiveness of individual education pieces.

6.1   Costs of Education and Outreach

Table 6-1 summarizes the expenditures associated with PG&E's 2012 and 2013 education efforts. The costs are separated into fixed and variable costs. Most fixed costs are foundational. Foundational costs typically are not solely for SMB accounts; sometimes they relate to both mandatory TOU and default PDP; and sometimes they affect multiple cohorts, including customers that have not yet transitioned to TOU or PDP. On the other hand, variable costs can be directly linked to SMB outreach approaches – person-to-person outreach, phased tactics, and always on tactics – and are the basis for the comparison of effectiveness of different education tactics.

Over the course of 2012 and 2013, the cost of PG&E's SMB and small agricultural education campaign totaled $17.84 million, of which $16.10 million is associated with specific education tactics. Person-to-person outreach efforts, which targeted the top 10% of most impacted customers and traditionally hard-to-reach sectors, added up to $8.97 million in costs, while phased mail tactics accounted for $3.56 million of expenditures. The remainder of the effort was associated with marketing and education materials that were always on and designed to provide education materials to customers who sought additional information.

Table 6-1: Small and Medium Business and Agricultural Education Campaign Costs

Type of Cost	Cost-Item	2012	2013	2012-2013 Total
Foundational fixed costs[1]	Customer Research	$255,152	$328,909	$584,061
	Educational Materials Design	$0	$0	$0
	Training Program Development and Facilitation (2)	$10,411	$1,938	$12,349
	Foundational Customer Research and Outreach Staffing	$571,389	$553,862	$1,125,251
	Database Operations	$1,992,269	$861,060	$2,853,329
	Customer Notifications (3)	$80,704	$19,973	$100,677
	Foundational Total	**$2,909,925**	**$1,765,742**	**$4,675,667**
SMB fixed costs[2]	Post-Foundational Customer Outreach and Education Staffing	$881,727	$855,963	$1,737,690
	SMB Fixed Cost Total	**$881,727**	**$855,963**	**$1,737,690**
In-person[2]	Staffing - Account Services	$4,463,040	$2,861,029	$7,324,069
	Third-Party Partnerships (7)	$327,990	($63)	$327,927
	In person Total	**$4,791,030**	**$2,860,966**	**$7,651,996**
Phased Tactics[2]	Direct Outreach	$980,320	$1,265,398	$2,245,718
	Educational Materials[3]	$1,034,274	$280,858	$1,315,132
	Phased Tactics Total	**$2,014,594**	**$1,546,256**	**$3,560,850**
Always On[2]	Customer Workshops	$639,888	$674,780	$1,314,668
	Online Content Development	$264,756	$411,819	$676,575
	Paid Media	$1,216,531	$1,682,421	$2,898,952
	Customer Recognition	$0	$0	$0
	Always On Total	**$2,121,175**	**$2,769,020**	**$4,890,195**
Total SMB Variable Costs		**$8,926,799**	**$7,176,242**	**$16,103,041**
Total SMB Specific Costs		**$9,808,526**	**$8,032,205**	**$17,840,731**

(1) Foundational costs support all customer classes and are not categorized by individual customer segments. They also provide the basis for the transition of all cohorts transitioning to mandatory TOU and default Peak Day Pricing. The costs are not included in the return of investment calculations because they were not incurred exclusively for SMB customers, and include time-varying rates besides mandatory TOU.

(2) Only includes costs associated with small and medium businesses and small agricultural accounts. This excludes costs associated with large commercial, industrial, and agricultural accounts.

(3) Some Education Materials costs relate to planning and are linked to all three education approaches, but were assigned to phased outreach to simplify matters and to ensure line items directly correspond with line items in prior CPUC filings.

Table 6-2 summarizes the number of customers associated with the different campaign elements and per customer costs associated with different education approaches.[18] We emphasize the two-year period results because phased mail expenditures for each transition cohort are not limited to a single calendar year.

Table 6-2: Per Customer Costs by Education Campaign Component

Metric	Component	2012	2013	Overall
Variable Costs	In-person outreach	$4,791,030	$2,860,966	$7,651,996
	Phased	$2,014,594	$1,546,256	$3,560,850
	Always on	$2,121,175	$2,769,020	$4,890,195
	Total	**$8,926,799**	**$7,176,242**	**$16,103,041**
Customers	In-person outreach	42,220	33,704	75,924
	Phased outreach	225,146	122,313	347,459
	Always on	N/A	N/A	N/A
	All customers	**225,146**	**122,313**	**347,459**
Variable costs per customer	In-person outreach	$113.48	$84.89	$100.78
	Phased	$8.95	$12.64	$10.25
	Always on	N/A	N/A	N/A
	All customers	**$39.65**	**$58.67**	**$46.35**

On average, PG&E spent $46.35 per customer on TOU education and outreach, with the majority of expenses associated with person-to-person outreach. There was a notable difference in per person costs in 2012 versus 2013 – $39.65 versus $58.67 per customer – but the difference is almost entirely due to the proportion of person-to-person outreach, which was 18.8% in 2012 and 27.6% in 2013.

Over the course of the two years, person-to-person outreach costs were $100.78 per service account. This amount includes labor costs from PG&E personnel associated with contacting customers, scheduling visits, driving to customer locations, and speaking with them. It also includes cost for contracts with third parties. The customer contact protocols were different in 2012 and 2013. In 2012, PG&E representatives attempted to reach customers three times. If representatives were unable to establish personal contact, customers were sent a distinct education packet through first class mail to ensure confirmed delivery. In 2013, PG&E was supposed to reach each eligible customer either in-person or on the phone even if more than three contact attempts were needed.

Phased mail tactics cost $10.25 per customer, on average, and included eight to nine letters or postcards and four bill inserts. At first glance, costs appear higher in 2013 than in 2012, but this is primarily

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[18] The number of customers that received PG&E communications varied by date, due to normal turnover in businesses. The values represent all customers who received communications regarding the transition.

because the expenditures for any given cohort (e.g., the November 2012 transition group) are not limited to a single calendar year. For example, PG&E sent two letters and two bill inserts in 2013 to customers who transitioned in November 2012. The customer transition occurred in 2012, but those costs were incurred in 2013.

6.2 Return on Investment

As noted earlier, person-to-person outreach did not lead to detectable gains over and above those attained by phased mail tactics alone. In addition, a large share of customers that were defined as Most Impacted based on CPUC guidance would not have experienced large changes in their bills absent changes in behavior. Overall, 9 out of 10 customers defined as Most Impacted would have experienced less than a 3.6% increase in their bills if they did not modify their behavior. In practice, they had the opportunity to manage their bills by either reducing consumption or shifting it to lower-cost periods.

Table 6-3 summarizes the effectiveness of the different education campaign components on awareness, understanding of TOU rates, and understanding of options to help manage the TOU transition, and for a composite measure of all three areas. It also summarizes the average cost per customer required for each tactic to attain a 1% improvement in the goal areas within the SMB population. For example, increasing awareness of TOU rates by 1% using phased outreach costs $0.31 per customer. The change itself is the simple average of the individual metrics in each category for the 2013 transition group (as summarized in Tables 3-1 and 4-2). The 2013 impact was used because it reflects the overall effect of the campaign prior to decay that occurs naturally as time elapses. The combined metric is simply the average of the results for each metric category.

In comparison to phased mail tactics, person-to-person outreach required 25 times more funding ($15.34/$0.60) in order to achieve the same percent change in TOU knowledge, as measured by the combined metric. As noted earlier, person-to-person outreach may have other benefits (such as helping to reduce complaints about the rate transition), but direct impacts on awareness and customer understanding appear to be small. Comparing the three education goals, it is not surprising that PG&E's campaign led to larger changes in TOU awareness than in TOU understanding or of options to manage the rate transition, which are more complex concepts.

The implications of the assessment are clear. PG&E should reduce the amount of person-to-person outreach, because it is more costly and does not lead to detectable gains over and above those attained by phased mail tactics alone. The person-to-person outreach was targeted at customers expected to be most affected by the TOU transition due to their pre-existing load shapes (which determine bill impacts). The reality, however, is that less than 1% of customers are expected to experience changes in electricity bills that exceed +3.5% even if they do not modify their electricity consumption patterns. While views about what constitutes a large change in bills varies, it is possible to reduce person-to-person outreach tenfold and still contact customers expected to experience more than a 5% change in their bill assuming they do not change their electricity use patterns. A tenfold reduction in person-to-person outreach may not directly result in a tenfold reduction in costs (due to set up, planning, reduced volume, and other factors), but will still lead to substantial ratepayer savings.

Table 6-3: Effectiveness of Campaign Components

Metric	Education Goal	Phased	In-person outreach	Overall
Variable Costs Per Customer		$10.25	$100.78	$46.35
Change due to outreach component (Percentage points)	Awareness	32.8%	5.6%	33.5%
	Understanding of TOU Rates	8.6%	5.0%	9.6%
	Understanding of options to manage transition	9.4%	9.1%	12.3%
	Combined Metric	**17.0%**	**6.6%**	**18.4%**
Effectiveness (Dollars per 1% change)	Awareness	$0.31	$18.11	$1.38
	Understanding of TOU Rates	$1.19	$20.13	$4.83
	Understanding of options to manage transition	$1.09	$11.03	$3.77
	Combined Metric	**$0.60**	**$15.34**	**$2.51**

6.3   Conclusions

- Phased mail tactics were highly effective and led to statistically significant changes in customer awareness and understanding of TOU rates. They account for nearly all of the overall effect.

- Person-to-person outreach does not lead to detectable gains over and above those attained by phased mail tactics alone.

- It was not possible to asses if person-to-person outreach contributed to the low rate of complaints (4 out of 360,000+ customers) regarding the transitions to mandatory TOU.

- For the 2012 and 2013 transitions to mandatory TOU, PG&E spent $48.90 per customer on education and outreach. The majority of expenses were associated with person-to-person outreach, which costs $118.10 per customer, and was only directed at a subset of customers. In contrast, phased mail tactics were directed at all customers transitioning to TOU at a cost of $10.25 per customer.

- In comparison to phased mail tactics, person-to-person outreach required 30 times more funding to attain a similar change in customer awareness and comprehension of TOU. The return on investment was calculated based on two main factors: per customer costs and the effect of the education and outreach component. To assess effectiveness, we calculated the amount of expenditures per customer required to achieve a 1% increase in TOU comprehension (which includes awareness, understanding of TOU rates, and understanding of options to manage the rate transition).

7   Recommendations

The empirical data from PG&E's implementation of mandatory TOU rates produced many practical insights about the effectiveness of different education approaches. Although we recommend specific research steps, we also recognize that additional research can impose additional costs.

- **Limit use of person-to-person outreach to customers whose bill would increase by more than 5% if they do not change their behavior when they transition to TOU.**

- **Study the influence of incremental communications regarding TOU on demand reduction persistence and/or improvements.** This is essentially a dosage study. What is the right level and frequency of TOU reminders? In specific, we recommend randomly assigning a subset of the population into zero, low, standard, and high dosage groups, and sending follow up reminders of TOU rates to them according to the dosage assignment. While these groups can be compared to each other, the earlier recommendation of withholding a randomly assigned control group, allows for a more comprehensive assessment of how incremental communication regarding TOU affect customer awareness, understanding, and behavior.

