BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

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Application of PACIFIC GAS AND ELECTRIC COMPANY for Authority to Increase Revenue Requirements to Recover the Costs to Upgrade Its SmartMeter™ Program (U 39 E)	Application No. 07-12-009 (Filed December 12, 2007)

COMPLIANCE FILING OF PACIFIC GAS AND ELECTRIC COMPANY (U 39 E) PURSUANT TO DECISION 09-03-026

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April 30, 2012

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Pursuant to Ordering Paragraph 10 of Decision (D.) 09-03-026, Pacific Gas and Electric Company (PG&E) hereby files its 2011 Program Year SmartMeter™ Program Enabled Demand Response and Energy Conservation Annual Report. As directed by the Commission in D.09-03-026, PG&E—in direct consultation with Energy Division—files within this docket its report on the energy savings and associated financial benefits of all demand response, load control, and conservation programs enabled by PG&E's SmartMeter™. The Report is due in April of each year until 2019. PG&E's Report is attached hereto as Appendix A.

Respectfully submitted,

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2011 Program Year SmartMeter™ Program Enabled Demand Response and Energy Conservation Annual Report

Pacific Gas and Electric Company

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Abstract

Pursuant to Ordering Paragraph 10 of Decision 09-03-026, Pacific Gas and Electric Company (PG&E) submits this report to provide a review of PG&E's 2011 program year ex post load impacts, energy conservation and financial benefits for the demand response and energy conservation programs enabled by PG&E's SmartMeter™ program. The report provides a description of each program as well as the measurement methodology. In 2011, PG&E operated three SmartMeter™ enabled programs: SmartRate™, which is a demand response program, and Customer Web Presentment and Energy Alerts, which are both energy conservation programs. As the future availability of data changes, and methodologies evolve, the information developed for and presented in future Demand Response and Energy Conservation Reports under Ordering Paragraph 10 of D.09-03-026 can be expected to change accordingly.

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1. Executive Summary

This report documents the 2011 program year ex post load impacts, energy conservation, and financial benefits for the PG&E SmartMeter™ program enabled Demand Response (DR) and energy conservation programs. The DR programs that are or will be enabled by PG&E's SmartMeter™ program include, but are not limited to, a Programmable Communicating Thermostat Program, the Peak Time Rebate Program, the Peak Day Pricing Rate, the Real Time Pricing Rate and Time-Of-Use Rates. The energy conservation programs that would benefit from the PG&E SmartMeter™ infrastructure are Customer Web Presentment of customer interval usage data, Home Area Networks, and the Energy Alerts Program.[1/]

Much of the energy savings and financial benefits attributable to the programs enabled by PG&E's SmartMeter™ infrastructure are expected to come in future years as PG&E completes the deployment of SmartMeter™ meters, programs are authorized and available, and customers enroll in various programs. This report describes these programs, the measurement methods, and more.

This report has been prepared pursuant to Ordering Paragraph 10 of the SmartMeter™ Upgrade Decision (D.09-03-026) which—similar to the reporting requirements for Southern California Edison Company in Decision 08-09-039—requires PG&E to report to the Commission:

> "…the energy savings and associated financial benefits of all demand response, load control, energy efficiency, and conservation programs enabled by advanced metering infrastructure (AMI), including programmable communicating thermostat (PCT) programs, Peak Time Rebate (PTR) programs, and other dynamic rates for residential customers."[2/]

The Demand Response impact estimates contained herein are consistent with the load impact protocols in Decision 08-04-050.[3/]

2. Program Overview

There were two types of SmartMeter™ enabled programs in operation during 2011. These are described below:

1/ In PG&E's 2009 Program Year Benefits Report, Customer Web Presentment and Energy Alerts were referred to as "Web Presentment of Internal Data" and "Tier Notification Program," respectively. This report (PY 2011) updates the program names to accurately reflect their operational titles.

2/ D.09-03-026, Ordering Paragraph 10, p. 196.

3/ *Decision Adopting Protocols for Estimating Demand Response Load Impacts*, D. 08-04-050 (April 24, 2008).

- SmartMeter™ Enabled Dynamic Pricing Programs: These programs currently include SmartRate™ (Residential Critical Peak Pricing), Peak Day Pricing (Small and Medium Business (SMB) Critical Peak Pricing), and Time-Of-Use rates (Residential & SMB).
- Informational Energy Conservation Programs: These programs currently include Energy Alerts and Customer Web Presentment of interval data.

In addition, on March 1, 2012, PG&E began implementing the initial rollout phase of its Home Area Network (HAN) Enabled Programs Pilot. These programs operate by devices located in customers' premises communicating with the HAN radio embedded within the SmartMeter™ and are expected to initially include In-Home Displays (IHDs) with the potential for other future applications, such as home energy management systems or appliances. Up to 500 IHDs will be installed as a part of the initial rollout phase by the end of 2012. The first phase of the rollout will be evaluated in 2013. PG&E will be evaluating this pilot program because it is a PG&E sponsored and administered program. However, the IHDs and/or other PG&E-approved HAN devices that customers purchase and install outside of pilot program will not be subject to PG&E evaluation process. Advice Letter 3965-E, dated November 28, 2011, details PG&E's SmartMeter™ HAN Implementation Plan as directed by CPUC Decision 11-07-056.

There are four additional PG&E SmartMeter™ enabled demand response programs envisioned in the future. These are: (1) Programmable Communicating Thermostat (PCT) Program, (2) Peak-Time Rebate (PTR) Program, (3) Real Time Pricing (RTP) Rate, and (4) Time-Of-Use (TOU) Rate.

2.1. Programmable Communicating Thermostat (PCT) Program

Under Decision 09-03-026, PG&E is required to incorporate a HAN gateway device into advanced electric meters to support in-home HAN applications. Deployment of this technology enables two-way communications with compatible home appliances and automated controls (e.g., PCTs) which can communicate such data as temperature set points, event status, and customer overrides.

In PG&E's supplemental testimony (A.07-12-009), PG&E assumed the new Title 24 building code air conditioning standards, which included PCTs, would be effective in 2012. The Title 24 PCTs manufactured and installed by third parties or customers would have been available for enrollment in a PG&E direct load control program. However, shortly after the application filing, the California Energy Commission withdrew its Title 24 building code air conditioning standards recommendation. Once programmable communicating thermostats are

reinstated within Title 24, PG&E will assess opportunities to integrate such devices with its existing direct load control program, SmartAC, and/or other applicable or successor programs.

As stated in its 2012 - 2014 Demand Response Programs Application testimony (A.11-03-001), PG&E plans to test direct load control devices that communicate bi-directionally via PG&E's HAN gateway.[4/] If testing during 2012-2014 suggests it is prudent to proceed, PG&E will begin deploying switches that have a two way communication capability via an embedded 2-way HAN-enabled radio.

2.2. Peak Time Rebate (PTR) Program

On October 28, 2011 PG&E filed an updated version of its application (A.10-02-028) with the Commission for a Peak Time Rebate (PTR) Program designed to encourage residential customers to reduce load by responding to pricing signals during PTR event periods.[5/] As directed by the Commission, PG&E proposed a two-part rate structure for customers with and without enabling technology. Under its original proposal in the 2010 Rate Design Window, PG&E proposed that PTR would be available to eligible customers in a staged rollout beginning on May 1, 2011. In the updated testimony PG&E is proposing a two year staged rollout of the PTR program with May 1, 2013 as the earliest start date. This schedule assumes the Commission will issue a final decision in September 2012.

The proposed program would be available year-round and would be called on a day-ahead basis for a 5-hour period from 1:00 pm to 6:00 pm.[6/] Events can be called on any day, including weekends and holidays. PTR leverages the interval load data provided by an installed and operating PG&E SmartMeter™ meter to calculate the appropriate rebate a customer earns during specified event hours.

PTR will provide customers a rebate on event days for demand reductions below a customer-specific reference level (CRL). The CRL is defined as the customer's average electric usage between 1:00 pm to 6:00 pm for usage during the highest of three of five previous similar

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4/ Pacific Gas and Electric Company 2012-2014 Demand Response Programs and Budgets Prepared Testimony and Appendices (A. 11-03-001) March 1, 2011, p. 2-17.

5/ The CPUC assigned a new Administrative Law Judge in Application 10-02-028 originally filed February 26, 2010. The schedule provided in an August 2011 Scoping Memo included an updated filing from PG&E in October 2011.

6/ In PG&E's February 26, 2010 testimony submitted in A.10-02-028, the event hours were 2:00 pm to 7:00 pm. The effective hours of a PTR event have been changed to be consistent with changes to other PG&E dynamic rates based on resource adequacy requirements.

days for weekday events and one of the previous three similar days for weekend/holiday events. In addition, PG&E has proposed a two-part PTR incentive designed to encourage the use of enabling technologies. Customers with qualifying enabling technology (i.e., initially SmartAC™ participants) will earn a rebate of $1.25/kWh during event hours. Customers without enabling technology will earn a rebate of $0.75/kWh during event hours.[7/] Furthermore, PTR is included as the default rate option in PG&E's residential rate schedules. PTR and SmartRate ™ or Peak day Pricing (PDP)[8/] events will be called on the same days under the same operating criteria. Specifically, events will be called the day ahead when "tomorrow's" forecast temperature equals or exceeds 98 degrees Fahrenheit (°F) for events on non-holiday weekdays and 105°F for events on holidays and weekends. Events may also be called for either extremely high market prices or California Independent System Operator (CAISO) declared emergency conditions. Events will be called by 1:00 pm on the day prior to the event day.

2.3. Peak Day Pricing (PDP) Rate

Residential Customers (SmartRate™)

In May 2008, PG&E began offering a critical peak pricing tariff known as SmartRate™ to residential and small and medium commercial customers in the Bakersfield and greater Kern County area. Starting in May 2009, enrollment expanded both in the number of customers and the geographic regions covered as the SmartMeter™ program's deployment progressed. Pursuant to Decision 10-02-032 (Peak Day Pricing Decision), SmartRate™'s small and medium commercial customers were transitioned to PG&E's new Peak Day Pricing program on May 1, 2010.[9/] The details of this transition are discussed in the Non-Residential section that follows.

By May 1, 2010 (summer season), roughly 24,500 residential customers were enrolled in SmartRate™. Enrollment remained stable at this level throughout the program season. At the time the April 1, 2012 Load Impact Reports were produced and the enrollments and load

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7/ PG&E stipulated in its 2010 Rate Design Window (A.10-02-028) Rebuttal Testimony (April 3, 2012) that it was willing to support the Division of Ratepayer Advocate's recommendation that incentive levels for PRT-a and PRT-b be reduced to $0.50 per kWh and $0.75 per kWh, respectively. See p. 1-7, lines 24-17. The CPUC, however, has not yet approved these recommended incentive levels.

8/ Decision 11-11-008 modified Decision 10-02-032 to allow PG&E to retain SmartRate™ as an option for residential customers until the Commission completes its review of default residential pricing rates.

9/ *Decision on Peak Day Pricing for Pacific Gas and Electric Company*, D.10-02-032, p. 10, (March 2, 2010).

impacts were calculated, active enrollment remained at approximately 23,000 customers as of December 31, 2011.[10/] The evaluation shows that the average per event, per customer ex post load impact was 0.24 kW, or a 13% reduction in per customer load. The average aggregate event load impacts for the program were 5.6 MW.

The SmartRate™ pricing structure is an overlay on top of PG&E's standard rate schedules. SmartRate™ pricing consists of an incremental charge that applies during the peak period on Smart Days and a per kilowatt-hour credit that applies for all other hours from June through September. For residential customers, the additional peak-period charge on Smart Days is 60¢/kWh, and applies between 2:00 pm and 7:00 pm. Up to fifteen Smart Days can be called during non-holiday weekdays from May 1 to October 31.

On January 14, 2011, PG&E filed a Petition for Modification of Decision 10-02-032 (PFM) and proposed a new timetable for transitioning customers to time-varying rates, including both residential and non-residential PDP. PG&E proposed the elimination of the requirement to implement a new residential PDP rate by November 1, 2011 and requested that SmartRate™ be retained as an option for residential customers until residential dynamic pricing options are considered again by the Commission. PG&E also proposed that the timing of default enrollment of residential customers onto time-varying rates be addressed in the Peak Time Rebate and Default Residential Rate Program applications (A.10-02-028 and A.10-08-008).[11/] Although the Petition does not affect 2010 ex post program load impacts, the Commission's decision may influence future impacts for residential time-varying rates.

On November 10, 2011, the CPUC issued Decision 11-11-008, in which the CPUC granted PG&E's PFM, with some exceptions.[12/] Importantly, the CPUC granted "PG&E's proposal to eliminate the requirement to implement a new residential PDP rate, and, instead, to retain SmartRate™ as an option for residential customers until the Commission completes its pending review of default residential dynamic pricing rates in Application 10-08-005."[13/] The CPUC decision also provided extensions for PG&E to implement existing CPUC orders, while ordering PG&E to engage in additional customer education and outreach efforts. The

10/ Freeman, Sullivan & Co., *2011 Ex Post Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-Based Pricing* (March 29, 2012).

11/ Petition of Pacific Gas and Electric Company for Modification of Decision 10-02-032. (January 14, 2011) (A.09-02-022), p. 19.