- **Send annual or bi-annual reminders of TOU rates and the benefits of peak reduction.** Eventually, all small and medium businesses will be defaulted on CPP rates. As part of annual summer readiness, we recommend reminding customers to reduce demand during peak periods every day, in addition to reducing on event days. It is also prudent to send reminders to customers who opt out of CPP, but remain on TOU rates, and to small Agricultural pumping customers (who are not being defaulted onto TOU).

- **Estimate the effectiveness of future education and outreach efforts through controlled tests and phased roll-outs rather than after-the-fact analysis.** The basic idea is to conduct small scale tests that provide rigorous answers as early as possible in order to avoid making more costly mistakes later in the process. This can be accomplished through a pilot or through phased rollouts of actual policies. The key is to provide the opportunity to test, learn, and optimize rather than implement wide scale changes with little or no precedent. This allows utilities an opportunity to make appropriate adjustments prior to full implementation. A key element of obtaining accurate results is random assignment of customers to treatment and control conditions. This process ensures the cause (or treatment) precedes the effect, the effect is related to the cause, and that there are no plausible explanations or alternative explanations for the effect besides the cause. In short, it helps ensure the findings are valid, answered with scientific accuracy.

Appendix A Education and Outreach Assessment Survey Instrument

Pacific Gas and Electric Company®

Tell us how we're doing and earn $20.00

Customer Name
Customer Company
1234 Happy Lane
Bakersfield, CA 93304

Dear Customer Name:

We have hired Population Research Systems (PRS) to conduct a short survey among PG&E business customers. This short online survey will ask about your satisfaction with the service you receive and the rate plan your business is on. Your business has been randomly selected to participate. After we receive your completed survey, we will send you (or any organization you designate) a **$20 thank-you check.**

We understand this a busy time for many of our business customers and would greatly appreciate your time and feedback. Most customers can complete the survey within 10 minutes. When answering the questions, please think about the PG&E service you receive at your business. There will be a comment box at the end of the survey that you can use to provide additional feedback regarding service you receive at your residence.

Evaluations such as this are very important as we plan for 2014 and will help us improve our service. Please be assured that your answers will be kept confidential and will not be associated with your name, company or address.

How to Access the Survey Immediately

Go to: **www.pgesurveys.com**
Enter ID: **12345**

What to Expect
If we do not receive your online responses, a representative from PRS will call you to follow up. At that time, you can decide to either complete the survey over the telephone or request that the survey link be emailed to you. In any case, the website address and ID above are valid during the course of the study. We hope you will speak with the PRS representative when he or she calls. The telephone interview will ask the same questions and will also take about ten minutes.

We know it is important to you and your business that we continuously improve our service and offer rate plans that fit your needs. So, please take a few minutes to provide us with your feedback. If you have questions, please call PRS at **1-877-932-0613**.

Thank you in advance,

Signature

Name
Title
Department

Hello, my name is _____ and I'm calling from Population Research Systems on behalf of Pacific Gas & Electric Company. May I please speak with [CONTACT NAME] or the person most knowledgeable about your PGE&E service and how your business uses electricity at [SERVICE ADDRESS]? [If not, ask for the most knowledgeable person and reintroduce as necessary.]

S1. I am calling to follow up on a letter PG&E mailed a few days ago to [MAILING ADDRESS]. The letter referred to a short online survey that pays $20. Did you get a chance to read that letter?
1. Yes
2. No

IF S1=1

S2. It doesn't look like your business' survey has been completed. Do you have about eight to ten minutes complete it over the phone now?
1. Yes
2. Not now, but call me back at _____
3. Not now, but you can email me the link to _____
4. Refused to participate

IF S2=1 – Great, We will begin by asking about your satisfaction with PG&E service and your understanding of the rates you pay for electricity. Remember that all your answers will be confidential. Your name and address will be kept anonymous and will not be associated with your answers.

IF S2=3 – Thank you, I will email you the link shortly. The email subject line is *PG&E $20 Online Survey*. At the end of the survey, you will be asked to specify where you want the $20 thank-you check sent. Your survey contains only _____ questions, so please complete it within three business days. Thank you!

1. Overall, using a 10-point scale where 1 means you are "not at all satisfied" and 10 means you are "extremely satisfied" how would you rate your overall satisfaction with PG&E as a provider of energy for your specific business location? [1-10, DK/Ref]

   Not at all satisfied   Extremely Satisfied

   1   2   3   4   5   6   7   8   9   10

2. Which of the following best describes the way you are currently charged for electricity?**Check only one**

   ☐ you pay the same price per kWh for electricity no matter when you use it – called a flat rate. ➔ **Q3**

   ☐ you pay a different price per kWh for electricity depending on the season and time of day –called a time-of-use rate. ➔ **Q4**

   ☐ on most days during the summer you pay a different price per kWh for electricity depending on the time of day. However on 9-15 days during the summer there is a

significant additional surcharge for power consumed during the afternoon hours – called a peak day pricing rate. ➔ **Q3**

☐ Don't know ➔ **Q3**

3. Instead of the rate which you say you are on currently, the utility could charge you <u>more</u> for electricity used during the afternoon hours when it costs most to produce it and less during the morning and night when it is less expensive to produce. This is called a time-of-use rate and is in place every day. Have you heard of it?

☐ Yes ➔ **Q4**
☐ No ➔ **Q9**
☐ Not-sure ➔ **Q5**

4. How did you hear about it?

☐ bill insert
☐ PG&E letter
☐ website
☐ friend
☐ Other _____
☐ Not sure/don't know

The next few questions are about customers' understanding of how time-of-use rates work.

5. Which of the following best describes how the price of electricity varies by time of day during the <u>summer</u>? ***Check only one***

☐ there are three rate periods each day – peak, partial peak and off-peak
☐ there are two rate periods per day – peak and off-peak
☐ same price all day ➔ **Q7**
☐ Not sure

6. In the summer, during what hours of the day is the price for electricity highest? Is it…

☐ between Midnight and 6:00 AM
☐ between 6:00 AM and Noon
☐ between 12:00 Noon and 6:00 PM
☐ between 8:30 AM and 9:30 PM
☐ Other _____
☐ Not sure/don't know

7. Which of the following best describes how the price of electricity varies by time of day during the winter? *Check only one*

   ☐ there are three rate periods each day – peak, partial peak and off-peak
   ☐ there are two rate periods per day – peak and off-peak
   ☐ same price all day➔ **Q9**
   ☐ Not sure

8. In the winter, during what hours of the day is the price you pay for electricity highest? Is it…

   ☐ between Midnight and 6:00 AM
   ☐ between 6:00 AM and Noon
   ☐ between 12:00 Noon and 6:00 PM
   ☐ between 8:30 AM and 9:30 PM
   ☐ Other _____
   ☐ Not sure/don't know

(Ask Q9-Q22 only of 2013 transition customers)

9. In the last three months, were you informed by PG&E that the electricity accounts for your business were going to be changed to a time-of-use rate?

   ☐ Yes   ☐ No

10. (if Q9 = yes) When is this change supposed to take place (month and year)?

Month _____ Year_____ ☐ Don't know

11. I'm going to read a list of ways in which you might have received this notice. As I do you tell me whether you recall receiving information in this way.

   ☐ Information included with my bill
   ☐ A call of in person visit from a PG&E representative
   ☐ A PG&E letter
   ☐ PG&E's website

☐ E-mail from PG&E
☐ Other online announcement or video
☐ Television, radio or newspaper ➔ Where did you hear about it? _____
☐ PG&E hosted event
☐ Other _____
☐ Not sure/don't know

12. Are you aware that flat electricity rates will be completely phased out for all commercial electricity customers in California and replaced with time-of-use rates?

☐ Yes
☐ No
☐ Not-sure

13. Are you aware that you will not be able to return to flat rates once you are switched to a time-of-use rate?

☐ Yes
☐ No
☐ Not-sure

14. Are you aware that your monthly bills could increase or decrease once you are switched from a flat rate to a time-of-use rate?

☐ Yes
☐ No
☐ Not-sure

15. Do you understand that you can reduce your electricity bill by minimizing the amount of electricity your firm used during summer peak hours, between 12-6PM when electricity prices are highest?

☐ Yes
☐ No
☐ Not-sure

16. (if Q15 = yes) Do you think your firm will be able to reduce the amount of electricity it uses during summer peak hours, between 12-6PM?

☐ Yes
☐ No

☐ Not-sure

17. (Phrase tense based on Q2 response) Which of the following best describes how your bill will change when you are on a time of use rate? Would you say it…..?

☐ Will increase significantly
☐ Will increase slightly
☐ No change
☐ Will decrease slightly
☐ Will decrease significantly
☐ Don't know

18. Did PG&E provide you with advice concerning how you could lower your energy cost once you have been switched to time-of-use rates?

☐ Yes ➜ What did they advise you to do?_____
☐ No
☐ Not-sure

19. Did PG&E advise you to visit its website to find out how you can lower your energy cost when you are on time-of-use rates?

☐ Yes
☐ No
☐ Not-sure

20. Has your business taken any of the following actions because of the switch from a flat rate to a time-of-use rate?

☐ Install energy efficient equipment
☐ Use less power through other manual actions
☐ Adjust or reprogram your thermostat
☐ Explore other rate options
☐ Check electricity use patterns online
☐ Sign on for a PG&E online account
☐ Other _____

21. Does your business __plan__ to take any actions to change the way you use electricity now that you have been switched from a flat rate to a time-of-use rate?

☐ Yes

☐ No➜ **Q47**
☐ Not-sure➜**Q47**

22. What actions do you plan to take?

☐ Install energy efficient equipment
☐ Use less power through other manual actions
☐ Adjust or reprogram your thermostat
☐ Explore other rate options
☐ Check electricity use patterns online
☐ Sign on for a PG&E online account
☐ Other _____

(Ask Q23-Q35 only of 2012 transition customers)

23. Do you recall being informed by PG&E that your businesses' electricity accounts would be changed to time-of-use rates last year?

☐ Yes
☐ No
☐ Not present in November 2012
☐ Don't recall

24. (if Q23 = yes) When was this change supposed to take place (month and year)?

Month _____ Year_____ ☐ Don't know

25. I'm going to read a list of the ways in which you might have received this notice in 2012. As I do you tell me whether you recall receiving it.

☐ Information included with my bill
☐ A call of in person visit from a PG&E representative
☐ A PG&E letter
☐ PG&E's website
☐ E-mail from PG&E
☐ Other online announcement or video
☐ Television, radio or newspaper ➔ Where did you hear about it? _____
☐ PG&E hosted event
☐ Other _____
☐ Not sure/don't know

26. Are you aware that flat electricity rates will be completely phased out for all commercial electricity customers in California and replaced with time-of-use rates?

☐ Yes
☐ No
☐ Not-sure

27. Are you aware that you are not be able to return to flat rates once you were switched to time-of-use rates?

☐ Yes
☐ No
☐ Not-sure

28. Prior to being switched to time-of-use rates, were aware that your monthly bill might increase or decrease when you were switched from a flat rate to a time-of-use rate in 2012?

☐ Yes
☐ No
☐ Not-sure

29. Do you understand that you can reduce your electricity bill by minimizing the amount of electricity your firm uses during summer peak hours when prices are higher?

☐ Yes
☐ No
☐ Not-sure

30. (if Q27 = yes) Has your firm reduced the amount of electricity it uses during summer peak hours, between 12-6 pm?

☐ Yes
☐ No
☐ Not-sure

31. (Phrase tense based on Q2 response) Which of the following best describes how your bill changed with a time-of-use rates? Would you say it.....?

☐ Increased significantly
☐ Increased slightly
☐ No change
☐ Decreased slightly
☐ Decreased significantly
☐ Don't know
☐ Never looked

32. Did the information you received from PG&E help you understand how to keep your energy costs low under the time-of-use rate?

☐ Yes
☐ No
☐ Did not receive any information
☐ Not-sure

33. Has your business take any of the following actions because of the switch from flat rates to time-of-use rates?

☐ Install energy efficient equipment
☐ Use less power through other manual actions
☐ Adjust or reprogram your thermostat
☐ Explore other rate options
☐ Check electricity use patterns online
☐ Sign on for a PG&E online account
☐ Other _____

34. Does your business **plan** to take any actions because of the switch from flat rates to time-of-use rates?

☐ Yes
☐ No**➜ Q47**_____
☐ Not-sure**➜Q47**

35. What actions do you plan to take?

☐ Install energy efficient equipment
☐ Use less power through other manual actions
☐ Adjust or reprogram your thermostat
☐ Explore other rate options
☐ Check electricity use patterns online
☐ Sign on for a PG&E online account
☐ Other _____

(Ask Q36 – Q44 only of 2014 transition customers)

36. In the last three months, were you informed by PG&E that the electricity accounts for your business were going to be changed to a time-of-use rate?

☐ Yes   ☐ No

37. (if Q36 = yes) When is this change supposed to take place (month and year)?

Month _____ Year_____ ☐ Don't know

38. I'm going to read a list of ways in which you might have received this notice. As I do you tell me whether you recall receiving information in this way.

☐ Information included with my bill
☐ A call of in person visit from a PG&E representative
☐ A PG&E letter
☐ PG&E's website
☐ E-mail from PG&E
☐ Other online announcement or video
☐ Television, radio or newspaper ➔ Where did you hear about it? _____
☐ PG&E hosted event
☐ Other _____
☐ Not sure/don't know

39. Are you aware that flat electricity rates will be completely phased out for all commercial electricity customers in California and replaced with time-of-use rates?

☐ Yes
☐ No
☐ Not-sure

40. Are you aware that your monthly bills could increase or decrease once you are switched from a flat rate to a time-of-use rate?

☐ Yes
☐ No
☐ Not-sure

41. (Phrase tense based on Q2 response) Which of the following best describes how your bill will change when you are on a time of use rate? Would you say it.....?

   ☐ Will increase significantly
   ☐ Will increase slightly
   ☐ No change
   ☐ Will decrease slightly
   ☐ Will decrease significantly
   ☐ Don't know

42. Have you received any information from PG&E to help you understand how to keep your energy costs low when you are switched?

   ☐ Yes
   ☐ No
   ☐ Not-sure

43. Do you understand that once you are switched to time-of-use rates you can reduce your electricity bill by minimizing the amount of electricity your firm uses during peak hour?

   ☐ Yes
   ☐ No
   ☐ Not-sure

44. Has your business take any of the following actions because of the switch from flat rates to time-of-use rates?

   ☐ Install energy efficient equipment
   ☐ Use less power through other manual actions
   ☐ Adjust or reprogram your thermostat
   ☐ Explore other rate options
   ☐ Check electricity use patterns online
   ☐ Sign on for a PG&E online account
   ☐ Other _____

45. Does your business plan to take any actions because of the switch from flat rates to time-of-use rates?

   ☐ Yes ☐ No➔ **Q47** _____
   ☐ Not-sure➔**Q47**

46. What actions do you plan to take?

☐ Install energy efficient equipment
☐ Use less power through other manual actions
☐ Adjust or reprogram your thermostat
☐ Explore other rate options
☐ Check electricity use patterns online
☐ Sign on for a PG&E online account
☐ Other _____

FIRMOGRAPHICS

I have just a few more questions for statistical purposes only. Your responses are completely confidential. They will only be reported together, not individually.

47. What is your position or job title?

        Senior Management
        ☐ President/CEO/COO/Pastor
        ☐ Owner/Partner
        ☐ General Manager/GM/Senior Administrator
        ☐ Other Vice President/Director/Executive (Not Financial)
        Accounting or Financial
        ☐ Chief Financial Officer /VP of Finance
        ☐ Accountant/Accounts payable/Bookkeeper
        ☐ Controller/Comptroller
        ☐ Other financial or accounting
        Office Management/Executive Assistant
        ☐ Store Manager
        ☐ Office Manager
        ☐ Executive assistant/Admin assistant
        ☐ Other office administrator
        Facilities/Engineering
        ☐ Building/Facilities/Maintenance Manager
        ☐ Engineer/Chief Engineer
        ☐ Other (Spec:___)
        ☐ Don't Know/Refused

48. Is your office location …?

        ☐ Your company headquarters
        ☐ A division or branch unit headquarters
        ☐ A branch office, local office, or other non head quarters facility
        ☐ Don't know/Refused

49. How many locations or sites do you oversee in total?

        (RECORD NUMBER _____
        ☐ Don't know/Refused

50. How many employees do you have at your current location? (DO NOT READ)

☐ Less than 5
☐ 5-9
☐ 10-19
☐ 20-49
☐ 50-99
☐ 100-199
☐ 200-399
☐ 400 or more
☐ Don't know/Refused

51. What is your business' average MONTHLY PG&E bill, electricity and gas combined? [READ ONLY IF NECESSARY]

☐ Less than $500 (less than $6,000 per year)
☐ $500 to $999 ($6,000 to $11,999 per year)
☐ $1,000 to $1,499 ($12,000 to $17,999 per year)
☐ $1,500 to $1,699 ($18,000 to $20,399 per year)
☐ $1,700 to $1,999 ($20,400 to $23,999 per year)
☐ $2,000 to $4,999 ($24,000 to $59,999 per year)
☐ $5,000 to $9,999 ($60,000 to $119,999 per year)
☐ $10,000 or higher ($120,000 per year or higher)
(VOL) Don't know/Refused

52. Approximately what percent of your total monthly costs are energy related? [IF NEEDED: Your best estimate is fine.]

☐ Less than 5%
☐ 5% to 9%
☐ 10% to 14%
☐ 15% to 19%
☐ 20% to 24%
☐ 25% to 32%
☐ 33% to 49%
☐ 50% or more
☐ Don't know/Refused

53. What is your business's annual revenue? (READ LIST UNTIL ANSWERED)

☐ Less than $100,000
☐ $100,000 to less than $250,000
☐ $250,000 to less than $500,000
☐ $500,000 to less than $1 million
☐ $1 million to less than $2 million
☐ $2 million to less than $5 million
☐ $5 million to less than $10 million
☐ $10 million to less than $100 million
☐ $100 million to less than $1 billion
☐ $1 billion or more
☐ Not applicable, Government agency
☐ (DO NOT READ) Don't know
☐ (DO NOT READ) Refused

54. (BY OBSERVATION)

☐ Male
☐ Female

Appendix B TOU Awareness and Demand Reduction Analysis Details

The analysis relied on after-the-fact analysis. It was limited to 732 customers who participated in the survey and also experienced a full summer under TOU rates, after their transition. For simplicity, this group is referred to as the TOU group throughout this appendix. The smaller samples were used so we could determine if awareness, as reported by customers in the survey, had any relation to customer behavior, in the form of demand reductions during summer afternoons.

The effect of mandatory TOU rates was analyzed through difference-in-differences, using a control group that was developed via propensity score matching. This approach allows comparisons of the control and treatment groups before and after implementation of TOU. A quality control group should mirror electricity demand patterns of the treatment groups when both groups were still on flat pricing. If TOU leads to reductions in demand, we should observe a change in their demand but no similar change for control group customers that remain on flat pricing. The timing of the change should coincide with the implementation of mandatory TOU.

Using the two methods jointly – propensity score matching and difference-in-differences – ensures more robust results than if either method is used in isolation. By developing a matched control group, we ensure the difference-in-differences results are not overly reliant on the differencing correction. By using difference-in-differences, we are able to net out pre-existing differences that may be due to unobservable factors that could not be included in the matching. The analysis approach used, in our assessment, is the best quasi-experimental method that could be implemented in the absence of random assignment.

The remainder of this appendix provides details regarding the control group selection, the estimation technique employed – including the specification of the regression model, and the regression output.

B.1   Control Group Development

The control groups were selected via propensity score matching. Although customers did not self-select into TOU rates, the timing of smart meter installations in different areas of PG&E's territory led to regional differences between customers who transitioned to TOU in November 2012 and the cohorts scheduled to transition in later years. Propensity score matching allowed us to identify a control group with similar characteristics as the TOU group.

The control group was selected from among 30,000 candidates who had not experienced TOU rates in the 2012 and 2013 summers (and had full interval data for those periods). The matching took into account:

- Industry type;[19]
- Geographic location;[20]

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[19] The industry groups were based on the first two digits of the North American Industrial Code System of the TOU group.

[20] The location matching factored in the assigned PG&E weather station. In total, all of PG&E's customers are mapped to 25 weather stations.

- Pre-TOU consumption patterns (January–August 2012); and
- Load shapes.[21]

In total, we identified matches for 664 out of 732 TOU group customers (91%). Only customers with a matched control group member were included in the analysis. Table B-1 compares the characteristics of the TOU and control groups. Any differences are small and are not statistically significant. Figure B-2 compares the loads during summer weekdays when both groups were on flat rates and after the TOU group transitioned.

Table B-1: Comparison of Matched TOU and Control Groups

Category	Variable	TOU Group (n=664)	Control Group (n=664)	t	p>t
Pre-TOU Monthly Consumption (kWh)	Jan 2012				
	Feb 2012	2,529	2,605	-0.44	0.663
	Mar 2012	2,687	2,738	-0.28	0.777
	Apr 2012	2,597	2,638	-0.24	0.814
	May 2012	2,932	2,995	-0.31	0.754
	June 2012	3,062	3,113	-0.24	0.807
	July 2012	3,346	3,413	-0.29	0.770
	Aug 2012	3,578	3,616	-0.16	0.875
Summer Weekday - Pre TOU Avg. Demand (kW) by Time Period	12:00 -3:00 AM	6.19	6.40	-0.37	0.714
	3:00-6:00 AM	6.09	6.34	-0.46	0.649
	6:00-9:00 AM	11.34	12.26	-0.92	0.36
	9:00AM-12:00PM	22.56	23.31	-0.49	0.627
	12:00-3:00 PM	26.46	27.39	-0.55	0.584
	3:00-6:00PM	24.21	24.25	-0.03	0.977
	6:00-9:00 PM	12.69	11.93	0.71	0.476
	9:00PM-12AM	7.91	7.83	0.11	0.911
Summer Weekday - Pre-TOU Share of Consumption by Time Period	12:00 -3:00 AM	5.7%	5.7%	0.02	0.985
	3:00-6:00 AM	5.7%	5.7%	-0.10	0.923
	6:00-9:00 AM	8.8%	9.4%	-1.77	0.077
	9:00AM-12:00PM	18.8%	18.9%	-0.19	0.850
	12:00-3:00 PM	22.3%	22.8%	-1.13	0.260
	3:00-6:00PM	21.3%	20.7%	1.30	0.195
	6:00-9:00 PM	10.5%	10.1%	1.04	0.298
	9:00PM-12AM	7.0%	6.8%	0.42	0.673
Climate (Weather Station)	AUBURN	4.8%	5.1%	-0.25	0.801
	BAKERSFIELD	2.7%	3.5%	-0.79	0.428
	BELMONT	3.5%	3.5%	0.00	1.000
	CHICO	4.7%	5.6%	-0.75	0.455

---

[21] Load shapes were estimated as the percentage of weekday consumption that occurred at different time periods of the day.