12/ *Decision Granting in Part and Denying in Part Petitions for Modification of Decision 10-02-032*, D.11-11-008 (November 10, 2011).

13/ *Ibid*, pp. 3-4.

CPUC decision rejected PG&E's proposals to change the dynamic pricing implementation schedule.

The residential PDP tariff option approved by the CPUC is an overlay on tariff E-1, and has a relatively high peak period price on PDP days and a very small price differential between peak and off-peak prices on other weekdays. Although it has time-varying pricing on all weekdays, because of the very modest price differential on non-PDP days, the effective price signals associated with PDP are quite similar to SmartRate™, which did not have time-varying pricing on days other than event days. There will be between nine and fifteen PDP event days per calendar year. All customers that are defaulted to, or choose, PDP rate will be afforded bill protection for the first year, unless they choose to wave such protection.

PG&E submitted its load impact analysis for SmartRate™ on April, 2012 in R.07-01-041. The title is *2011 Ex Post Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-based Pricing Programs*. It can be accessed using the following link:

https://www.pge.com/regulation/DemandResponseOIR/Other-Docs/PGE/2012/DemandResponseOIR_Other-Doc_PGE_20120402_233862.docx

Non-Residential Customers (Peak Day Pricing)

Decision 10-02-032 adopted most of the PDP rates and implementation schedule that PG&E proposed in its 2009 Rate Design Window application (A.09-02-022). As ordered in the decision, PG&E began defaulting qualified large commercial and industrial customers[14/] to the new PDP rate on May 1, 2010.[15/] On this date, PG&E was also required to both transition all existing non-residential SmartRate™ customers to PDP and make the rate available on a voluntary basis to small and medium agricultural and C&I customers with SmartMeter™ meters that are interval-billed enabled. In the 2011 program year there were only 180 SmartMeter™ customers enrolled on PDP. According to PG&E's 2011 *ex post* load impact tables, these customers provided an average of 0.5 MW of load reduction during the event season. Customers that default or voluntarily enroll in PDP have the opportunity to opt-out of

14/ Defined as ≥200 KW of demand.

15/ Currently most of PG&E's large commercial and industrial customers are equipped with legacy interval meters rather than SmartMeter™ meters. As such, the demand reduction and financial benefits associated with these customers are not attributable to the SmartMeter™ program. Once PG&E's small and medium business customers begin participating in PDP, the demand reduction would be attributable to the SmartMeter™ program as the customers would be on SmartMeters™ at that time.

the rate at any time. If they choose to remain on PDP, they receive twelve months of bill protection. Under bill protection, the bills customers face on PDP are compared to the charges they would incur on their otherwise applicable rate. If a customer is charged more on PDP, they are credited the difference retroactively.

On February 1, 2011, PG&E's large agricultural customers were defaulted to PDP.[16/] These customers were also safeguarded by twelve months of bill protection and were able to opt-out of the rate at any time.

On November 10, 2011, the CPUC issued Decision 11-11-008, which granted PG&E's PFM, with some exceptions. In this decision, the CPUC ordered that on March 1, 2012, PG&E's small and medium agricultural customers that have access to at least 12 months of interval billing data will default to mandatory TOU.[17/] Small and medium C&I customers that have had an interval-billed electric SmartMeter™ meters for at least 12 months will default to mandatory TOU rates on November 1, 2012. These same customers, if they have at least 24 months of interval billing data, will on November 1, 2014 default to PDP rates. All these customers are safeguarded by twelve months of bill protection and may opt-out of the rate at any time. PG&E's non-residential PDP rate applies a critical peak price overlay to one of three underlying TOU rates. The November 10, 2011 decision also adopted the PDP rates, with the exception of that for Schedules A-10, and the TOU rates without changing the implementation schedule. The event can be called year-round and the event period hours are from 2:00 pm to 6:00 pm. PG&E is required to call a minimum of nine events up to maximum of fifteen events during any twelve month period. The adopted event-period price adder for customers on the A-10 rate is $0.90/kWh and $1.20/kWh for E-19 and E-20 customers. During the May to October period, PDP customers receive energy and demand credits during on-peak and semi-peak periods.

PG&E's submitted its load impact analysis for critical peak pricing on April, 2012 in R.07-01-041. The title is *2011 California Statewide Non-residential Critical Peak Pricing Evaluation – Ex Post Report.* It can be accessed as the following link:

16/ Like PG&E's large commercial and industrial customers, virtually none of the large agricultural customers are equipped with a SmartMeter™ meter. Given this, the demand reduction and financial benefits associated with these customers are not attributable to the SmartMeter™ program.

17/ *Decision Granting in Part and Denying in Part Petitions for Modification of Decision 10-02-032*, D.11-11-008, p. 3 (November 10, 2011).

http://sdge.com/sites/default/files/regulatory/CPP%20Statewdie%20Program%20Year%202011%20Ex%20Post%20Study%20Non-Residential.pdf

2.4. Real Time Pricing (RTP) Rate

On March 22, 2010, PG&E filed its RTP rate proposal (A.10-03-014) in which PG&E proposed a new voluntary RTP tariff option for all customer classes.[18/] Since then, however, the Division of Ratepayer Advocates, The Utility Reform Network and other interveners have filed motions requesting that consideration of RTP be suspended until the Commission provides further guidance regarding dynamic pricing options. On March 3, 2011, ALJ Pulsifer granted the parties' joint motion and ruled that "Real Time Pricing issues are deferred pending further notice."[19/] Given this ruling, PG&E halted its implementation of RTP until the Commission directs it to do otherwise. As of April 2012 no additional guidance from the Commission related to RTP has been issues. The program details outlined below are based on the PG&E's original RTP proposal and are subject to adjustment based on future applications and Commission decisions.

PG&E's RTP = proposal and proposed framework for RTP program implementation have been formulated with the goal of meeting Commission directives expressed in the Commission's original dynamic pricing policy decision (D.08-07-045).

Although all customer classes are eligible, RTP rates will not be offered under special-purpose rate classifications such as streetlight and standby tariffs, nor will RTP be offered by PG&E for Direct Access, Community Choice Aggregation, master meter or Net Energy Metering program customers. PG&E estimates that no more than 5,000 to 10,000 RTP participants will enroll during the course of the 2011 General Rate Case (GRC) cycle.

PG&E's proposed RTP rates are based on a "one-part tariff" approach—hourly price adjustments will apply to a customer's entire hourly load (as opposed to a "two-part" RTP tariff in which hourly charges or credits are applied only to incremental deviations above or below a predetermined customer-specific baseline load profile). RTP energy charges would be "indexed" to the California Independent System Operator's (CAISO's) day-ahead hourly

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18/ Large Commercial and Industrial Customers; Medium Business Customers; Small Business Customers; Large Agricultural Customers; Small Agricultural Customers, and; Residential Service Customers.

19/ *Administrative Law Judge's Ruling Granting Motion to Revise Schedule for Phase III,* A. 10-03-014, p. 3 (March 3, 2011).

market prices.[20/] Initial RTP rates would be based on day-ahead hourly CAISO prices that are aggregated across PG&E's entire service area. PG&E proposed that neither "bill protection" and "bill stabilization" nor capacity reservation features need be offered under the new RTP tariffs.

2.5. Time-Of-Use (TOU) Rate

PG&E has had a traditional TOU tariff in place for many years. The E-7 rate schedule is a two-period, five-tier rate. The peak period for the E-7 rate is from noon to 6:00 pm on weekdays, with off-peak prices in effect at all other times. The peak period is the same the entire year. The E-7 rate has been closed to new customers since 2008. It was replaced by the E-6 rate, which is a three-period, four-tier TOU rate.[21/] With the E-6 rate, the peak period is from 1:00 pm to 7:00 pm in the summer months. The partial peak period in the summer is from 10:00 am to 1:00 pm and 7:00 pm to 9:00 pm, Monday through Friday and from 5 pm to 8 pm on Saturdays and Sundays. In the winter, peak period prices do not apply, and partial peak prices occur from 5:00 pm to 8:00 pm on weekdays only.

A substantial number of E-6 and E-7 customers are net metered. Net metered customers typically have very different load patterns compared with standard metered customers, as they very often have solar power or some other form of distributed generation. As of December 31, 2011, approximately 18% of E-7 customers and 90% of E-6 customers are net metered.[22/]

Decision 08-07-045 issued by the CPUC on August 1, 2008 adopted a tentative timetable for PG&E to implement time- and seasonally-differentiated year-round time of use (TOU) rates for non-residential small and medium C&I customers (i.e., demands less than 200 kW). As part of PG&E's 2009 Rate Design Window Proposal for Dynamic Pricing (A.09-02-022), PG&E proposed a set of TOU rates for non-residential small and medium C&I customers. Customers on TOU rates also may participate in PDP. In these cases, in addition to paying

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20/ This CAISO market became publicly available to all California market participants starting on April 1, 2009 with implementation of Phase 1 of the CAISO Market Redesign and Technology Upgrade (MRTU) process, referred to herein as "day-ahead hourly ISO prices."

21/ Rate schedule EL-6 Residential Care Program Time-Of-Use Service for single-family dwellings where the applicant qualifies for California Alternate Rates for Energy (CARE) program is a three-period, three-tier TOU rate.

22/ Freeman, Sullivan & Co., *2011 Ex Post Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-Based Pricing* (March 29, 2012).

TOU rates, customers on a PDP rate would pay surcharges over TOU rates for usage during PDP event hours and receive credits against TOU rates for usage in nonevent hours.

Decision 10-02-032 (Peak Day Pricing decision) adopted most of the TOU rates PG&E proposed. Under the currently approved schedule, small and medium C&I customers with interval-billed SmartMeter™ meters will face mandatory year-round TOU rates starting November 1, 2011. On November 8, 2010, the Commission's Executive Director administratively approved extensions of time to implement two provisions of Ordering Paragraph Two of the Decision. The extensions deferred default of Small and Medium Agricultural customers to mandatory TOU rates to February 1, 2012, which was later further deferred to March 1, 2013 in Decision 11-11-008, and delayed the implementation of optional residential PDP/TOU rates and default of residential SmartRate™ customers to PDP/TOU rates until November 1, 2011. Decision 11-11-008 also requires small and medium C&I customers to default to mandatory TOU rates on November 1, 2012 and states that decisions regarding its residential customers would be put on TOU rates will be determined in the Peak Time Rebate and Default Residential Rate Program applications (A.10-02-028 and A.10-09-005).

2.6. Customer Web Presentment (CWP)

CWP provides online access to interval usage data and analysis tools tailored to customers with PG&E SmartMeter™ meters. CWP is available through PG&E's online portal, known as My Energy. Once an installed SmartMeter™ meter is being read remotely, customers may log onto My Energy to pay and manage their bill, check their energy usage on previous days and learn about ways to save energy. The "My Usage" tab within My Energy provides customers with a variety of tools that use their SmartMeter™ interval data. These resource include an overview of their daily, monthly and yearly usage characteristics, as how much their next monthly bill is projected to be and what their average daily cost of electricity is. Additionally, customers can see how much they are paying per hour of electric use during the month and can compare their bill to previous month bill, or the bill from twelve months prior.

Customer Web Presentment was available for all of 2011 to eligible SmartMeter™ customers. As of December 31, 2011, there were 1.8 million customers with a current My Energy account, all of which are either SmartMeter™ read or billed. Of the SmartMeter™ enabled customers, about 199,833 residential customers logged in to CWP at least once

during 2011.[23/] The program was primarily marketed to customers via two channels: Pre-installation bill inserts to customers who were about to receive a SmartMeter™ and the SmartMeter™ Transition Booklet. For each campaign, CWP was marketed as a feature of My Energy.

The energy savings associated with participation in CWP were estimated by comparing energy use of customers using CWP with a carefully selected control group of non-CWP customers. A stratified matching technique is used to construct a control group that is very similar to the treated group in all observable ways, except being exposed to the program treatment. In a pilot setting it is often possible to use an experimental design with randomized treatment and control groups to control for self-selection bias. However, when a program is fully deployed and a randomized control group is no longer an option, a stratified matching technique or quasi-experimental design offers the next best strategy to minimize selection bias.

To match each treatment customer with a control customer, all populations where divided into buckets using the following filters: 5 digit zip code, SmartAC participation, presence of central AC, and electric or non-electric heat. Within each of the buckets created by these four filters, an algorithm matched each treatment customer with a unique control customer whose pre-treatment electric usage characteristics are most similar. The treatment effect is then estimated by the mean difference in energy usage between the customers in the treatment and control groups during the treatment period. The treatment group is further stratified by level of engagement to see if savings vary with either more frequent participation or a longer history of program participation.

Using a direct comparison, the impact analysis of the CWP program showed an estimated 1,917 MWh reduction in usage among CWP participants who accessed their SmartMeter™ interval usage data more than 15 times during 2011. For that subpopulation of 8,279 participants (about 4% of the entire CWP population), this estimate reflects a reduction in total annual usage of approximately one to three percent. Savings estimates in both the

23/ To be consistent with PY2010 evaluation, the PY2011 analysis focuses exclusively on residential customer. Small and medium business customers and agricultural customers can also participant in CWP. Future evaluations of the program will include these customers once there is sufficient data to do so.

overall population, and in other subpopulations were smaller and inconsistent. The complete analysis of CWP is provided in Appendix A of this report.[24/]

2.7. Home Area Network (HAN)

Under the SmartMeter™ Upgrade Decision (D.09-03-026), PG&E is incorporating a HAN gateway device into advanced electric meters. The HAN gateway on the meter will be able to securely connect to a customer's in-premise device and obtain near real time (anticipated to be delayed by approximately six to fifteen seconds) consumption information. This information will give customers the ability to monitor or automate their home energy usage to balance between comfort and cost.