Category	Variable	TOU Group (n=664)	Control Group (n=664)	t	p>t
	COLMA	1.4%	1.2%	0.24	0.807
	CONCORD	6.2%	4.8%	1.08	0.279
	CUPERTINO	6.3%	5.7%	0.46	0.645
	EUREKA	2.6%	1.8%	0.94	0.348
	FRESNO	11.7%	12.5%	-0.42	0.675
	MARYSVILLE	2.9%	2.9%	0.00	1.000
	MILPITAS	14.8%	13.7%	0.55	0.583
	OAKLAND	4.1%	2.6%	1.53	0.125
	PASO ROBLES	1.1%	0.9%	0.28	0.781
	POTRERO	2.6%	2.7%	-0.17	0.864
	RED BLUFF	0.3%	0.2%	0.58	0.564
	SACRAMENTO	6.9%	6.9%	0.00	1.000
	SALINAS	3.6%	3.6%	0.00	1.000
	SAN RAFAEL	2.4%	2.7%	-0.35	0.728
	SAN RAMON	2.9%	3.0%	-0.16	0.871
	SANTA MARIA	1.1%	0.9%	0.28	0.781
	SANTA ROSA	5.9%	7.5%	-1.21	0.228
	STOCKTON	5.4%	5.9%	-0.36	0.722
Industry Type	11 - Agriculture, Forestry, Fishing and Hunting	0.6%	1.1%	-0.91	0.364
	22 - Utilities	1.1%	1.5%	-0.73	0.464
	23 - Construction	1.7%	0.9%	1.22	0.223
	31 - Manufacturing - Food and finished products	0.6%	0.9%	-0.63	0.526
	32 - Manufacturing - Primary materials	0.9%	0.8%	0.30	0.762
	33 - Manufacturing -Metals and machinery	2.4%	2.3%	0.18	0.856
	42 - Wholesale Trade	2.1%	2.3%	-0.19	0.851
	44 - Retail Trade	5.9%	6.0%	-0.12	0.908
	45 - Retail Trade	3.3%	2.9%	0.48	0.634
	48 - Transportation	0.5%	0.2%	1.00	0.317
	49 - Warehousing, Storage and Couriers	1.5%	1.8%	-0.43	0.667
	51 - Information	0.2%	0.3%	-0.58	0.564
	52 - Finance and Insurance	0.8%	1.5%	-1.30	0.194
	53 - Real Estate and Rental and Leasing	3.3%	2.9%	0.48	0.634
	54 - Professional, Scientific, and Technical Services	4.4%	4.1%	0.27	0.785
	55 - Management of Companies and Enterprises	1.1%	0.6%	0.91	0.364
	56 - Waste Management and Remediation Services	1.4%	1.7%	-0.45	0.653
	61 - Educational Services	1.5%	0.8%	1.30	0.194
	62 - Health Care and Social Assistance	8.9%	8.4%	0.29	0.770
	71 - Arts, Entertainment, and Recreation	1.5%	0.8%	1.30	0.194
	72 - Accommodation and Food Services	4.4%	4.1%	0.27	0.785
	81 - Other Services (except Public Administration)	12.0%	12.7%	-0.33	0.739

Category	Variable	TOU Group (n=664)	Control Group (n=664)	t	p>t
	92 - Public Administration	0.2%	0.3%	-0.58	0.564
	0 - Unclassified or other	1.1%	0.5%	1.27	0.204

**Figure B-1: Avg. Customer Summer Weekday Loads (May–Sept)
Before and After TOU Implementation**

B.2   Regression Models

The impacts were estimated using a difference-in-differences panel regression with fixed effects and time effects. This technique accomplishes three things: it nets out the differences between the control and TOU groups observed during the 2012 pre-enrollment period; it takes into account whether peak and off peak demand patterns changed for customers placed on TOU; and it determines whether demand patterns also changed for customers who did not experience mandatory TOU. In addition, the technique accounts for unobserved time invariant customer characteristics (fixed effect) and for unobserved factors that are the same across all customers but unique to specific time periods (time effects). The fixed effects and time effects explain a substantial share of the variation, leading to more precise estimation of the demand reduction. The precision is further improved by including variables that explain energy use, such as temperature and day-of-week effects. These explanatory variables filter background noise (variation) allowing the signal (customer response to TOU rates) to be more easily detected.

The dependent variable was each customer's peak period (12 to 6 PM) electricity use for each summer weekday in 2012–2013. In total, the analysis included 143,420 observations, or 212 days for each of 1,328 customers. However, a separate model with an identical specification was estimated for customers who were and were not aware of TOU and for customers who did and did not correctly

identify they were on a TOU rate. This reduces the sample sizes available for comparison. The panel regressions were estimated using clustered, robust standard errors, to reflect the fact that individual customer observations were related.

The difference-in-differences panel models are expressed by the below equations:

$$PeakW_{i,t} = a + b \cdot Treatment_i + c \cdot TOUperiod_t + d \cdot (Treatment_i \cdot TOUperiod_t)$$

$$+ e \cdot CDD_{i,t} + \sum_{dow=1}^{n} f_{dow} \cdot DOW_t + \sum_{ym=629}^{644} g_{ym} \cdot YM_t + v_i + \varepsilon_{i,t}$$

Variable	Definition
i, t	Indicate observations for each individual (i) and date (t).
a	The model constant.
b	Average difference between treatment and control customer.
c	The difference pre and post TOU implementation period unrelated to treatment.
d	The change in electricity use due to the treatment. This change is only experienced by the treatment group after TOU is implemented. The parameter represents the difference-in-differences.
e-g	Parameters for variables meant to explain variation in electricity due to weather or day of week.
v	Customer fixed effects, which control for unobserved factors that are time invariant and unique to each customer. However, fixed effects do not control for fixed characteristics such as air conditioning that interact with time varying factors like weather.
ε	The error for each individual customer and time period.
$Treatment$	A binary indicator of whether or not the customer is part of the treatment or control group.
$TOUperiod$	A binary indicator of whether the time period occurs before (0) or after (1) implementation of TOU.
CDD	Cooling degree hours (Base 60°F). The variable is calculated as the difference between the average daily temperature minus 60°F, with a minimum of zero. The hotter the day, the larger the value. Days too cool to warrant use or space cooling have a value of zero.
DOW	Day of week indicator variables.
YM	This reflects the year and month. For example, July 2012 and July 2013 would have separate values.

B.3 Regression Model Output

Table B-2: Regression Output for Customers Who Correctly Identified TOU as Their Current Rate

```
Linear regression, absorbing indicators          Number of obs   =      124836
                                                  F( 15,    617) =        7.49
                                                  Prob > F       =      0.0000
                                                  R-squared      =      0.8852
                                                  Adj R-squared  =      0.8846
                                                  Root MSE       =      1.7590

                                    (Std. Err. adjusted for 618 clusters in sp_id)

                            Robust
        peakkw  |    Coef.   Std. Err.      t     P>|t|     [95% Conf. Interval]

touperiodxtreatment | -.014284   .1103307   -0.13   0.897   -.2309533    .2023852
            cdd |  .0996228   .0105208    9.47   0.000    .0789618    .1202838

             ym |
            629 |  .0186661   .0511536    0.36   0.715   -.0817901    .1191223
            630 |  .0711368   .0602734    1.18   0.238    -.047229    .1895026
            631 |   .113739   .0675449    1.68   0.093   -.0189068    .2463848
            632 |  .0762147    .067376    1.13   0.258   -.0560995    .2085289
            640 | -.1578693   .1089174   -1.45   0.148   -.3717631    .0560245
            641 | -.0145774   .1107551   -0.13   0.895   -.2320801    .2029252
            642 |  .0760054   .1170651    0.65   0.516   -.1538889    .3058997
            643 |  .0147042   .1126542    0.13   0.896    -.206528    .2359364
            644 | -.0406916   .1178641   -0.35   0.730    -.272155    .1907717

            dow |
              2 |   .060507   .0255314    2.37   0.018    .0103679     .110646
              3 |  .1042307   .0408764    2.55   0.011    .0239569    .1845045
              4 |  .1214243   .0571124    2.13   0.034     .009266    .2335826
              5 | -.0801381   .0412105   -1.94   0.052   -.1610679    .0007916

          _cons |  2.755916   .1254529   21.97   0.000     2.50955    3.002282

          sp_id |  absorbed                                  (618 categories)
```

Table B-3: Regression Output for Customers Who Did Not Correctly Identify Their Rate

```
Linear regression, absorbing indicators          Number of obs   =      143420
                                                  F( 15,    709) =       12.03
                                                  Prob > F       =      0.0000
                                                  R-squared      =      0.8713
                                                  Adj R-squared  =      0.8706
                                                  Root MSE       =      1.8493

                                    (Std. Err. adjusted for 710 clusters in sp_id)

                            Robust
        peakkw  |    Coef.   Std. Err.      t     P>|t|     [95% Conf. Interval]

touperiodxtreatment | -.0933988   .1349087   -0.69   0.489   -.3582671    .1714696
            cdd |  .1034356    .009198   11.25   0.000    .0853771    .1214941

             ym |
            629 |  .0836308   .0430151    1.94   0.052   -.0008214     .168083
            630 |  .1739034   .0624084    2.79   0.005    .0513759    .2964308
            631 |  .1923059   .0666261    2.89   0.004    .0614978    .3231139
            632 |  .1153819   .0736043    1.57   0.117   -.0291267    .2598904
            640 |  -.109733   .1208323   -0.91   0.364   -.3469649    .1274989
            641 | -.0207981   .1318308   -0.16   0.875   -.2796235    .2380273
            642 |  .0511315    .135523    0.38   0.706   -.2149429     .317206
            643 |   .070037   .1398623    0.50   0.617   -.2045568    .3446308
            644 |  .0245374   .1456274    0.17   0.866   -.2613751    .3104499

            dow |
              2 |  .0683683   .0294382    2.32   0.020    .0105718    .1261647
              3 |  .0796744   .0288136    2.77   0.006    .0231043    .1362446
              4 |  .0853797   .0315955    2.70   0.007    .0233477    .1474117
              5 | -.1275944   .0679797   -1.88   0.061    -.26106    .0058712

          _cons |  3.245012    .107134   30.29   0.000    3.034674     3.45535

          sp_id |  absorbed                                  (710 categories)
```