On March 1, 2012, PG&E began implementing the Initial Rollout phase of its HAN pilot. In this phase, up to 500 In-Home Displays (IHD) will be installed as a part of the initial rollout phase by the end of 2012. In 2013, PG&E will begin Phase 2, or the Early Adopter phase, and will be providing customers with a list of up to five PG&E approved devices that they can buy through manufacturers or retail channels. In this phase, up to 5,000 customers will be able to self-register their HAN device through My Energy and obtain their near real time energy information.

The Initial Rollout phase effort will be evaluated in 2013. PG&E will evaluate this program because it is sponsored and administered by PG&E. However, any IHDs installed by customers or third parties after this initial roll-out will not be included in the PG&E evaluation process. Advice Letter 3965-E, dated November 28, 2011, includes PG&E's SmartMeter™ HAN Implementation Plan as required by Decision 11-07-056.

2.8. Energy Alerts Program

The Energy Alerts Program became operational in June 2010 as an option for PG&E customers with an installed SmartMeter™ meter that is being read remotely. The program allows customers to receive advance warning via email, phone, or text message if their electricity usage is projected to push them into higher pricing tiers by the end of the current billing cycle. Projected usage is calculated on the eighth day of the customer's billing cycle, and Energy Alerts are subsequently sent out to those customers whose total usage for the billing cycle is likely to enter the higher (third, fourth, or fifth) pricing tiers. Energy Alerts are

24/ EnerNOC Utility Solutions, *PG&E SmartMeter™ Enabled Programs: PY2011 Evaluation* (April 30, 2012).

also sent out when the customer's usage has actually entered any of the higher pricing tiers, but total Energy Alerts per billing cycle are capped at four per service agreement.

As of December 31, 2011, there were 73,261 customers enrolled in Energy Alerts. The program's enrollment grew at a rate of approximately 3,000 customers per month during 2011 with the exception of July and October, which both saw an increase in enrollment to approximately 8,000 customers each month in response to an email campaign targeted at customers consistently consuming in tiers three and four. During the remainder of the year, Energy Alerts was marketed to customers as part of the information they receive during the SmartMeter™ installation process.

The energy savings for Energy Alerts participants was estimated by comparing the energy use of customers signed up for the program with a carefully selected control group. Similar to the CWP program above, a stratified matching technique is used to construct a control group that is very similar to the treated group in all observable ways, except being exposed to the program treatment. In a pilot setting it is often possible to use an experimental design with randomized treatment and control groups to control for self selection bias. However, when a program is fully deployed and a randomized control group is no longer an option, a stratified matching technique or quasi-experimental design offers the next best strategy to minimize selection bias.

To match each treatment customer with a control customer, all populations where classified into buckets using the following filters: 5 digit zip code, SmartAC participation, presence of central AC, and electric or non-electric heat. Within each of the buckets created by these four filters, an algorithm matched each treatment customer with a unique control customer whose pre-treatment electric usage characteristics are most similar. The treatment effect is then estimated by the mean difference in energy usage between the customers in the treatment and control groups during the treatment period. The treatment group is further stratified by level of engagement to see if savings vary with either more frequent receipt of Alerts or a longer history of program participation

The direct comparison analysis attempted to detect savings by comparing both daily and monthly usage between treatment and control customers in order to capture small changes in usage that may be may be significant on a daily basis, but not on a monthly basis. It was not possible to identify a statistically significant savings using either the daily or monthly

analysis. In this program, the quality of the match was less than optimal, which may be preventing the analysis from identifying savings.

A daily regression analysis was also conducted for a sample of Energy Alerts customers. The results of this analysis were consistent with the results of the direct comparison and unable to detect any statistically significant changes in daily usage resulting from receiving an alert. Because the conservation effect of the Energy Alerts is presumed to be less than five percent it is very difficult to obtain statistically significant results. Given the results of the analysis the conservation effects for Energy Alerts in 2011 are estimates to be zero. There is significant uncertainty in this estimate, so it is possible that the program could affect usage by between plus or minus one to two percent. A more detailed evaluation of Energy Alerts with sections explaining the analysis methodology and results are presented in Appendix A of this report.[25/]

3. PG&E SmartMeter™ Program Enabled Demand Response Programs

The PCT, PTR, PDP, RTP and TOU programs enabled by the SmartMeter™ infrastructure encourage (or will encourage) PG&E customers to temporarily reduce loads during periods in which demand might outstrip supply, or the system is constrained. The reported demand response will be equal to the number of enrolled service accounts multiplied by the per-customer demand response load impacts by program.

Table I within this report provides the number of participating service accounts, estimated demand response (MW), energy savings (MWh), and financial benefits (in thousands) associated with the PG&E SmartMeter™ project enabled demand response programs. The following sections describe the measurement methods and assumptions used in developing the demand response results.

3.1. Service Accounts

During the PG&E SmartMeter™ deployment period, the number of service accounts available for program participation will be dependent on a billing-ready PG&E SmartMeter™ meter. A billing-ready PG&E SmartMeter™ meter is defined as a meter which has been installed, communicating, tested, cut-over to operations to allow for billing using interval data. Meter installations will occur throughout the deployment period. In 2011, PG&E had 23,019 active enrollments which included customers both with SmartMeter™ program billing and enrollment in SmartRate™. For the 2011 program year, there were no service accounts

25/ EnerNOC Utility Solutions, *PG&E SmartMeter™ Enabled Programs: PY2011 Evaluation* (April 30, 2012).

enrolled in the PCT, PTR or PDP programs and there were minimal, if any, residential customers who enrolled in the E-6 TOU rate after receiving a SmartMeter™. Specific information regarding the service account enrollments is discussed below.

PCT Program. Residential service accounts enrolled in the PCT program will also require a working PCT device. A working PCT device is defined as a PCT which has been installed, tested, registered with PG&E, and properly communicating. PCT program service accounts will be determined by the number of sites with registered PCT devices.

PTR Program. Upon meter installation, testing, and cutover to operations, most residential customers will be automatically enrolled in the PTR program as dictated by the rollout schedule detailed within PG&E's recently filed Peak Time Rebate application.[26/] PTR program service accounts will be determined by the number of PTR program enrollments.

PDP Rate. Service accounts enrolled in the PDP rate include residential, C&I and agriculture service accounts that have defaulted or opted into the PDP rate. The PDP service accounts may also include those service accounts that participate in a SmartMeter™ project enabled PCT program. PDP service accounts will be determined by the rate enrollments.

RTP Rate. Service accounts enrolled in the RTP rate include residential, C&I and agriculture service accounts that have opted into the voluntary RTP rate. RTP service accounts will be determined by the rate enrollments.

TOU Rate. Service accounts enrolled in the TOU rate include residential, small and medium C&I (less than 200 kW), and small and medium agriculture customers (less than 200 kW) that have opted into the TOU rate. TOU service accounts will be determined by the rate enrollments.

3.2. Demand Response

The calculated demand response load impacts will be estimated based on the number of end-of-year participating service accounts and the load impacts for each program. The load impacts will be based on an analysis of the demand response events which occurred during the calendar year ("ex post"), in a manner consistent with the Load Impact Protocols approved in D.08-04-050. The analysis may incorporate a number of variables including the

26/ Pacific Gas and Electric Company 2010 Rate Design Window Prepared Testimony, A.10-02-028 (February 26, 2010).

location of customers by CAISO-defined local capacity areas, weather zones, and customer types. PG&E expects to perform a load impact analysis for all SmartMeter™ program enabled demand response resources. The protocols require that plans be developed for load impact evaluations for each program and submitted to the Demand Response Measurement and Evaluation Committee (DRMEC) prior to execution. Detailed load impact evaluation plans have yet to be developed for the following new programs:

- PCT
- PTR (technology enabled and non-technology enabled)
- PDP (residential, C&I less than 20 kW, C&I 20 to 200 kW, Agriculture less than 200 kW)
- RTP
- TOU (residential, C&I less than 200 kW, and agriculture customers less than 200 kW)

Suitable evaluation plans will be developed once the magnitude and nature of the enrolled populations becomes clear. It is anticipated that impacts for most of these resources will vary geographically, based on differences in climate and customer characteristics and, therefore, these factors will be taken into account during program evaluation.

3.3. Energy Savings

Annual energy savings associated with the SmartMeter™ project enabled demand response programs will be estimated based on results from the ex post load impact analysis for each program.

3.4. Financial Benefits

Financial benefits will be calculated by adding financial benefits associated with the demand reduction and the energy savings for each program. The demand reduction financial benefits will be calculated by multiplying the demand response times the most recently accepted avoided generation capacity cost. PG&E's most recent GRC Phase 2 settlement value for the avoided marginal generation capacity cost is $91.73/kW-year and originates in PG&E's January 7, 2011 updated testimony. Once the Commission adopts new values for the avoided marginal generation capacity costs in this proceeding, PG&E will use those adopted values to quantify the financial benefits in the annual report. The conservation financial benefits will be

calculated by multiplying the energy savings times the most recently authorized measure of energy costs appropriate for the program's characteristics.

To the extent that the Commission requires different (than those indicated above) marginal generation costs to be used for various programs, PG&E will use the most recently agreed upon settlement value to calculate the financial benefits.

4. PG&E SmartMeter™ Program Enabled Energy Conservation Programs

The PG&E SmartMeter™ program enabled Customer Web Presentment, Home Area Network, and Energy Alerts Program will provide information on energy conservation. The energy impacts of CWP and Energy Alerts were evaluated according to the guidelines presented in the California Energy Efficiency Evaluation Protocols. [27/]

Table II, located at the end of this report, provides the service accounts, energy conservation (MWh), demand response (MW), and financial benefits (in thousands) associated with the PG&E SmartMeter™ project enabled energy conservation programs on an ex post basis. The following sections describe the measurement methods and assumptions used in developing the energy conservation results.

4.1. Service Accounts

During the PG&E SmartMeter™ deployment period, the number of service accounts will be dependent on a billing ready PG&E SmartMeter™ meter. A billing ready PG&E SmartMeter™ meter is defined as a meter which has been installed, communicating, tested, and cut-over to operations to allow for billing using interval data. Meter installations will occur throughout the deployment period. In 2011, 286,565 customers logged in to Customer Web Presentment at least once and 73,261 customers who were enrolled in Energy Alerts. There were no meter installations which included customers participating in the HAN program.

Customer Web Presentment. All PG&E SmartMeter™ program enabled service accounts will have next day access to their interval usage data, as well as 13-month historical energy usage through the portal. However, only a subset of these customers will access their usage data. The number of Customer Web Presentment service accounts has been calculated based on the number of customers who sign-up and access the CWP pages available on PG&E's web site.

27/ California Energy Efficiency Evaluation Protocols, prepared for the California Public Utilities Commission by the TecMarket Works Team, April 2006.

Note that this number is different than the number of customers who sign-up for a PG&E My Account. My Account is available to all customers, SmartMeter™ enabled or otherwise.

Home Area Network. HAN service accounts will be determined based on the number of devices (e.g., In-Home Displays) registered with PG&E. The HAN program may include but is not limited to the (1) building integrated graphical display (new construction and existing homes), (2) dedicated handheld graphical display, and (3) PC based graphical display.

Energy Alerts Program. The number of Energy Alerts service accounts is calculated based on the number of customers who sign up for the program through PG&E's My Account web portal.

4.2. Energy Conservation

For the CWP and Energy Alerts programs, energy conservation was estimated by taking into account each program's unique features and creating control and treatment groups using statistical matching strategies. Detailed results of this evaluation are provided in Appendix A. Rigorous energy savings analysis will be performed for future SmartMeter™ enabled energy conservation program, such as HAN. Participation in PG&E's behavior-based programs began in the fall of 2011. Experimental design is being used to measure the amount of conservation enabled solely by SmartMeter™ program and the energy savings derived solely from the behavior-based program, per CPUC Decision 10-04-029.

4.3. Demand Reduction

The methods used to estimate impacts associated with PG&E SmartMeter™ Project Enabled Energy Conservation Programs will be conceptually similar to those described above for PG&E SmartMeter™ Project Enabled Demand Response Programs. That is, they will be developed in conformance with the CPUC Load Impact Protocols and will rely on statistical analysis of usage data for suitable groups of customers. Given the nature of these programs, it may be necessary to draw samples from both participating and non-participating customers and ideally to obtain usage information before and after customers participate in the program. Detailed plans can be provided once the nature of the participant population is known. Since the results of the energy impact analysis for 2011 CWP indicated an impact of approximately 2% and Energy Alerts indicated no measurable energy impact, PG&E determined that it was not constructive to estimate load impacts of those programs at this time.