Table B-4: Regression Output for Customers Who Heard of TOU Rates

```
Linear regression, absorbing indicators          Number of obs   =     210484
                                                  F( 15,   1041) =      33.87
                                                  Prob > F       =     0.0000
                                                  R-squared      =     0.8578
                                                  Adj R-squared  =     0.8570
                                                  Root MSE       =     1.9162

                                   (Std. Err. adjusted for 1042 clusters in sp_id)
```

peakkw	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.1500823	.0962146	-1.56	0.119	-.3388789	.0387143
cdd	.0995485	.004741	21.00	0.000	.0902455	.1088515
ym						
629	.0752518	.0327424	2.30	0.022	.0110032	.1395004
630	.1741767	.0465407	3.74	0.000	.0828524	.2655009
631	.1907488	.0409774	4.65	0.000	.110341	.2711566
632	.1782163	.0407872	4.37	0.000	.0981818	.2582508
640	.0350805	.0860322	0.41	0.684	-.1337358	.2038968
641	.154599	.0932302	1.66	0.098	-.0283416	.3375396
642	.2115649	.1012439	2.09	0.037	.0128995	.4102303
643	.2344313	.0961318	2.44	0.015	.0457971	.4230655
644	.1396686	.0957744	1.46	0.145	-.0482643	.3276015
dow						
2	.0886363	.0252361	3.51	0.000	.039117	.1381557
3	.1030333	.0273447	3.77	0.000	.0493762	.1566904
4	.1477642	.0294527	5.02	0.000	.0899708	.2055576
5	-.144002	.0417575	-3.45	0.001	-.2259404	-.0620635
_cons	2.84415	.0672435	42.30	0.000	2.712201	2.976098
sp_id	absorbed				(1042 categories)	

Table B-5: Regression Output for Customers Who Were not Aware of TOU Rates

```
Linear regression, absorbing indicators          Number of obs   =      57772
                                                  F( 15,    285) =      11.16
                                                  Prob > F       =     0.0000
                                                  R-squared      =     0.8763
                                                  Adj R-squared  =     0.8757
                                                  Root MSE       =     2.0984

                                    (Std. Err. adjusted for 286 clusters in sp_id)
```

peakkw	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.1017027	.2156434	-0.47	0.638	-.5261585	.3227531
cdd	.1237504	.0118455	10.45	0.000	.1004346	.1470663
ym						
629	.0757237	.0618781	1.22	0.222	-.0460723	.1975197
630	.1793534	.0891117	2.01	0.045	.0039528	.354754
631	.1989926	.0869787	2.29	0.023	.0277906	.3701947
632	.0751106	.0844668	0.89	0.375	-.0911474	.2413685
640	-.188938	.21601	-0.87	0.382	-.6141153	.2362393
641	-.1076827	.2349714	-0.46	0.647	-.5701823	.3548169
642	-.0098428	.2361399	-0.04	0.967	-.4746424	.4549568
643	.0416916	.2354354	0.18	0.860	-.4217212	.5051044
644	-.0258727	.2365438	-0.11	0.913	-.4914672	.4397217
dow						
2	.1801023	.0648832	2.78	0.006	.0523913	.3078133
3	.2037927	.0644925	3.16	0.002	.0768506	.3307347
4	.1903973	.0717961	2.65	0.008	.0490794	.3317153
5	-.1517893	.1093339	-1.39	0.166	-.3669937	.0634151
_cons	4.372373	.144492	30.26	0.000	4.087966	4.65678
sp_id	absorbed				(286 categories)	

Table B-6: Regression Output for Customers Who Could Identify the Summer Peak

```
Linear regression, absorbing indicators          Number of obs   =    176144
                                                 F( 15,   871) =     27.89
                                                 Prob > F      =     0.0000
                                                 R-squared     =     0.8558
                                                 Adj R-squared =     0.8551
                                                 Root MSE      =     1.9411

                            (Std. Err. adjusted for 872 clusters in sp_id)
```

		Robust				
peakkw	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.0611141	.092403	-0.66	0.509	-.2424728	.1202445
cdd	.0993121	.0053702	18.49	0.000	.0887721	.1098521
ym						
629	.0563661	.0331505	1.70	0.089	-.0086981	.1214302
630	.1658077	.0504729	3.29	0.001	.0667449	.2648704
631	.1449903	.049151	2.95	0.003	.048522	.2414586
632	.1423354	.0485338	2.93	0.003	.0470785	.2375923
640	-.061615	.0808436	-0.76	0.446	-.220286	.097056
641	.0307607	.088326	0.35	0.728	-.142596	.2041174
642	.1342039	.096578	1.39	0.165	-.0553488	.3237566
643	.1576669	.0892685	1.77	0.078	-.0175397	.3328735
644	.0648744	.0867697	0.75	0.455	-.1054277	.2351765
dow						
2	.0887882	.0351129	2.53	0.012	.0198723	.157704
3	.0827957	.0363145	2.28	0.023	.0115215	.1540698
4	.1284397	.0356842	3.60	0.000	.0584027	.1984768
5	-.1940494	.055767	-3.48	0.001	-.3035028	-.0845961
_cons	2.95561	.0803013	36.81	0.000	2.798003	3.113216
sp_id	absorbed				(872 categories)	

Table B-7: Regression Output for Customers Who Could Not Identify the Summer Peak

```
Linear regression, absorbing indicators          Number of obs   =     90900
                                                 F( 15,   449) =     17.14
                                                 Prob > F      =     0.0000
                                                 R-squared     =     0.8468
                                                 Adj R-squared =     0.8460
                                                 Root MSE      =     2.1730

                            (Std. Err. adjusted for 450 clusters in sp_id)
```

		Robust				
peakkw	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.1845848	.1471134	-1.25	0.210	-.4737011	.1045316
cdd	.1135642	.0086428	13.14	0.000	.0965789	.1305496
ym						
629	-.0994514	.0838495	-1.19	0.236	-.2642375	.0653347
630	-.038224	.1025293	-0.37	0.709	-.2397208	.1632728
631	.1286285	.0745556	1.73	0.085	-.0178927	.2751497
632	.0373164	.0904184	0.41	0.680	-.1403794	.2150121
640	-.1442093	.133955	-1.08	0.282	-.4074659	.1190473
641	-.1879428	.146926	-1.28	0.201	-.4766909	.1008052
642	-.1658907	.1670769	-0.99	0.321	-.4942405	.1624591
643	-.0259634	.1546033	-0.17	0.867	-.3297994	.2778725
644	-.0864701	.1519467	-0.57	0.570	-.3850851	.2121448
dow						
2	.1128117	.0472455	2.39	0.017	.0199619	.2056615
3	.1404791	.0418683	3.36	0.001	.0581969	.2227612
4	.1071605	.0533626	2.01	0.045	.002289	.2120319
5	-.1219894	.0628879	-1.94	0.053	-.2455806	.0016018
_cons	3.739778	.1168011	32.02	0.000	3.510233	3.969322
sp_id	absorbed				(450 categories)	

Table B-8: Regression Output for Customers Who Understood They Could Save by Reducing During Peak Hours

```
Linear regression, absorbing indicators        Number of obs   =    224220
                                                F( 15,   1109) =     34.82
                                                Prob > F       =    0.0000
                                                R-squared      =    0.8541
                                                Adj R-squared  =    0.8534
                                                Root MSE       =    1.9730
```

```
                                 (Std. Err. adjusted for 1110 clusters in sp_id)
```

peakkw	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.1145617	.0892513	-1.28	0.200	-.2896823	.0605588
cdd	.0994537	.0047781	20.81	0.000	.0900786	.1088287
ym						
629	-.0092651	.0354799	-0.26	0.794	-.0788804	.0603501
630	.0744403	.0504586	1.48	0.140	-.0245648	.1734455
631	.1080672	.0445329	2.43	0.015	.020689	.1954455
632	.0826829	.0479154	1.73	0.085	-.0113322	.176698
640	-.0977375	.0803972	-1.22	0.224	-.2554853	.0600103
641	-.0492904	.0879456	-0.56	0.575	-.221849	.1232682
642	.015937	.09665	0.16	0.869	-.1737005	.2055745
643	.0633607	.0897393	0.71	0.480	-.1127173	.2394387
644	-.0093759	.0872024	-0.11	0.914	-.1804761	.1617244
dow						
2	.0926095	.0306659	3.02	0.003	.0324398	.1527792
3	.085277	.0309255	2.76	0.006	.024598	.145956
4	.1022849	.0333572	3.07	0.002	.0368345	.1677353
5	-.1970321	.0474639	-4.15	0.000	-.2901613	-.103903
_cons	3.111002	.0725616	42.87	0.000	2.968629	3.253376
sp_id	absorbed				(1110 categories)	

Table B-9: Regression Output for Customers Who Did Not Understand They Could Save by Reducing During Peak Hours

```
Linear regression, absorbing indicators        Number of obs   =     42824
                                                F( 15,    211) =      8.40
                                                Prob > F       =    0.0000
                                                R-squared      =    0.8444
                                                Adj R-squared  =    0.8435
                                                Root MSE       =    2.2649
```

```
                                 (Std. Err. adjusted for 212 clusters in sp_id)
```

peakkw	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiodxtreatment	-.0453144	.1561839	-0.29	0.772	-.3531951	.2625663
cdd	.1302152	.0141102	9.23	0.000	.1024002	.1580302
ym						
629	.0678936	.1262175	0.54	0.591	-.1809153	.3167025
630	.2132552	.1440725	1.48	0.140	-.0707508	.4972611
631	.304475	.107859	2.82	0.005	.0918556	.5170944
632	.2369639	.1182611	2.00	0.046	.0038392	.4700886
640	-.0497351	.1191648	-0.42	0.677	-.2846412	.185171
641	-.0165567	.1324452	-0.13	0.901	-.2776421	.2445288
642	.1196997	.1688995	0.71	0.479	-.2132469	.4526462
643	.2600324	.1484862	1.75	0.081	-.0326741	.5527389
644	.1239983	.1512767	0.82	0.413	-.1742091	.4222057
dow						
2	.1199155	.0717016	1.67	0.096	-.0214277	.2612588
3	.1927488	.0630241	3.06	0.003	.0685113	.3169864
4	.2222908	.0617817	3.60	0.000	.1005023	.3440792
5	-.0246141	.092667	-0.27	0.791	-.2072858	.1580577
_cons	3.80363	.1576058	24.13	0.000	3.492946	4.114313
sp_id	absorbed				(212 categories)	

Appendix C Structural Bill Impacts and Behavior Analysis Details

The analysis relied on after-the-fact analysis. It is based on a random sample of 8,559 customers and a control group of 8,559 selected using propensity score matching. Importantly, the results are not based exclusively on matching. Impacts were analyzed through difference-in-differences, using a control group that was developed via propensity score matching. This approach allows comparisons of the control and treatment groups before and after implementation of TOU. A quality control group should mirror electricity demand patterns of the treatment groups when both groups were still on flat pricing. If TOU leads to reductions in demand, we should observe a change in their demand but no similar change for control group customers that remain on flat pricing. The timing of the change should coincide with the implementation of mandatory TOU. The benefit of using a difference-in-differences is that it nets out any differences between the treatment and control group that remain after matching.

Using the two methods jointly – propensity score matching and difference-in-differences – ensures more robust results than if either method is used in isolation. By developing a matched control group, we ensure the difference-in-differences results are not overly reliant on the differencing correction. By using difference-in-differences, we are able to net out pre-existing differences that may be due to unobservable factors that could not be included in the matching. The analysis approach used, in our assessment, is the best quasi-experimental method that could be implemented in the absence of random assignment.

The remainder of this appendix provides details regarding the control group selection, the estimation technique employed – including the specification of the regression model, and the regression output.

C.1 Control Group Comparison

The control groups were selected via propensity score matching. Although customers did not self-select into TOU rates, the timing of smart meter installations in different areas of PG&E's territory led to regional differences between customers who transitioned to TOU in November 2012 and the cohorts scheduled to transition in later years. Propensity score matching allowed us to identify a control group with similar characteristics as the TOU group.

The control group was selected from among 30,000 candidates who had not experienced TOU rates in the 2012 and 2013 summers (and had full interval data for those periods). Control group candidates were allowed to be selected up to five times, if they were the best available match for multiple TOU customers. The matching took into account:
- Industry type,[22]
- Geographic location,[23]
- Pre-TOU consumption patterns (January–August 2012); and
- Load shapes.[24]

---

[22] The industry groups were based on the first two digits of the North American Industrial Code System of the TOU group.

[23] The location matching factored in the assigned PG&E weather station. In total, all of PG&E's customers are mapped to 25 weather stations.

In total, we identified matches for 8,559 TOU participants out of the randomly selected sample of 8,662 who transitioned to TOU in November 2012 and had data from January 2012 through September 30, 2013. Suitable control group matches were identified for over 98.8% of the sample. Only customers with a matched control group member were included in the analysis. Table C-1 compares the characteristics of the TOU and control groups. Any differences are small and are not statistically significant. Figure C-2 compares the loads during summer weekdays when both groups were on flat rates and after the TOU group transitioned. The load patterns for both groups were nearly identical before the TOU went into effect, indicating a quality control group prior to the difference-in-differences calculation.

Table C-1: Comparison of Matched TOU and Control Groups

Category	Variable	TOU Group (n=8,559)	Control Group (n=8,559)	t	p>t
Pre-TOU Monthly Consumption (kWh)	Jan-12				
	Feb-12	2,186	2,212	-0.60	0.550
	Mar-12	2,314	2,345	-0.65	0.515
	Apr-12	2,220	2,238	-0.39	0.697
	May-12	2,451	2,458	-0.14	0.890
	Jun-12	2,541	2,546	-0.08	0.933
	Jul-12	2,741	2,742	-0.01	0.989
	Aug-12	2,926	2,922	0.07	0.947
Summer Weekday - Pre TOU Avg. Demand (kW) by Time Period	12:00 -3:00 AM	1.20	1.20	-0.18	0.859
	3:00-6:00 AM	1.16	1.17	-0.25	0.800
	6:00-9:00 AM	1.54	1.54	-0.13	0.893
	9:00AM-12:00PM	2.52	2.50	0.40	0.689
	12:00-3:00 PM	2.92	2.91	0.21	0.830
	3:00-6:00PM	2.78	2.76	0.42	0.676
	6:00-9:00 PM	1.87	1.89	-0.53	0.593
	9:00PM-12AM	1.44	1.45	-0.28	0.782
Summer Weekday - Pre-TOU Share of Consumption by Time Period	12:00 -3:00 AM	9.04%	8.88%	1.28	0.200
	3:00-6:00 AM	8.77%	8.65%	1.03	0.303
	6:00-9:00 AM	9.41%	9.42%	-0.17	0.869
	9:00AM-12:00PM	15.07%	14.97%	0.72	0.470
	12:00-3:00 PM	17.00%	16.97%	0.22	0.829
	3:00-6:00PM	16.14%	16.08%	0.43	0.667
	6:00-9:00 PM	11.61%	11.78%	-1.50	0.134
	9:00PM-12AM	10.37%	10.22%	1.22	0.221
Climate	AUBURN	5.54%	5.55%	-0.03	0.973

[24] Load shapes were estimated as the percentage of weekday consumption that occurred at different time periods of the day.

Category	Variable	TOU Group	Control Group	t	p>t
(Weather Station)	BAKERSFIELD	6.33%	6.48%	-0.40	0.686
	BELMONT	4.00%	3.69%	1.07	0.284
	CHICO	3.56%	3.44%	0.41	0.678
	COLMA	2.07%	2.51%	-1.94	0.053
	CONCORD	6.30%	6.38%	-0.22	0.827
	CUPERTINO	5.55%	5.65%	-0.30	0.765
	EUREKA	1.31%	1.69%	-2.01	0.045
	FRESNO	11.91%	11.83%	0.17	0.869
	MARYSVILLE	2.35%	2.41%	-0.25	0.802
	MILPITAS	11.79%	11.37%	0.86	0.391
	OAKLAND	6.47%	6.55%	-0.22	0.829
	PASO ROBLES	1.22%	1.23%	-0.07	0.945
	POTRERO	0.95%	1.08%	-0.84	0.403
	RED BLUFF	0.34%	0.34%	0.00	1.000
	SACRAMENTO	5.14%	4.99%	0.45	0.651
	SALINAS	2.57%	2.61%	-0.14	0.885
	SAN RAFAEL	3.20%	3.47%	-0.98	0.328
	SAN RAMON	2.49%	2.36%	0.55	0.586
	SANTA MARIA	0.72%	0.94%	-1.60	0.111
	SANTA ROSA	5.32%	5.41%	-0.27	0.787
	STOCKTON	8.44%	7.78%	1.59	0.111
	UKIAH	0.01%	0.00%	1.00	0.317
Industry Type	11 - Agriculture, Forestry, Fishing and Hunting	1.63%	1.78%	-0.77	0.444
	22 - Utilities	3.68%	3.81%	-0.48	0.630
	23 - Construction	1.61%	1.68%	-0.36	0.719
	31 - Manufacturing - Food and finished products	0.43%	0.49%	-0.56	0.573
	32 - Manufacturing - Primary materials	0.61%	0.71%	-0.85	0.396
	33 - Manufacturing -Metals and machinery	1.63%	1.55%	0.43	0.669
	42 - Wholesale Trade	1.94%	2.19%	-1.13	0.260
	44 - Retail Trade	5.50%	5.55%	-0.13	0.894
	45 - Retail Trade	2.50%	2.44%	0.25	0.806
	48 - Transportation	1.73%	1.55%	0.96	0.337
	49 - Warehousing, Storage and Couriers	1.94%	1.76%	0.91	0.365
	51 - Information	4.12%	4.08%	0.12	0.908
	52 - Finance and Insurance	1.90%	1.81%	0.40	0.692
	53 - Real Estate and Rental and Leasing	9.14%	9.11%	0.08	0.937
	54 - Professional, Scientific, and Technical Services	2.88%	2.79%	0.37	0.713
	55 - Management of Companies and Enterprises	1.61%	1.57%	0.18	0.855
	56 - Waste Management and Remediation	0.99%	1.24%	-1.60	0.110

Category	Variable	TOU Group	Control Group	t	p>t
	Services				
	61 - Educational Services	1.70%	1.79%	-0.47	0.641
	62 - Health Care and Social Assistance	6.70%	6.28%	1.11	0.265
	71 - Arts, Entertainment, and Recreation	2.13%	2.12%	0.05	0.958
	72 - Accommodation and Food Services	4.62%	4.70%	-0.25	0.800
	81 - Other Services (except Public Administration)	12.83%	12.70%	0.25	0.802
	92 - Public Administration	1.44%	1.81%	-1.93	0.054
	0 - Unclassified or other	1.08%	1.12%	-0.22	0.826

**Figure C-1: Avg. Customer Summer Weekday Loads (May–Sept)
Before and After TOU Implementation**

C.2 Regression Models

The impacts were estimated using a difference-in-differences panel regression with fixed effects and time effects. This technique accomplishes three things: it nets out the differences between the control and TOU groups observed during the 2012 pre-enrollment period; it takes into account whether peak and off peak demand patterns changed for customers placed on TOU; and it determines whether demand patterns also changed for customers who did not experience mandatory TOU. In addition, the technique accounts for unobserved time invariant customer characteristics (fixed effect) and for

unobserved factors that are the same across all customers but unique to specific time periods (time effects). The fixed effects and time effects explain a substantial share of the variation, leading to more precise estimation of the demand reduction. The precision is further improved by including variables that explain energy use, such as temperature and day-of-week effects. These explanatory variables filter background noise (variation) allowing the signal (customer response to TOU rates) to be more easily detected.

The dependent variable was the natural log of each customer's peak period (12 to 6 PM) electricity use for each summer weekday in 2012–2013. We estimated a separate model with an identical specification for customers in specific structural bill impact categories and the corresponding matched control group customers. As a result, the sample size varies by group and is summarized in Table C-2.

Table C-2: Number of Regression Model Observations by Group

Season	Structural Bill Impact Group	Customers		Weekdays		Total Observations
		Treatment	Control	Pre-TOU	Post-TOU	
Summer	(1) Decrease of 2% or more	728	728	96	95	278,096
	(2) Decrease of 1-2%	1347	1347	96	95	514,554
	(3) Decrease of 0-1%	2580	2580	96	95	985,560
	(4) Increase of 0-1%	1616	1616	96	95	617,312
	(5) Increase of 1-2%	1409	1409	96	95	538,238
	(6) Increase of 2% or more	879	879	96	95	335,778
Winter	(1) Decrease of 2% or more	728	728	79	113	279,552
	(2) Decrease of 1-2%	1347	1347	79	113	517,248
	(3) Decrease of 0-1%	2580	2580	79	113	990,720
	(4) Increase of 0-1%	1616	1616	79	113	620,544
	(5) Increase of 1-2%	1409	1409	79	113	541,056
	(6) Increase of 2% or more	879	879	79	113	337,536

The panel regressions were estimated using clustered, robust standard errors, to reflect the fact that individual customer observations were related. Very importantly, the results reflect the typical demand reductions by structural bill impact category, weighing all customers, large and small, equally. This is due to the fact the dependent variable is logged and used in conjunction with fixed effects, which normalizes the data so that larger customers do not dominate the weighting. The benefit of this model is that it reflects how the typical customer responded. It is not the same as program impacts because all customers are weighted equally, rather than assigning more weight to larger customers.