4.4. Financial Benefits

Financial benefits will be calculated using the same methodology as the demand response financial benefits described previously. However, instead of using an avoided marginal generation *capacity* cost, the calculation for conservation programs will use an avoided *generation* energy costs of $49.19/MWh. This source of this value is Line No. 2 in Table 1-4 under the Secondary Distribution column from PG&E's *2011 General Rate Case Phase 2, January 7, 2011 Update to Prepared Testimony* (A.10-03-014).

5. 2010 Demand Response and Energy Conservation Results

Tables I and II, located in the following pages, provide the 2011 program year demand response and energy conservation results. Because several of these programs are either in their very early startup stages or not yet initiated, the 2011 program enrollments, load impacts, energy conservation, and financial benefits are either zero or near-zero for these SmartMeter™ project enabled programs.

Table I
PG&E SmartMeter™ Program Enabled Demand Response Programs
Subscription Statistics – December 31, 2011

Program	Service Accounts[28/]	Demand Reduction (MW)		Energy Savings (MWh)		Total Financial Benefits (thousands)
		Aggregate Load Impact[29/]	Financial Benefits[30/] (thousands)	Energy Savings[31/]	Financial Benefits[32/] (thousands)	
Demand Response						
PCT	0[33/]	0	$0	0	$0	$0
PTR	0[34/]	0	$0	0	$0	$0
SmartRate™	23,019[35/]	5.6	$514	0	$0	$514
PDP	180[36/]	0.5	$46	0	$0	$46
RTP	0[37/]	0	$0	0	$0	$0
TOU	0[38/]	0	$0	0	$0	$0
Total	23,199	6.1	$560	0	$0	$560

28/ As of December 31, 2011, there were no meaning number of service accounts enrolled in all programs with the exception of the SmartRate™ and non-residential PDP.

29/ Program MWs equal the sum of each enrolled participant's interruptible/curtailable load defined as follows:
- PCT: Number of PCT service accounts x estimated average PCT load impact per customer, from Annual Load Impact Analysis Report.
- PTR: Number of PTR service accounts x estimated average PTR load impact per customer, from Annual Load Impact Analysis Report.
- SmartRate™ and PDP: Number of SmartRate™/PDP service accounts x estimated average SmartRate™/PDP load impact per customer. Includes only residential.
- TOU: Number of TOU service accounts x estimated average TOU load impact per customer, from Annual Load Impact Analysis Report. Includes residential and small and medium C&I less than 200 kW.

30/ Financial benefits (in thousands of dollars) = total DR load reduction (kW) x accepted avoided marginal generation capacity costs per kW-year ($91.73/kW-year). This cost figure comes from the Transmission column of Line No. 1 in Table 1-5 of PG&E's *2011 General Rate Case Phase 2, January 7, 2011 Update to Prepared Testimony* (A.10-03-014).

31/ Energy savings will be calculated based on the results of the Annual Load Impact Analysis for each program.

32/ Financial benefits = energy savings (kWh) x avoided generation energy costs (in thousands of dollars).

33/ Number of residential service accounts enrolled in PCT program who have (1) a billing ready PG&E SmartMeterTM meter (installed, communicating, and cut-over to operations to allow for billing using interval data), and (2) a working PCT device (installed, registered, and communicating). For customers that are both on PDP with a SmartMeter-enabled PCT, their MWs and service accounts are included in PDP rate subscription statistics.

34/ Number of PTR service accounts that have a billing ready PG&E SmartMeterTM meter (installed, communicating, and cut-over to operations).

35/ Number of residential service accounts enrolled in SmartRate™ who have a billing ready PG&E SmartMeterTM meter (installed, communicating, and cut-over to operations to allow for billing using interval data). For customers that are both on SmartRate™ with a SmartMeterTM program enabled PCT, their MWs and service accounts are included in SmartRate™ rate subscription statistics.

36/ Number of non-residential service accounts enrolled in Peak Day Pricing who have a billing ready PG&E SmartMeterTM meter (installed, communicating, and cut-over to operations to allow for billing using interval data).

37/ Number of eligible service accounts enrolled in RTP who have a billing ready PG&E SmartMeterTM meter (installed, communicating, and cut-over to operations to allow for billing using interval data).

38/ Number of residential and small and medium C&I (< 200kW) service accounts enrolled in TOU who have a billing ready PG&E SmartMeter^{TM} meter (installed, communicating, and cut-over to operations to allow for billing using interval data).

Table II
PG&E SmartMeter™ Program Enabled Energy Conservation Programs
Subscription Statistics – December 31, 2011

Program	Service Accounts[39/]	Energy Savings (MWh)		Demand Reduction (MW)		Total Financial Benefits (thousands)
		Energy Savings	Financial Benefits[40/] (thousands)	Load Impacts (MW)[41/]	Financial Benefits[42/] (thousands)	
Energy Conservation						
Customer Web Presentment	199,833[43/]	1,917	$94	0	$0	$0
Home Area Network	0[44/]	0	$0	0	$0	$0
Energy Alerts	73,261[45/]	0	$0	0	$0	$0
Total	243,432	1,917	$94	0	$0	$0

39/ As of December 31, 2011, there were 243,432 unique service accounts enrolled in these programs. This figure takes into account the 29,662 customers that were dually enrolled in both CWP and EA during 2011.

40/ Financial benefits = energy savings (kWh) x avoided generation energy costs (in thousands of dollars). The avoided generation energy cost used in the calculation in Table II above is $49.19/MWh. This source of this value is Line No. 2 in Table 1-4 under the Secondary Distribution column from PG&E's *2011 General Rate Case Phase 2, January 7, 2011 Update to Prepared Testimony* (A.10-03-014). Line No. 2 of Table 1-4 shows values for the Summer Partial-Peak TOU price period.

41/ Demand reductions for the energy conservation programs will be calculated based upon an analysis consistent with that required by the Energy Efficiency Measurement and Evaluation Protocols.

42/ Financial benefits (in thousands of dollars) = total load reduction (kW) x accepted marginal avoided generation capacity costs per kW-year.

43/ Number of Customer Web Presentment service accounts will be calculated based on number of customer sign-ups for access to interval data on PG&E's web site.

44/ Number of HAN service accounts will be determined based on number of devices registered with PG&E's HAN program.

45/ Number of Tier Notifications Program service accounts will be determined by the number of program enrollments.

APPENDIX A

2011 Energy Conservation Evaluation of Pacific Gas and Electric Company's Energy Alerts and Customer Web Presentment Programs

PACIFIC GAS & ELECTRIC
SMARTMETER ENABLED PROGRAMS: PROGRAM YEAR 2011 EVALUATION FINAL DRAFT

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EXECUTIVE SUMMARY

Customer Web Presentment and Energy Alerts are two SmartMeter™ enabled informational energy conservation programs available to Pacific Gas & Electric (PG&E) customers. Customer Web Presentment (CWP) of interval electric usage data is available to customers though PG&E's My Energy web portal. The My Energy website is a single, multi-functional, customer-facing portal that provides customers with tools to help manage their energy usage. The relevant aspect of the portal is the My Usage tab which allows customers who are SmartMeter™ read and billed to view their electricity usage at a daily or hourly level. Energy Alerts (EA) is a program in which participants elect to receive notifications during the billing cycle regarding their electricity usage. PG&E residential customers are billed according to an increasing block rate structure where successively higher tiers of electric usage are billed at successively higher per-kWh rates. Energy Alert customers are notified for the first time if their bill forecast, calculated on the 8th day of their billing cycle, projects that they will cross into tiers 3, 4, or 5. Customers are subsequently notified after they cross each of those three tiers for a maximum of 4 alerts in each billing cycle.

The two objectives of this report are to evaluate the ex-post electricity savings associated with the two SmartMeter™ enabled energy conservation programs described above. The evaluation was conducted in four basic steps:

1. Characterize the participants in each program by examining both enrollment data and level of engagement as defined by the number of times a participant views the web tools, or the number of alerts a participant receives during the 2011 program year.
2. Design the treatment samples for each program by stratifying on the aspects of participation that are hypothesized to affect savings. Namely, the duration of participation, and the level of engagement with the program.
3. Match the treatment customers with non-participant "control" customers using a stratified matching strategy employing both demographic and pre-treatment energy usage data and post-stratify them into single and dual participants.
4. Estimate the savings for each program using a direct comparison of monthly usage for the entire program year between the treatment and control customers. For Energy Alerts, create a daily regression model to look for changes in daily usage that may occur in the days immediately following alerts.

PG&E began active marketing of both CWP and Energy Alerts early in 2010, with 2011 being the second year that either program has undergone a formal evaluation. In 2010, detectable savings were not reported at the program level for either program. Consequently, this evaluation has employed a more granular approach which will improve the ability to detect savings in the subpopulations of customers who are most likely to respond to the program. The sample design takes advantage of the fact that customers who are more engaged with informational type programs tend to save more energy. These highly engaged customers are likely to be early adopters of energy information, and are also likely to be looking for tools to help them manage and reduce their energy usage.

CWP Savings Analysis

Using a direct comparison, we examined the savings for the entire population of program participants, and the three subpopulations described below:

- Participants who accessed the web portal more than 15 times in 2011
- Participants who accessed the web portal more than 6 times in 2011 and
- Participants who accessed the web portal more than once in 2011

Based on the results of that analysis, the CWP program demonstrated savings for participants in the subpopulation who accessed the web portal more than 15 times during the program year. Savings estimates in both the overall population, and in other subpopulations were smaller and inconsistent.

Table E-1 shows the statistically significant differences between the treatment and control groups in the subgroup of customers who viewed their usage data more than 15 times during 2011. The statistically significant differences are highlighted in blue. In this subpopulation a significant savings is clearly occurring in the treatment customers. The savings is approximately 38 kWh per month.

Table E-1 Monthly difference in participants who viewed > 15 times

Month	All Participants n= 1,500	Singly Enrolled n= 1,007	Dually Enrolled n= 493
January	-26.34	-21.52	-35.21
February	-4.99	-7.88	0.34
March	-0.66	2.13	-5.79
April	1.37	6.38	-7.84
May	7.83	16.12	-7.41
June	26.20	35.30	9.46
July	46.67	52.96	35.09
August	46.77	53.46	34.46
September	55.48	57.79	51.23
October	24.64	30.67	13.54
November	31.82	38.00	20.46
December	-2.90	5.75	-18.83

Based on the analysis of both the entire sample and the subpopulations described above, we estimate the cumulative CWP savings for the entire program. In order to do this we make an important assumption; customers who view the web portal less than 15 times per year are either not saving energy, or their savings is too small to be estimated given the variation in usage within the sample. Based on these assumptions the savings for the CWP program is presented in Table E-2, for all participants and singly enrolled participants. Dually enrolled participants are not included as they did not demonstrate a statistically significant savings. The savings are estimated by summing all of the monthly statistically significant differences over the course of the year.

Table E-2 CWP Savings: Participants with > 15 views per year

	All Participants N=8,279	Singly Enrolled N=5,364
Annual Savings (kWh)	232	268
Average Annual Usage (kWh)	9,348	9,276
Percent savings	2.48%	2.89%
Total Savings (kWh)	**1,917,251**	**1,438,518**

The savings attributable to this subgroup are consistent with estimates of savings from other informational conservation programs, falling in the 1-3% range. However, these percentages are only valid for those participants who view the website often. These participants represent a unique subgroup of the CWP population that is likely to be eager to learn more about energy use and also likely to be actively looking for ways to manage usage. Because of their unique interest in energy, these customers likely respond to the information presented in a different way than others in the population, and as a result save more energy. Furthermore, encouraging other participants to use the web more often, may not necessarily increase savings in those other participants. We see this same type of dichotomy in nearly all utility programs, conservation, efficiency, or demand response, where a relatively small group is responsible for the majority of the savings.

Energy Alerts Savings Analysis

The savings analysis of customers participating in Energy Alerts did not detect statistically significant energy usage reductions using either a direct comparison, or a regression method.

The direct comparison analysis looked for savings by comparing both daily and monthly usage between treatment and control customers. The daily method was used to attempt capture small changes in usage that may be significant on a daily basis, but not on a monthly basis. Results for both daily and the monthly analysis are unable to identify any statistically significant savings resulting from the Energy Alerts program. In this program, the quality of the match may be an issue that is preventing us from identifying those savings.

The results of the daily regression analysis conducted for energy alerts customers was consistent with the results of the direct comparison and unable to detect any statistically significant changes in daily usage resulting from receiving an alert.

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OVERVIEW

1.1 PROGRAM BACKGROUND

This report includes the Ex Post (after the fact) Evaluation of Pacific Gas and Electric Company's (PG&E) SmartMeter™ Enabled Programs for the Program Year 2011 (PY2011). The report provides an estimation of the energy savings for PG&E customers that participated in one of two SmartMeter™ enabled informational energy conservation programs:

> **Customer Web Presentment –** In this program, interval electric usage data is available to customers though the Customer Web Presentment (CWP) pages of PG&E's My Energy web portal. The My Energy website is a single, customer-facing portal with many different functions and tools beyond the scope of this evaluation. The relevant aspect of the portal is the My Usage tab which allows customers who are SmartMeter™ read and billed to view their electricity usage at the daily or hourly level.
>
> **Energy Alerts –** In this program, customers can sign up for Energy Alerts (EA) to receive notifications during the billing cycle about energy usage. PG&E customers are billed according to an increasing block rate, where successively larger tiers of energy usage are billed at successively higher per-kWh rates. Energy Alert customers are notified for the first time if their bill forecast, calculated on the 8th day of their billing cycle, projects that they will cross into tiers 3, 4, or 5. Customers are subsequently notified after they cross each of those three tiers for a maximum of 4 alerts in each billing cycle.