The difference-in-differences panel models are expressed by the below equations:

$$lnPeakW_{i,t} = a + b \cdot Treatment_i + c \cdot TOUperiod_t + d \cdot (Treatment_i \cdot TOUperiod_t)$$

$$+ e \cdot CDD_{i,t} + \sum_{dow=1}^{n} f_{dow} \cdot DOW_t + \sum_{ym=629}^{644} g_{ym} \cdot YM_t + v_i + \varepsilon_{i,t}$$

Variable	Definition
i, t	Indicate observations for each individual (i) and date (t).
a	The model constant.
b	Average difference between treatment and control customer.
c	The difference pre and post TOU implementation period unrelated to treatment.
d	The change in electricity use due to the treatment. This change is only experienced by the treatment group after TOU is implemented. The parameter represents the difference-in-differences.
e-g	Parameters for variables meant to explain variation in electricity due to weather or day of week.
v	Customer fixed effects, which control for unobserved factors that are time invariant and unique to each customer. However, fixed effects do not control for fixed characteristics such as air conditioning that interact with time varying factors like weather.
ε	The error for each individual customer and time period.
$Treatment$	A binary indicator of whether or not the customer is part of the treatment or control group. In practice, this variable is embedded in fixed effects when they are included.
$TOUperiod$	A binary indicator of whether the time period occurs before (0) or after (1) implementation of TOU. In practice, this variable is embedded in time effects when they are included.
CDD	Cooling degree hours (Base 60°F). The variable is calculated as the difference between the average daily temperature minus 60°F, with a minimum of zero. The hotter the day, the larger the value. Days too cool to warrant use or space cooling have a value of zero.
DOW	Day of week indicator variables.
YM	This reflects the year and month. For example, July 2012 and July 2013 would have separate values.

C.3 Regression Model Output

Table C-3: Summer Weekday Peak (12-6 pm) Regression Output – Bill decrease of 2% or more

```
Linear regression, absorbing indicators          Number of obs   =     278096
                                                  F(  16, 276707) =     211.96
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.8401
                                                  Adj R-squared   =     0.8393
                                                  Root MSE        =     0.7281
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.2355022	.0088831	26.51	0.000	.2180916	.2529129
treatxpost	-.2224032	.0055229	-40.27	0.000	-.2332279	-.2115785
ym						
629	.0113832	.0058921	1.93	0.053	-.0001653	.0229316
630	.0056154	.0061347	0.92	0.360	-.0064084	.0176392
631	-.0035394	.006202	-0.57	0.568	-.0156952	.0086164
632	.0019997	.0075774	0.26	0.792	-.0128519	.0168513
640	.0082718	.0080906	1.02	0.307	-.0075856	.0241291
641	.0181886	.0080104	2.27	0.023	.0024885	.0338887
642	.0147845	.0079342	1.86	0.062	-.0007663	.0303353
643	.0003892	.007879	0.05	0.961	-.0150535	.0158319
644	0	(omitted)				
cdd	.0033164	.0003061	10.84	0.000	.0027165	.0039163
hdd	.0070336	.0017134	4.11	0.000	.0036754	.0103918
dow						
2	.0028404	.0045112	0.63	0.529	-.0060015	.0116824
3	-.0004758	.0045346	-0.10	0.916	-.0093636	.008412
4	.0006281	.0045174	0.14	0.889	-.0082259	.0094821
5	-.0036413	.0044948	-0.81	0.418	-.012451	.0051684
_cons	-2.762656	.0057916	-477.01	0.000	-2.774008	-2.751305
sp_id	absorbed				(1373 categories)	

Table C-4: Summer Weekday Peak (12-6 pm) Regression Output – Bill decrease of 1-2%

```
Linear regression, absorbing indicators          Number of obs   =     514534
                                                  F(  16, 511912) =     338.61
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.8503
                                                  Adj R-squared   =     0.8495
                                                  Root MSE        =     0.6850
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.108124	.0063187	17.11	0.000	.0957395	.1205085
treatxpost	-.0625461	.0038192	-16.38	0.000	-.0700317	-.0550605
ym						
629	.0351691	.004401	7.99	0.000	.0265433	.043795
630	.0420783	.0044716	9.41	0.000	.033314	.0508425
631	.062339	.0045056	13.84	0.000	.0535082	.0711697
632	.0426833	.0054264	7.87	0.000	.0320477	.053319
640	-.039674	.0054771	-7.24	0.000	-.0504089	-.0289391
641	-.0183357	.0054043	-3.39	0.001	-.0289279	-.0077435
642	-.0122844	.0054364	-2.26	0.024	-.0229396	-.0016293
643	-.011551	.0054594	-2.12	0.034	-.0222512	-.0008508
644	0	(omitted)				
cdd	.0116908	.0002124	55.04	0.000	.0112745	.0121072
hdd	.0048844	.0010932	4.47	0.000	.0027418	.0070271
dow						
2	.0260464	.0031084	8.38	0.000	.019954	.0321389
3	.0427129	.0031405	13.60	0.000	.0365576	.0488682
4	.0353838	.0031358	11.28	0.000	.0292377	.04153
5	.0195462	.0031222	6.26	0.000	.0134269	.0256656
_cons	-.7831782	.004258	-183.93	0.000	-.7915237	-.7748326
sp_id	absorbed				(2606 categories)	

note: 644.ym omitted because of collinearity

Table C-5: Summer Weekday Peak (12-6 pm) Regression Output – Bill decrease of 0-1%

```
Linear regression, absorbing indicators          Number of obs   =     985508
                                                  F( 16, 980658) =     718.63
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.9281
                                                  Adj R-squared   =     0.9278
                                                  Root MSE        =     0.6500
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.1359851	.0042472	32.02	0.000	.1276607	.1443096
treatxpost	-.0713411	.0026191	-27.24	0.000	-.0764745	-.0662077
ym						
629	.0172813	.0029622	5.83	0.000	.0114755	.023087
630	.029718	.0030334	9.80	0.000	.0237727	.0356633
631	.044248	.0030334	14.59	0.000	.0383027	.0501934
632	.0408947	.0036956	11.07	0.000	.0336515	.0481379
640	-.0379286	.0037639	-10.08	0.000	-.0453058	-.0305514
641	-.0236581	.0036999	-6.39	0.000	-.0309097	-.0164065
642	-.0118257	.0036918	-3.20	0.001	-.0190616	-.0045899
643	-.0114554	.003694	-3.10	0.002	-.0186956	-.0042153
644	0	(omitted)				
cdd	.0110035	.0001472	74.78	0.000	.0107151	.0112919
hdd	.0019507	.000773	2.52	0.012	.0004356	.0034657
dow						
2	.0209946	.0021413	9.80	0.000	.0167978	.0251914
3	.025825	.0021529	12.00	0.000	.0216053	.0300447
4	.0249398	.0021457	11.62	0.000	.0207344	.0291452
5	.0041652	.0021497	1.94	0.053	-.0000481	.0083785
_cons	-1.378084	.0029008	-475.06	0.000	-1.383769	-1.372398
sp_id	absorbed				(4834 categories)	

Table C-6: Summer Weekday Peak (12-6 pm) Regression Output – Bill increase of 0-1%

```
note: 644.ym omitted because of collinearity

Linear regression, absorbing indicators          Number of obs   =     617235
                                                  F( 16, 614161) =    1373.31
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.8458
                                                  Adj R-squared   =     0.8451
                                                  Root MSE        =     0.6274
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0484841	.0051721	9.37	0.000	.0383471	.0586212
treatxpost	-.0274617	.0031945	-8.60	0.000	-.0337229	-.0212006
ym						
629	.0299587	.0036003	8.32	0.000	.0229022	.0370152
630	.041616	.0036763	11.32	0.000	.0344106	.0488213
631	.0668147	.0037011	18.05	0.000	.0595607	.0740687
632	.0685807	.0044761	15.32	0.000	.0598076	.0773538
640	-.0463625	.0046086	-10.06	0.000	-.0553952	-.0373298
641	-.0232221	.0045507	-5.10	0.000	-.0321413	-.0143029
642	-.015203	.0045413	-3.35	0.001	-.0241038	-.0063021
643	-.0059336	.0045304	-1.31	0.190	-.0148131	.0029458
644	0	(omitted)				
cdd	.0216092	.0001844	117.17	0.000	.0212477	.0219706
hdd	.0025355	.0008963	2.83	0.005	.0007787	.0042923
dow						
2	.0574832	.0026293	21.86	0.000	.0523298	.0626366
3	.0716235	.0026497	27.03	0.000	.0664302	.0768168
4	.0630964	.0026324	23.97	0.000	.0579369	.0682559
5	-1.33e-06	.0026837	-0.00	1.000	-.0052612	.0052586
_cons	.3763031	.0035206	106.89	0.000	.369403	.3832033
sp_id	absorbed				(3058 categories)	

Table C-7: Summer Weekday Peak (12-6 pm) Regression Output – Bill increase of 1-2%

```
Linear regression, absorbing indicators        Number of obs   =     538185
                                                F( 16, 535498) =    1452.09
                                                Prob > F        =     0.0000
                                                R-squared       =     0.7873
                                                Adj R-squared   =     0.7863
                                                Root MSE        =     0.6291
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0401023	.0052156	7.69	0.000	.02988	.0503247
treatxpost	-.0162135	.0034297	-4.73	0.000	-.0229357	-.0094914
ym						
629	.0390726	.0038434	10.17	0.000	.0315396	.0466056
630	.0475144	.0040037	11.87	0.000	.0396672	.0553616
631	.0680483	.0039541	17.21	0.000	.0602984	.0757982
632	.0696035	.0049072	14.18	0.000	.0599856	.0792214
640	-.0612654	.0046373	-13.21	0.000	-.0703543	-.0521765
641	-.0418503	.0045718	-9.15	0.000	-.0508109	-.0328897
642	-.0302642	.004589	-6.59	0.000	-.0392584	-.0212699
643	-.0210611	.004516	-4.66	0.000	-.0299123	-.01221
644	0	(omitted)				
cdd	.0231858	.0001964	118.04	0.000	.0228009	.0235708
hdd	.002258	.0009756	2.31	0.021	.000346	.0041701
dow						
2	.084123	.0029006	29.00	0.000	.0784379	.0898081
3	.0875376	.0028795	30.40	0.000	.0818938	.0931814
4	.0889055	.0028849	30.82	0.000	.0832512	.0945598
5	.0000535	.0029853	0.02	0.986	-.0057976	.0059046
_cons	.4988322	.0038203	130.58	0.000	.4913446	.5063199
sp_id	absorbed				(2671 categories)	

Table C-8: Summer Weekday Peak (12-6 pm) Regression Output – Bill increase of 2% or more

```
Linear regression, absorbing indicators        Number of obs   =     335692
                                                F( 16, 333985) =     989.51
                                                Prob > F        =     0.0000
                                                R-squared       =     0.7128
                                                Adj R-squared   =     0.7113
                                                Root MSE        =     0.6884
```

lnkw_peak	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0214477	.0071194	3.01	0.003	.0074938	.0354015
treatxpost	-.0264362	.0047527	-5.56	0.000	-.0357513	-.0171211
ym						
629	.0267327	.0053007	5.04	0.000	.0163434	.037122
630	.033011	.0055466	5.95	0.000	.0221398	.0438821
631	.0581241	.0054108	10.74	0.000	.0475191	.068729
632	.0617458	.0064102	9.63	0.000	.0491821	.0743096
640	-.0437547	.0064724	-6.76	0.000	-.0564404	-.031069
641	-.0367514	.0064155	-5.73	0.000	-.0493255	-.0241772
642	-.0523136	.006475	-8.08	0.000	-.0650045	-.0396227
643	-.0249096	.0063428	-3.93	0.000	-.0373412	-.0124779
644	0	(omitted)				
cdd	.0255087	.0002727	93.53	0.000	.0249741	.0260432
hdd	-.0051101	.0014443	-3.54	0.000	-.0079409	-.0022793
dow						
2	.1067968	.0039804	26.83	0.000	.0989952	.1145983
3	.1075803	.0039814	27.02	0.000	.0997769	.1153837
4	.0995949	.0040102	24.84	0.000	.091735	.1074548
5	-.0365269	.0042638	-8.57	0.000	-.0448838	-.0281699
_cons	.6327066	.005301	119.36	0.000	.6223168	.6430964
sp_id	absorbed				(1691 categories)	

Table C-9: Winter Weekday Part-peak Regression Output – Bill decrease of 2% or more