It is important to note that the results of the PY2010 evaluation were considered in the objectives and design of this year's evaluation. At the program level, last year's third party evaluator did not report detectable savings for either CWP or EA in 2010. However, the evaluator noted in the Executive Summary that "there is significant uncertainty in these estimates, so it is possible that the programs could affect usage by 1-2% in either direction."[1] Because CWP and Energy Alerts were not implemented using experimental design, their analysis used statistical matching methods similar to those we use in this evaluation. This is the best known method of evaluating an opt-in information energy conservation program that does not incorporate randomized treatment and control. In 2010, however, it was not possible for the evaluator to take advantage of SmartMeter™ interval data. Using interval data in this year's evaluation improved the accuracy of the matching process and enhanced our ability to identify potential energy savings. In addition, we designed the samples for this evaluation specifically to take advantage of the fact that customers who are more engaged with informational type programs tend to save more energy. These highly engaged customers are likely to be early adopters of energy information, and are also likely to be looking for tools to help them manage and reduce their energy usage.

1.2 RESEARCH OBJECTIVES

Bearing in mind the PY2010 findings, the two research objectives for this project are to evaluate the ex-post electricity savings associated with SmartMeter™ enabled energy conservation programs:

> **Ex-Post Estimates of Energy Conservation for Customer Web Presentment –** It is hypothesized that customers who are aware of how much energy they are using on a daily basis will be more effective in managing their energy consumption. Therefore, the first

[1] Freeman, Sullivan & Co., *2010 Energy Conservation Evaluation of Pacific Gas & Electric Company's Energy Alerts and Customer Web Presentment Programs*, April 29, 2012, p. 2.

research objective is to estimate the effect on customers' monthly energy usage of viewing daily or hourly energy use during the billing cycle both at the program level and within subpopulations that are more likely to conserve energy.

Ex-Post Estimates of Energy Conservation for Energy Alerts – Because PG&E charges customers for energy use on an inverted block rate schedule, it is hypothesized that if a customer knows when she crosses into a higher priced tier, she will conserve energy in response to the higher price. The second research objective is to estimate the effect of Energy Alerts on customers' monthly or daily energy usage both at the program level, and if appropriate, within subpopulations that are more likely to conserve energy.

1.3 KEY ISSUES

PG&E began active marketing of both CWP and Energy Alerts early in 2010 and this is the second year that either program has undergone a formal evaluation. The programs are currently in full deployment and did not employ an experimental design during the roll-out phases that could later be used for evaluation. It is also expected that the savings for these programs will be very small and difficult to detect. Given these issues, there are some unique challenges associated with meeting the research objectives defined in this evaluation. Specifically, we have identified the following key challenges:

- **Lack of formal control group** – In a pilot setting it is often possible to use an experimental design with randomized treatment and control groups to control for self-selection bias. However, when a program is fully deployed, a randomized control group is no longer an option. This will be addressed by creating a matched control group from a larger pool of non-participants. We explain in detail in the sample design section how we closely match each treatment customer with a control customer based on a combination of filters and distance metrics.
- **Potentially small impacts relative to total usage** – Changes in energy use resulting from the programs are likely to be small in magnitude. This will be addressed in two ways. First, by stratifying based on levels of engagement, those who are most likely to show the biggest changes in energy use and therefore the most likely to be statistically significant, will be analyzed separately. Second, the use of a well-matched control group will remove as much of the random variation between customers as possible, which will also allow the detection of smaller changes in energy use. There is an additional and unique aspect of Energy Alerts which we can take advantage of in order to improve our ability to detect smaller changes in energy use. The likely changes in energy use resulting from the energy alerts will vary by timing, including key stages, such as a) days preceding alerts, b) shortly after alerts are received, and c) longer after alerts are received. Analysis of daily data is much more likely to be able to detect a change resulting from a notice.
- **Dual Participants –** A large portion of the participant population is dually enrolled in both the CWP and EA programs. This will require careful consideration in the estimation of savings for both groups.

While it is important to acknowledge the challenges associated with these issues, the availability of SmartMeter™ data and the more granular stratification used in this evaluation year have improved our ability to detect savings. However, because we are only able to match treatment to control customers based on observable characteristics, we will never be able to completely duplicate the results of a designed experiment and consequently the matching process will inevitably have some degree of bias. This, in turn, will always lead to uncertainty in the savings estimates. These uncertainties must be associated with the evaluation's context, not necessarily the effectiveness of the program.

PROGRAM DETAILS

2.1 PROGRAM MARKETING AND ENROLLMENT

Rollout and marketing of the CWP and Energy Alerts programs began in early 2010, targeting customers with the following mail and email messages.

- Introductory bill inserts were sent to customers who were about to have a SmartMeter™ meter installed. These inserts described the SmartMeter™ meters in general, and highlighted ways in which both CWP and Energy Alerts could help them manage their electricity use. Roughly 800,000 such inserts were sent out from January 2010 through April 2010.
- After SmartMeter™ installations, a Welcome Kit was sent with further information on the meters and supporting programming. These kits highlighted CWP, but did not mention Energy Alerts. Roughly 1.7 million SmartMeter™ Welcome Kits were sent out to residential customers from April 2010 through August 2010.
- After September 2010, a Transition Booklet replaced the SmartMeter™ Welcome Kits with similar information. The Transition Booklet advertised both CWP and Energy Alerts. About 900,000 Transition Booklets were sent to residential customers from September 2010 to December 2010.
- In June 2010, an email was sent to about 14,000 customers who had previously indicated interest in the Energy Alerts program. The email announced that the Energy Alerts were now available.
- The Anatomy of a Rate mailing was sent to customers who had had bills in tier 3 in August of 2010. This explained the tiered rate structure and again advertised both the CWP and Energy Alerts programs and how they can be used to manage electricity use. About 560,000 of these mailings were sent out.
- In July 2011, five-hundred thousand emails were sent to non-CARE customers that had a high propensity for crossing tier three. Then, in October of 2011, an additional 430,000 emails were sent customers with the same characteristics.

2.2 CUSTOMER WEB PRESENTMENT

Customer Web Presentment of usage data is a feature that lives inside the *My Energy* website, which is a single customer-facing portal with many different functions and tools. Only the functions or tools that display customer interval usage data from the SmartMeter™ system will be evaluated within the scope of this project. Residential and small business customers that are SmartMeter™ read or billed can view their interval data through tools in the My Usage tab on the website. These tools correspond to two individual web pages that present SmartMeter™ usage information directly to customers. Our objective is to estimate the effect on customers' monthly energy usage of viewing daily or hourly energy use through these two specific pages using a direct comparison of the treatment and control groups.

In 2011, PG&E transitioned to a new platform to handle the web presentment of SmartMeter™ interval usage data. After the upgrade was complete, a technical compatibility issue associated with the new platform limited PG&E's ability to track detailed customer activity within the web presentment pages. For residential customers, this began in mid-November 2011. As such, this year's evaluation draws on data available up until this point. It is important to note that the absence of data in the final weeks of 2011 does not affect the validity of the analysis or the

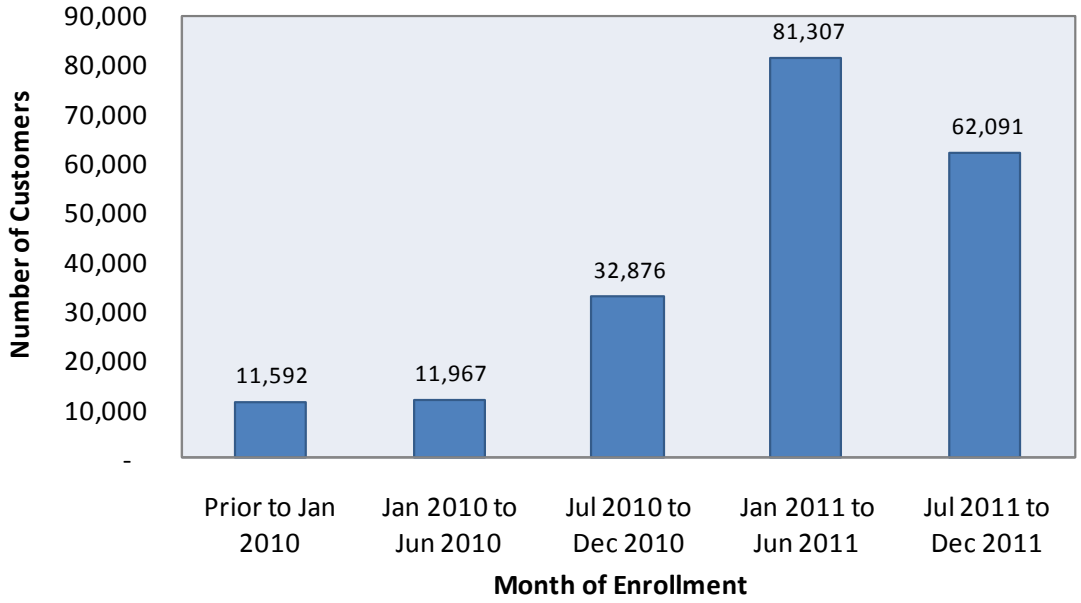
findings presented here. This is because in an ex post evaluation, a customer's future energy consumption and program activity, say December 2011, has no influence on their observed usage and behavior in past, for instance October 2011.

2.2.1 Enrollment

Customer Web Presentment was available for all of 2011 to eligible SmartMeter™ customers. As of December 31, 2011, there were 1.8 million customers with a current My Energy account, all of which were either SmartMeter™ read or billed. Of the SmartMeter™ enabled customers, about 199,833 residential customers logged in to CWP at least once during 2011.[2] The program was primarily marketed to customers via two channels: Pre-installation bill inserts to customers who were about to receive a SmartMeter™ and the SmartMeter™ Transition Booklet. For each campaign, CWP was marketed as a feature of My Account.

Figure 2-1 below shows the distribution of new CWP enrollments over time. An enrollment, in this sense, consists of accessing the online interval data for the first time.[3] The largest influx of participants occurred in the early half of 2011, which is 7 to 12 months prior to the end date of the evaluation period (12/31/2011). Figure 2-2 shows the cumulative number of participating customers over time. A very small percentage of customers began accessing their usage information more than 24 month ago, with the vast majority first accessing the information in the 18 months prior to the end of the evaluation period. The enrollment numbers are highly correlated with the SmartMeter™ roll-out, as customers are only able to view their interval data after their SmartMeter™ is installed.

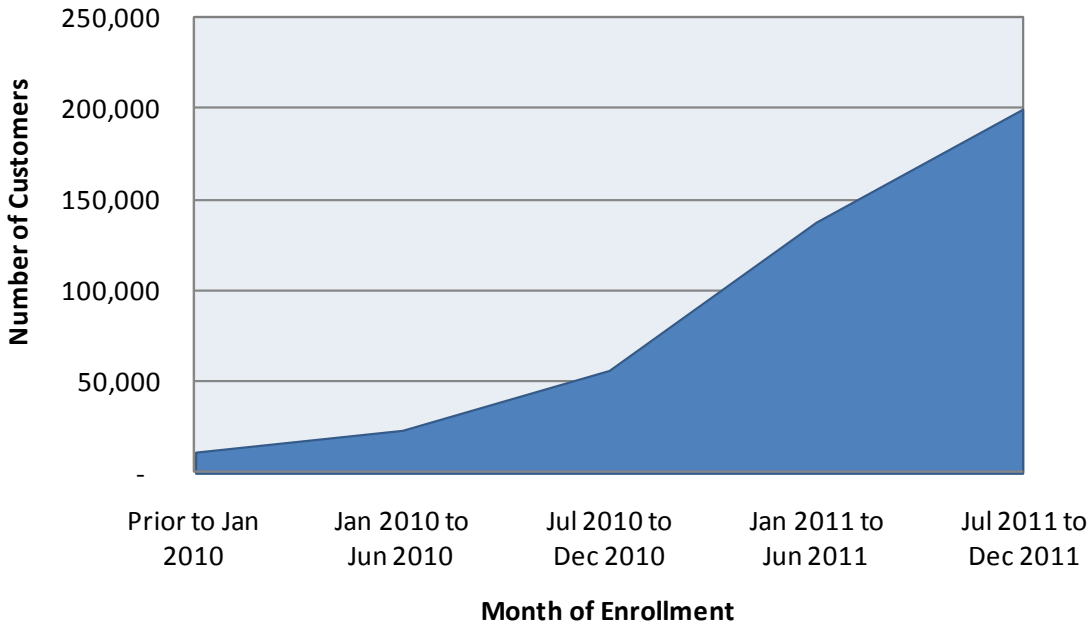
Figure 2-1 CWP - Graph of New Enrollments over Time



[2] To be consistent with PY2010 evaluation, the PY2011 analysis focuses exclusively on residential customer. Small and medium business customers and agricultural customers can also participant in CWP. Future evaluations of the program will include these customers once there is sufficient data to do so.

[3] Customers who accessed the web portal prior to 2011, but did not access in 2011 were not considered participants in this analysis.

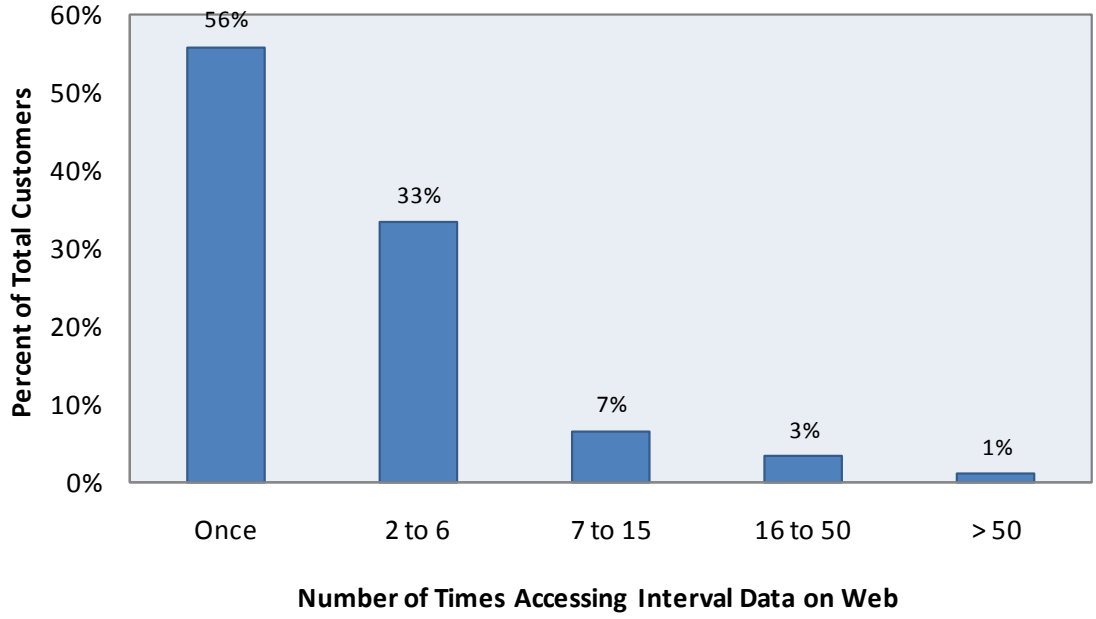
Figure 2-2 CWP - Graph of Cumulative Enrollments over Time



2.2.2 Level of Engagement

Figure 2-3 shows the distribution of participating customers that engaged with the program at various levels. Over half of the participants (56%) only viewed their CWP data once. Another sizeable block of participants (33%) viewed their data between 2 and 6 times. Only about 10% of the participants engaged with their data 7 or more times in 2011, including a very active 1% who racked up 50 or more views.

Figure 2-3 CWP - Graph of number of logins per customer in 2011



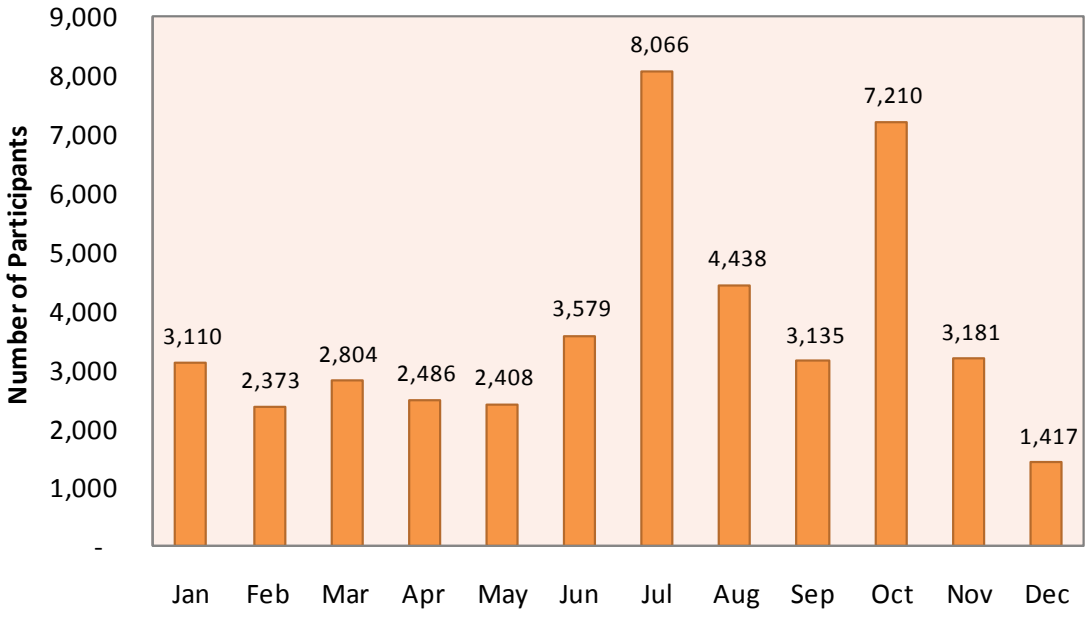
2.3 ENERGY ALERTS

Energy Alerts is a program that provides customers information about their cumulative energy use up to four times each billing month. Energy Alerts are only available for residential customers who are SmartMeter™ read and billed. As of December, 2011, there are approximately 73,000 participants in Energy Alerts. Energy Alert customers are notified for the first time if their bill forecast, calculated on the 8th day of their billing cycle, projects that they will cross into tiers 3, 4, or 5. Customers are subsequently notified after they cross each of those three tiers for a maximum of 4 alerts in each billing cycle. There is no price difference between tiers 4 and 5, however an alert is still issued if a customer crosses into tier five based on their usage above the baseline allocation applicable to their weather zone. CARE[4] customers are only charged for usage on three tiers and are therefore notified only as they cross into tier 3.

2.3.1 Enrollment

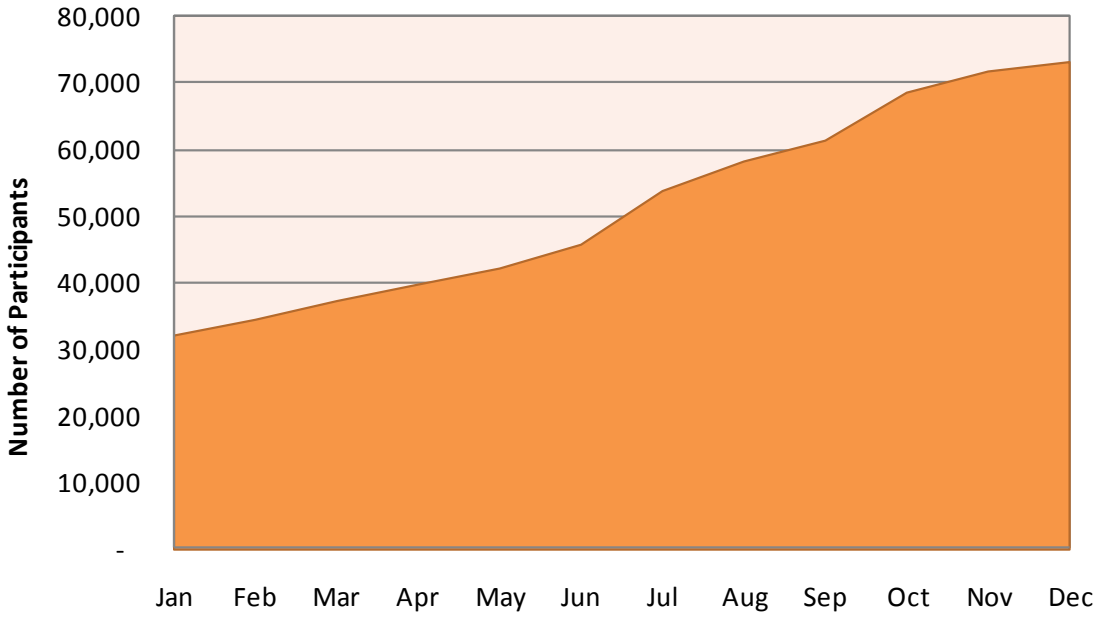
As of December 31, 2011, there were 73,261 customers enrolled in Energy Alerts. The program's enrollment grew at a rate of approximately 3,000 customers per month during 2011 with the exception of July and October which both saw an increase in enrollment of approximately 8,000 customers in each month. The enrollment spikes of July and October were associated with an email campaign targeted at customers with a high propensity to exceed tier three usage levels. During the remainder of the year, Energy Alerts was marketed to customers as part of the information they receive during the SmartMeter™ installation process. See Figure 2-4 and Figure 2-5 below for a graph of the new enrollments and cumulative enrollments throughout 2011.

Figure 2-4 Energy Alerts - Graph of New Enrollments over Time



[4] The California Alternate Rates for Energy (CARE) program provides discounted energy rates for low-income residential customers who qualify for the program based on the number of people living in the home and the household's total annual income.

Figure 2-5 Energy Alerts - Graph of Cumulative Enrollments over Time



2.3.2 Level of Engagement

Error! Reference source not found. shows the total number of Energy Alerts dispatched to articipants throughout 2011. The number of alerts rises steadily over the course of the year. The increase is likely partially a result of new enrollment; however seasonality also plays an important role here with higher usage in the summer and winter months. When the number of alerts is normalized on a per participant basis (see **Error! Reference source not found.**), the umber of alerts is still rising, although rather modestly considering the seasonality of usage. It may also be the case that more high usage customers are joining the program. Customers who use more energy will cross into the higher tiers more often and receive more alerts. The decrease in the number of customers receiving zero alerts in 2011 from 25% to 20% also indicates that more higher usage customers are signing up for the program.

Figure 2-6 Energy Alerts - Total Number of Alerts in 2011

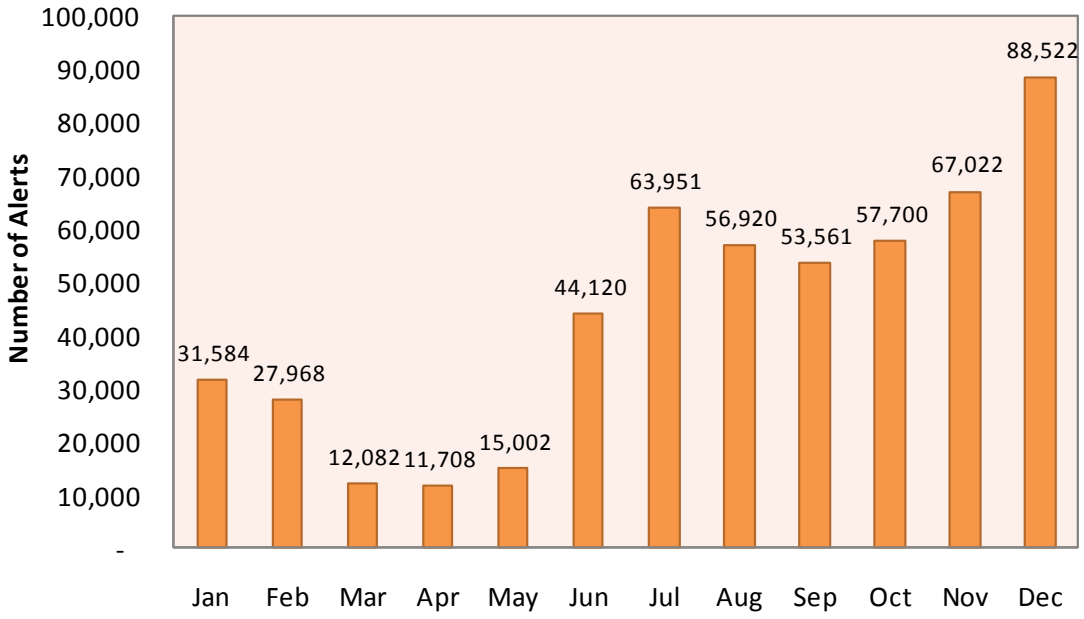
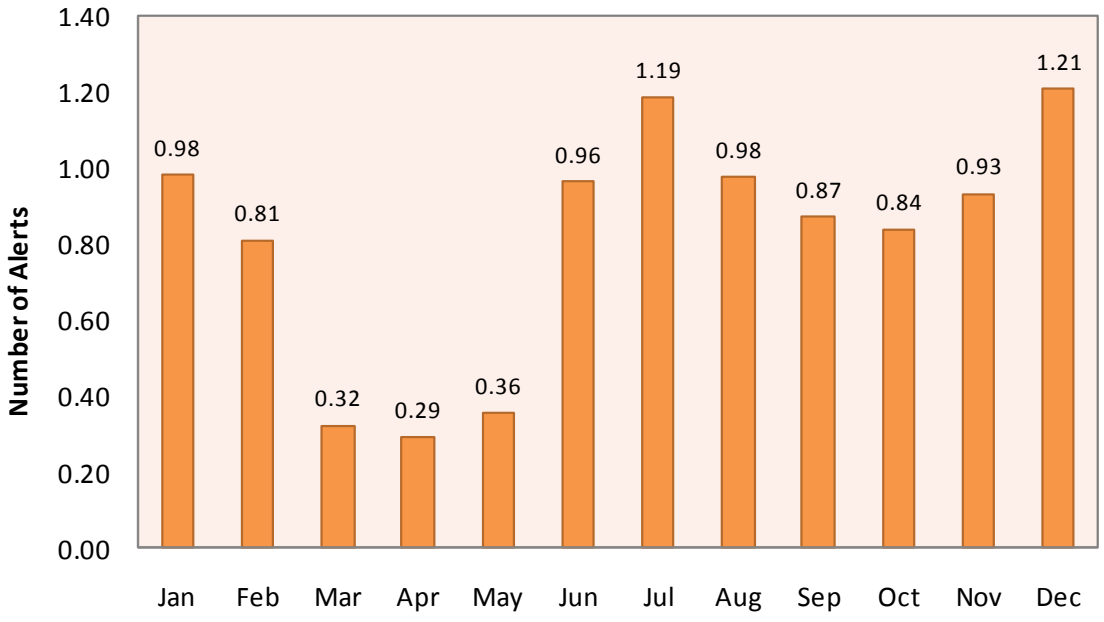
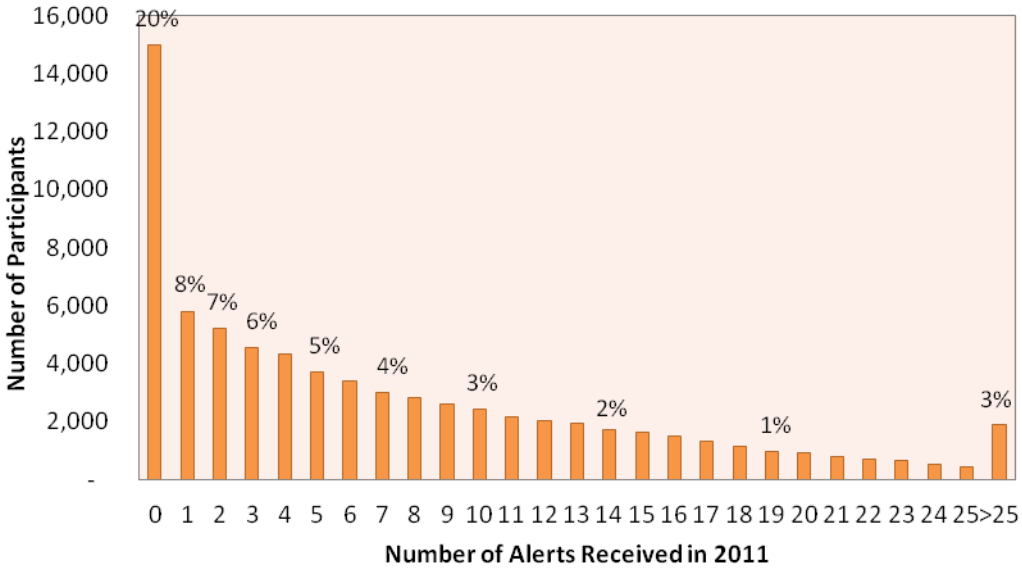