```
Linear regression, absorbing indicators          Number of obs   =    279552
                                                 F( 16, 278163) =    929.76
                                                 Prob > F        =    0.0000
                                                 R-squared       =    0.8497
                                                 Adj R-squared   =    0.8489
                                                 Root MSE        =    0.6382
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	-.231841	.0076742	-30.21	0.000	-.2468823	-.2167998
treatxpost	-.039394	.0050002	-7.88	0.000	-.0491943	-.0295937
ym						
625	-.0492691	.0060542	-8.14	0.000	-.0611351	-.0374031
626	-.1927501	.0060879	-31.66	0.000	-.2046822	-.1808179
627	-.3282986	.0064551	-50.86	0.000	-.3409504	-.3156468
634	.3234489	.0066206	48.85	0.000	.3104726	.3364251
635	.310699	.0061708	50.35	0.000	.2986044	.3227936
636	.2934103	.0064522	45.47	0.000	.2807641	.3060565
637	.2445854	.0059552	41.07	0.000	.2329134	.2562574
638	.1101286	.0053393	20.63	0.000	.0996637	.1205935
639	0	(omitted)				
cdd	-.0021342	.0006267	-3.41	0.001	-.0033625	-.000906
hdd	.0039753	.0003188	12.47	0.000	.0033505	.0046
dow						
2	.0148503	.0038816	3.83	0.000	.0072425	.0224582
3	.0184136	.0038635	4.77	0.000	.0108413	.0259859
4	.0164452	.0038836	4.23	0.000	.0088334	.024057
5	.0202063	.0038357	5.27	0.000	.0126884	.0277242
_cons	-1.392633	.0062803	-221.75	0.000	-1.404943	-1.380324
sp_id	absorbed				(1373 categories)	

Table C-10: Winter Weekday Part-peak Regression Output – Bill decrease of 1-2%

```
Linear regression, absorbing indicators          Number of obs   =    517248
                                                 F( 16, 514626) =    239.72
                                                 Prob > F        =    0.0000
                                                 R-squared       =    0.8439
                                                 Adj R-squared   =    0.8431
                                                 Root MSE        =    0.6111
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0205756	.0052386	3.93	0.000	.0103081	.0308431
treatxpost	-.1060963	.0035333	-30.03	0.000	-.1130215	-.0991712
ym						
625	-.0098975	.0044369	-2.23	0.026	-.0185937	-.0012013
626	-.0326837	.0043734	-7.47	0.000	-.0412554	-.0241121
627	-.0777819	.0046127	-16.86	0.000	-.0868226	-.0687412
634	.055299	.0045427	12.17	0.000	.0463953	.0642026
635	.0646056	.0042245	15.29	0.000	.0563258	.0728854
636	.0782845	.0043902	17.83	0.000	.0696799	.086889
637	.0626426	.0040551	15.45	0.000	.0546947	.0705906
638	.0209509	.0036099	5.80	0.000	.0138756	.0280262
639	0	(omitted)				
cdd	.0068378	.0004569	14.97	0.000	.0059423	.0077333
hdd	.0031531	.0002264	13.93	0.000	.0027093	.0035968
dow						
2	.0413111	.0027499	15.02	0.000	.0359215	.0467007
3	.0523332	.0027495	19.03	0.000	.0469442	.0577222
4	.0446607	.0027647	16.15	0.000	.0392419	.0500794
5	.0334657	.0027438	12.20	0.000	.0280879	.0388435
_cons	-.6019134	.0045816	-131.38	0.000	-.6108932	-.5929335
sp_id	absorbed				(2606 categories)	

Table C-11: Winter Weekday Part-peak Regression Output – Bill decrease of 0-1%

```
Linear regression, absorbing indicators          Number of obs   =     990720
                                                 F( 16, 985870) =     316.68
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.9280
                                                 Adj R-squared   =     0.9276
                                                 Root MSE        =     0.5959
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0149751	.0036888	4.06	0.000	.0077453	.022205
treatxpost	-.0541538	.0024853	-21.79	0.000	-.0590249	-.0492827
ym						
625	-.0162181	.0031786	-5.10	0.000	-.0224482	-.0099881
626	-.0246432	.0030871	-7.98	0.000	-.0306937	-.0185926
627	-.0589423	.0032214	-18.30	0.000	-.065256	-.0526285
634	.0279466	.0032148	8.69	0.000	.0216457	.0342474
635	.0464186	.0029441	15.77	0.000	.0406483	.0521888
636	.0719696	.0031013	23.21	0.000	.0658912	.078048
637	.0453106	.0028501	15.90	0.000	.0397246	.0508967
638	.0088193	.002522	3.50	0.000	.0038763	.0137623
639	0	(omitted)				
cdd	.0074922	.0003152	23.77	0.000	.0068745	.0081099
hdd	.0022478	.0001598	14.07	0.000	.0019346	.0025609
dow						
2	.0305816	.0019379	15.78	0.000	.0267834	.0343798
3	.0327055	.0019278	16.96	0.000	.0289271	.036484
4	.0325179	.0019384	16.78	0.000	.0287187	.036317
5	.0196713	.0019317	10.18	0.000	.0158852	.0234574
_cons	-1.20418	.0032338	-372.37	0.000	-1.210518	-1.197842
sp_id	absorbed				(4834 categories)	

Table C-12: Winter Weekday Part-peak Regression Output – Bill increase of 0-1%

```
Linear regression, absorbing indicators          Number of obs   =     620544
                                                 F( 16, 617470) =     351.11
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.8450
                                                 Adj R-squared   =     0.8443
                                                 Root MSE        =     0.5666
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0301733	.0043577	6.92	0.000	.0216324	.0387142
treatxpost	-.0849304	.002979	-28.51	0.000	-.0907692	-.0790915
ym						
625	.0104524	.0037582	2.78	0.005	.0030864	.0178184
626	.0137758	.0036668	3.76	0.000	.006589	.0209625
627	-.0193481	.0038644	-5.01	0.000	-.0269223	-.0117739
634	-.0064789	.0038789	-1.67	0.095	-.0140813	.0011235
635	.0167065	.0035437	4.71	0.000	.009761	.0236519
636	.070717	.0036539	19.35	0.000	.0635555	.0778784
637	.0398487	.0033951	11.74	0.000	.0331944	.0465031
638	.0015957	.0030092	0.53	0.596	-.0043022	.0074935
639	0	(omitted)				
cdd	.0152812	.0004003	38.17	0.000	.0144967	.0160658
hdd	.0036959	.0001929	19.16	0.000	.0033178	.0040741
dow						
2	.0706232	.002357	29.96	0.000	.0660036	.0752429
3	.0733216	.0023598	31.07	0.000	.0686964	.0779468
4	.0697783	.0023595	29.57	0.000	.0651539	.0744028
5	.0252822	.0023774	10.63	0.000	.0206227	.0299418
_cons	.294868	.0039174	75.27	0.000	.2871901	.302546
sp_id	absorbed				(3058 categories)	

Table C-13: Winter Weekday Part-peak Regression Output – Bill increase of 1-2%

```
Linear regression, absorbing indicators          Number of obs   =      541056
                                                 F( 16, 538369) =      460.19
                                                 Prob > F        =      0.0000
                                                 R-squared       =      0.7987
                                                 Adj R-squared   =      0.7976
                                                 Root MSE        =      0.5464
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.017014	.0045887	3.71	0.000	.0080203	.0260077
treatxpost	-.0650288	.0030699	-21.18	0.000	-.0710457	-.0590118
ym						
625	.0217307	.003921	5.54	0.000	.0140457	.0294156
626	.0233565	.0038528	6.06	0.000	.0158053	.0309078
627	-.0115802	.0040583	-2.85	0.004	-.0195344	-.0036261
634	-.0160114	.0040799	-3.92	0.000	-.0240079	-.0080149
635	.0042594	.0036872	1.16	0.248	-.0029674	.0114862
636	.0923809	.003787	24.39	0.000	.0849585	.0998033
637	.050808	.0035003	14.52	0.000	.0439476	.0576685
638	.00812	.0031154	2.61	0.009	.0020138	.0142261
639	0	(omitted)				
cdd	.0172216	.000421	40.90	0.000	.0163964	.0180468
hdd	.0032827	.0001985	16.53	0.000	.0028936	.0036719
dow						
2	.10742	.0024784	43.34	0.000	.1025625	.1122775
3	.094856	.002484	38.19	0.000	.0899875	.0997245
4	.1055697	.0024697	42.75	0.000	.1007293	.1104102
5	.0429819	.0025291	16.99	0.000	.0380248	.0479389
_cons	.345583	.0041809	82.66	0.000	.3373885	.3537774
sp_id	absorbed				(2671 categories)	

Table C-14: Winter Weekday Part-peak Regression Output – Bill increase of 2% or more

```
Linear regression, absorbing indicators          Number of obs   =      337536
                                                 F( 16, 335829) =      411.40
                                                 Prob > F        =      0.0000
                                                 R-squared       =      0.7479
                                                 Adj R-squared   =      0.7466
                                                 Root MSE        =      0.5966
```

lnkw_partp~k	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
touperiod	.0666282	.0061934	10.76	0.000	.0544892	.0787672
treatxpost	-.125877	.00423	-29.76	0.000	-.1341676	-.1175863
ym						
625	.0331379	.0054206	6.11	0.000	.0225136	.0437621
626	.0464985	.0053168	8.75	0.000	.0360776	.0569194
627	.0013489	.0056548	0.24	0.811	-.0097344	.0124322
634	-.0486285	.0059184	-8.22	0.000	-.0602284	-.0370285
635	-.0201409	.0051993	-3.87	0.000	-.0303313	-.0099505
636	.1030672	.0051597	19.98	0.000	.0929543	.11318
637	.0562284	.0048142	11.68	0.000	.0467926	.0656641
638	.0147229	.0042983	3.43	0.001	.0062983	.0231475
639	0	(omitted)				
cdd	.0205381	.0005893	34.85	0.000	.019383	.0216931
hdd	.0019056	.0002699	7.06	0.000	.0013767	.0024345
dow						
2	.1397496	.0034497	40.51	0.000	.1329884	.1465108
3	.1280775	.0034608	37.01	0.000	.1212944	.1348607
4	.1264709	.0034676	36.47	0.000	.1196745	.1332673
5	.0241997	.0036326	6.66	0.000	.0170798	.0313195
_cons	.4026379	.0059056	68.18	0.000	.3910632	.4142126
sp_id	absorbed				(1691 categories)	