Figure 2-7 Energy Alerts – Average Number per Participant in 2011



Error! Reference source not found. below shows the distribution of participating customers y number of alerts received. The largest group (14,995 participants, or about 20%) did not receive any alerts in 2011. This statistic is slightly lower than the 25% of participants who received no alerts in 2010. The next largest group (5,812 participants, or about 8%) received only one alert in 2011. 5,201 customers received two alerts, with declining representation in each successive tier after that.

Figure 2-8 Energy Alerts - Graph of engagement level



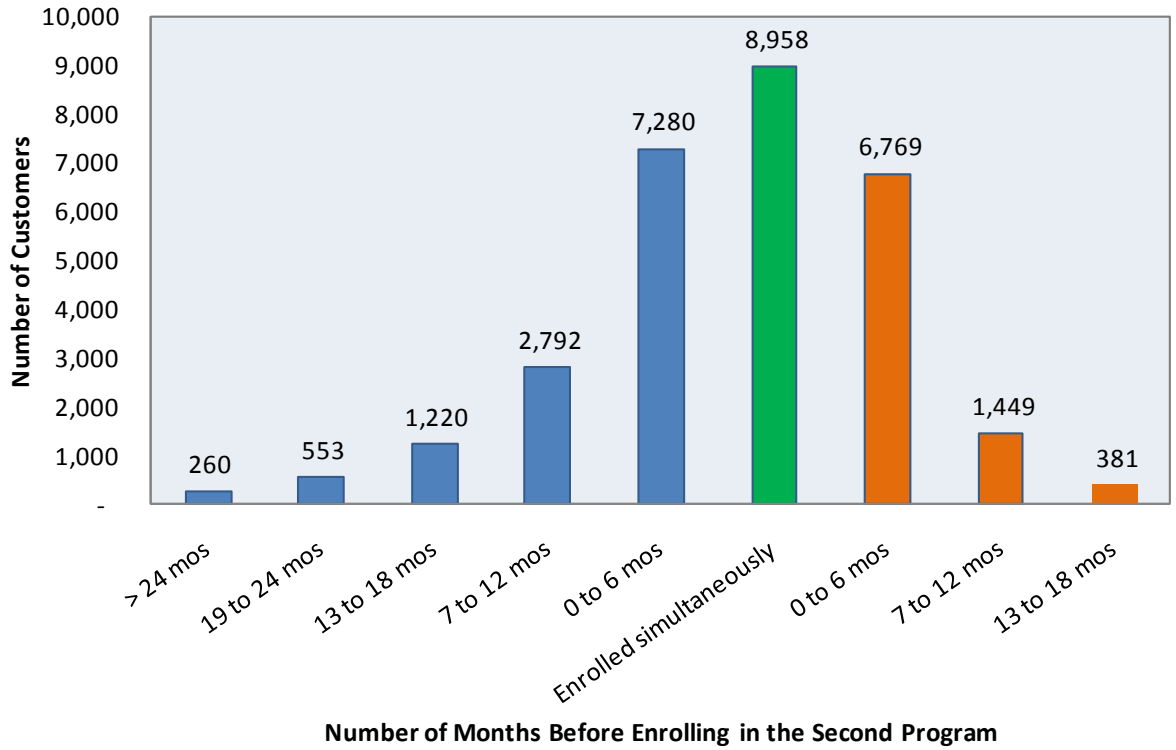
2.4 DUAL ENROLLMENT

A large percentage of participants are enrolled in both programs. Approximately 41% of the 73,261 Energy Alerts participants also use CWP, and about 15% of the 199,833 CWP participants are also receiving energy alerts. In total 29,662 customers are dually enrolled in both CWP and Energy Alerts.

EnrollmentError! Reference source not found. below shows the number of customers and the number of months in between enrollment to the other program. For the CWP program a customer is considered to "enroll" the first time they view their interval data on the web. For Energy Alerts, enrollment has the more traditional definition of the date the participant signed up for the program. The blue bars show the customers that enrolled in the Customer Web Presentment program first. The green bar shows the customers that enrolled in both programs on the same day. And lastly, the orange bars show the customers that enrolled in the Energy Alerts program first.

Forty one percent of the dual participants were enrolled in the CWP program first, most likely due to CWP being available since 2008; 30% of the customers enrolled in both programs on the same day; and 29% of dual enrollment participated in Energy Alerts first. Despite the almost even distribution among the three categories, it is still significant to point out that 78% of dual participants were enrolled in the second program within 6 months of enrollment with the first program.

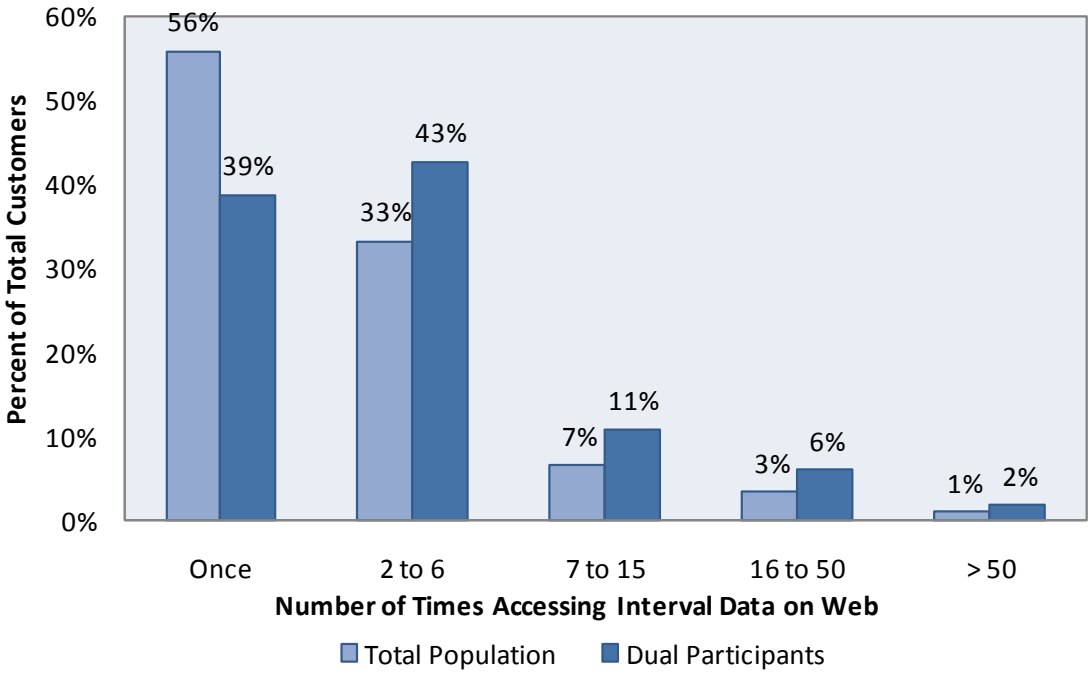
Figure 2-9 Graph of Dual Enrollments over Time



2.4.1 Level of Engagement

Figure 2-10 shows the distribution of dual participating customers that engaged with the CWP program at various levels. As compared to the total population of CWP participants, 43% of dual participants viewed their data between 2 and 6 times in 2011, whereas 33% viewed their data the same number of time in the total population. Although a sizeable block, 39% of dual participants, still viewed their data only once in 2011, this is significantly lower than the 56% of participants viewing their data only once in the total population. Consistently, 19% of dual participants viewed their data 7 or more times in 2011 compared to only 10% at the entire CWP participant population level. Clearly, dual participants are more highly engaged with the CWP portal, viewing their interval data more often that the singly enrolled participants.

Figure 2-10 CWP - Graph of Number of Logins per Dually Enrolled Customer in 2011



Error! Reference source not found. shows the total number of Energy Alerts dispatched to ual participants as compared to single participants, and all participants throughout 2011. As seen in the Energy Alerts population at large, the number of alerts rises steadily over the course of the year. But the more significant observation is that when normalized on a per participant basis, there is an increase in the number of energy alerts per participant in each month of 2011, although seasonality is again playing a role. Figure 2-12 shows the increase in average number of alerts per participant compared to the EA participant population.

Figure 2-11 Energy Alerts - Total number of Alerts for Dually Enrolled in 2011

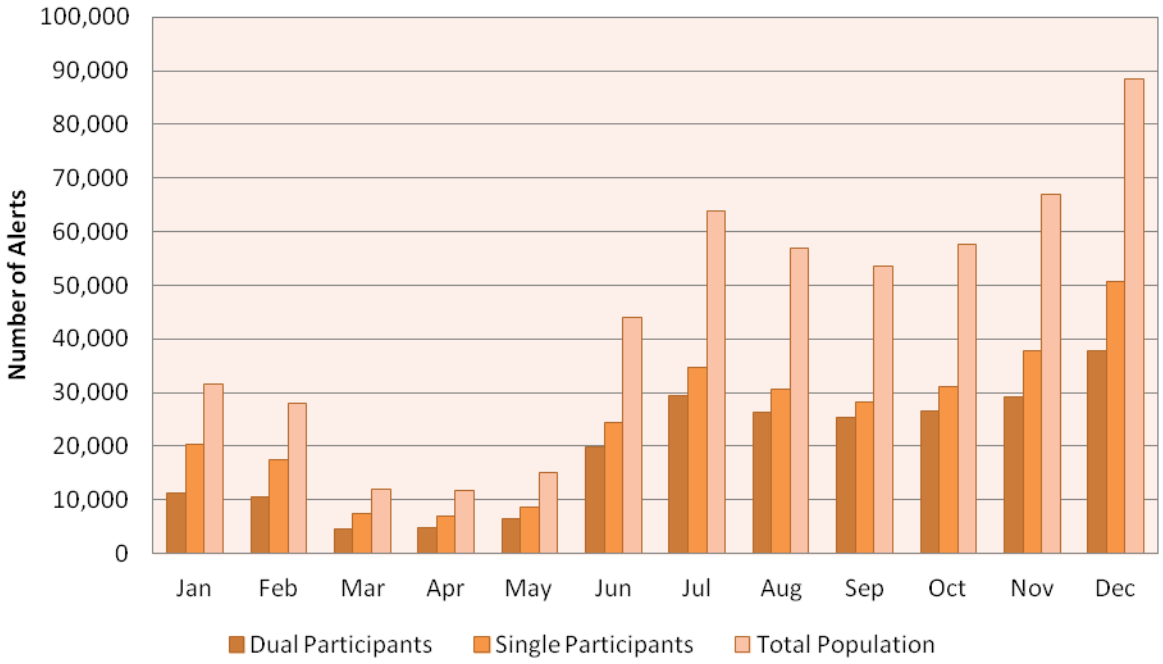
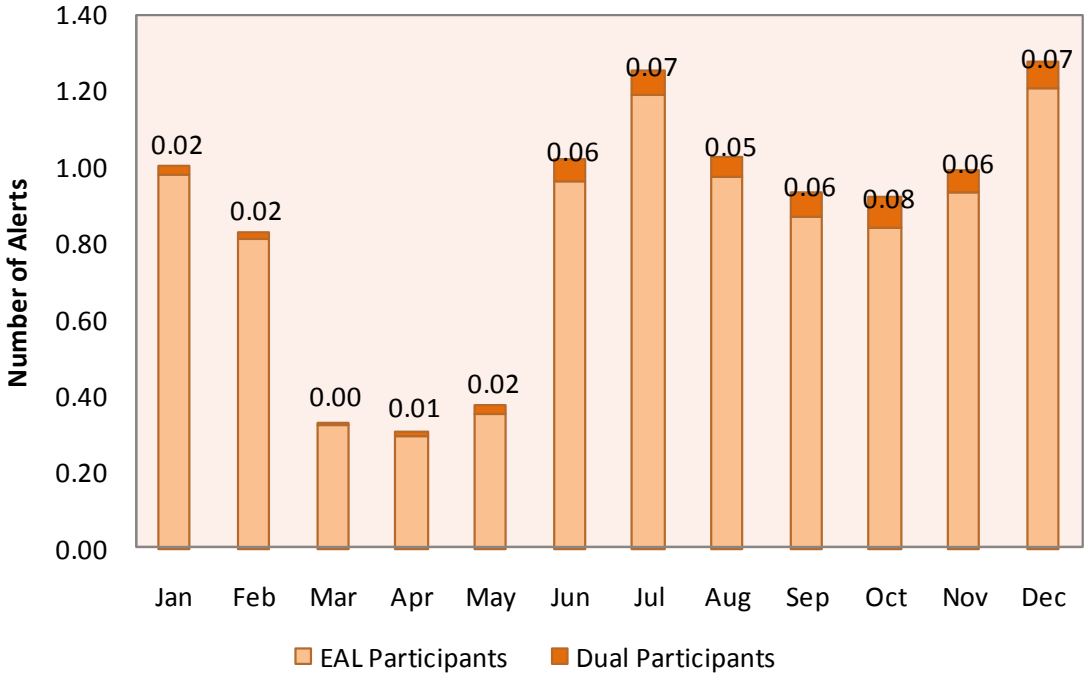


Figure 2-12 Energy Alerts – Average Number of Alerts per Participant in 2011



CHAPTER | 3

ANALYSIS METHODOLOGY

This section describes the analysis methodology for the evaluation. It begins with the sample design for both the Energy Alerts and Customer Web Presentment programs. It also describes in detail, the matching strategy that was used to match sample treatment customers to control customers. Finally, it describes the method used to estimate the impact of both programs by direct comparison, and the regression technique used to evaluate changes in daily usage associated with Energy Alerts.

3.1 SAMPLE DESIGN: CUSTOMER WEB PRESENTMENT

PG&E provided enrollment and web activity data for every customer who viewed their interval data through the My Usage tab within the *My Energy* web portal during 2011. In total, 199,833 residential customers viewed their interval usage data in 2011. As discussed previously, we restrict the analysis of CWP participants to the residential class for the PY2011 evaluation. Of the approximately two hundred thousand residential customers who viewed their usage in 2011, about 81 percent (162,069) had an interval smart meter installed and at least 6 months of good-quality pre-treatment billing data. We chose to limit the participants in this way to ensure that at least some interval data would be available, in addition to billing history, during the pre-treatment period which could then be used to match treatment and control customers.

We next looked at how the remaining participants used the web portal in 2011. The enrollment and web activity data included information regarding the first time that each participant viewed their usage via the web portal, and also the frequency with which their usage was viewed. Of those 162,069 who remained as part of the participant pool, less than one percent first viewed their usage during 2008, about 5% first viewed their usage data in 2009, 22% first viewed their data in 2010, and 72% first viewed their data in 2011. The data provided also allowed us to see how often a particular customer viewed their data. About 50% of all customers only viewed their data one time during 2011, 75% viewed it less than 3 times, 95% viewed it less than 13 times, and 99% viewed it less than 46 times. The maximum number of times any particular customer viewed their data in 2011 was 309 times. So, while nearly all customers only looked at their usage at most, once a month, there was a small subset of customers who viewed their usage data several times per week.

One of the key issues we identified in this evaluation is that the savings at the program level is likely to be very small and very difficult to detect. In order to increase our ability to detect savings, we stratified the participants by observable characteristics we believe will be highly correlated with savings, namely frequency and duration of use. We created 12 strata, with three duration strata and four frequency strata. The strata and sample sizes are displayed below in Table 3-1 shows the number of sample customers in each stratum. Table 3-2 shows the number of customers in the participant pool classified by strata. For the cells where we expect the least amount of savings, the sampling frequency (the ratio of sample participants to total participants) is relatively small, while in cells where we expect to see the most savings the sampling frequency is much larger.

Table 3-1 and Table 3-2. Customers were assigned to strata based on the first date that they had viewed their usage, 2008/2009 (combined), 2010, or 2011. They were further classified by the number of times they had visited the My Usage portion of the portal in 2011, once, twice to six times, seven to fifteen times, and sixteen times or more. We assigned 500 sample points to each of the twelve cells in order to maximize the chance of having statistically valid results within

each cell. We do this with equal sample sizes rather than proportionally because we expect to see little or no savings from customers who accessed the web portal only once, and we expect the most savings from those who accessed the portal more often. Having large samples within each cell will allow us to draw conclusions about each stratum individually. Within each of the twelve strata we selected a random sample of 500 participants to be included in the CWP sample for a total sample of 6,000 treatment customers.

Table 3-1 shows the number of sample customers in each stratum. Table 3-2 shows the number of customers in the participant pool classified by strata. For the cells where we expect the least amount of savings, the sampling frequency (the ratio of sample participants to total participants) is relatively small, while in cells where we expect to see the most savings the sampling frequency is much larger.

Table 3-1 CWP Sample Matrix with Sample Sizes

Year of first view	Frequency of Access in 2011			
	1	2 to 6	7 to 15	>= 16
2008 or 2009	500	500	500	500[5]
2010	500	500	500	500
2011	500	500	500	500

Table 3-2 CWP Participant Pool Classified by Strata

Year of first view	Frequency of Access in 2011			
	1	2 to 6	7 to 15	>= 16
2008 or 2009	2,397	2,327	620	529
2010	15,223	15,268	3,844	2,866
2011	72,283	37,518	6,052	3,142

3.1.1 Dual Participants in the CWP Sample

The level of dual participation between CWP and Energy Alerts is quite significant, so it is not possible or appropriate to exclude dual participants from the sample. Therefore, we have allowed the dual participants to be selected into the sample at random from the participant population. As a result, we have a statistically valid sample which represents the population distribution of participants both singly enrolled in CWP and dually enrolled in CWP and Energy Alerts within each stratum. Table 3-3 shows the number of dually enrolled participants by strata.

Table 3-3 Dual Participants by Strata

Year of first view	Frequency of Access in 2011			
	1	2 to 6	7 to 15	>= 16
2008 or 2009	82	121	159	145
2010	117	164	164	180
2011	43	117	125	168

[5] The number of customers in this cell ultimately fell to 472 based on eliminating some customers with erroneous or missing billing data. The population pool was so small that they were not all able to be replaced.

There are a total of 1,585 dual participants in the CWP sample, or about 36%. Because the dual enrollees were not selected separately, but were included in the sample randomly, the proportion of dual participants in the sample in each stratum represents approximately the proportion of dual participants in the population in each stratum. Interestingly the proportion of customers that are dually enrolled in the total sample is higher than the proportion of dually enrolled participants in the CWP population, which is about 15%. We see this result because the strata were not allocated proportionally and customers who are dually enrolled in Energy Alerts are also more likely to access the portal more frequently. This resulted in fewer dual participants in the low frequency cells, and more dual participants in the high frequency cells. We account for this difference by using a stratified estimate and by estimating the savings in two pieces, namely the savings for CWP participants only and the incremental savings for dually enrolled participants attributable to receiving alerts.

3.1.2 Sources of Bias in the Sample

Imposing any type of limitation on a sample can introduce bias. In this case, because we limited the sample to participants with adequate historical data we may have introduced bias. First, by selecting customers who did not view their interval data until three months after their meter was installed, and second by selecting customers who maintained the same residence over a specific time period. The first way, in our opinion, is less likely to introduce bias. While it is possible that some systematic difference may exist between how those who viewed their data right away and those who viewed it later react to that data, it seems unlikely to significantly influence the estimates. For example, customers who viewed their data right away may have been more likely to read the information materials sent out regarding the SmartMeter™ installation, while those who viewed it later may have been more likely to happen upon the page while paying their bill online. These types of differences do not seem to be strongly correlated with savings behavior. By limiting the treatment group to customers who maintain the same residence, we are more likely to select single family homes or long term renters. These types of customers may be likely to make changes in energy use that require investment in their property and are therefore may be more likely to act on information provided to them about their usage.

It is not possible to estimate the level of bias introduced into the sample due to these restrictions directly, but it is possible to get an idea of how much bias might be present by comparing the behavior of the participants selected for sampling and analysis and those that were excluded from the sample. When we looked at the distribution of the number of times that the web portal was accessed in 2011 for those that remained in the participant pool, vs. those that were excluded we found that they were very similar. Table 3-4 shows the quartiles for the number of days accessed by both the excluded participants and the participant pool. The median number of times that any participant viewed their usage is once, meaning that at least 50% of the participants never viewed their usage more than one time. Similarly, 75% of the participants viewed their usage information 3 times or less, and so on. Discrepancies between the two groups occur only within the top 10% of users, with those in the group that was excluded accessing the web portal more often than those that remain. This indicates that overall the two groups are very similar, and we are unlikely to be introducing bias by excluding some of the participants from the sample pool.

Table 3-4 CWP - Total Number of Days Accessed: Participant Pool vs. Exclusions

Quartiles	CWP Participants	
	Final Pool (n=162,069)	Excluded (n=37,764)
100% (maximum)	309	294
99%	46	64
95%	13	16
90%	7	8
75% Q3	3	3
50% Median	1	1
25% Q1	1	1

Even though the differences between the two groups are relatively small, the sample can be weighted in such a way as to mitigate some of the differences introduced by excluding a portion of the population. Traditionally the weight of each stratum is calculated as the number of customers in that stratum divided by the total number of participants in the final pool. However, we adjusted the calculation to be based on the entire participant population. By basing the weights on the entire population, the fact that the participants remaining in the pool are accessing the web portal somewhat less often than those that were excluded, is reflected in the weight of each stratum by assigning more weight to those high frequency strata.

3.2 SAMPLE DESIGN: ENERGY ALERTS

PG&E provided enrollment and alert notification data for every customer who was enrolled in the Energy Alerts program as of December 31, 2011. In total 73,261 customers were enrolled in the program during 2011. All of the participants joined the program between June of 2010 and December of 2011. Of those participants, about 83 percent (61,705) received at least one alert during 2011. We assume that participants who signed up for Energy Alerts but did not receive any alerts are very unlikely to save any energy due to enrollment in the program. Of the participants who received at least one alert during the program year, 64 percent (40,008) had at least 6 months of good quality billing data and a smart meter installed. We chose to limit the participants in this way to ensure that at least some interval data would be available, in addition to billing history, during the pre-treatment period to be used to match treatment and control customers.

Of those 40,008 participants who remained as part of the participant pool, the average number of alerts they received each bill-month ranged from 0 to 4 and the total number of alerts received in 2011 ranged from 0 to 43. Fifty percent of the participants who received at least one alert received an average of 1.25 alerts per month during the summer season and an average of 0.875 alerts per month during the winter season.

Again with the Energy Alerts sample, we use the sample design to increase our ability to detect saving among those customers who are most likely to respond to the alerts. Because we expect savings to be correlated with frequency of alerts and length of participation, we chose to stratify the Energy Alerts sample by both frequency of alerts and duration of participation. Energy savings will likely be less strongly correlated with the number of alerts received because the number of alerts is a function of which tier a particular participant tends to fall in. For many customers, it would require a significant change in behavior and appliance efficiency to drastically change the tier in which they generally consume. However, for those close to a breakpoint between tiers, especially between tiers two and three (where the steepest increase in price occurs) the alerts may help customers conserve enough energy to stay out of the next tier and therefore receive fewer alerts. Because customer energy use, and therefore the tiers that a customer will fall in can be quite different between summer and winter, we separated the number of alerts by season.

Based on both the average number of alerts per bill-month, per season, and length of participation we created eight strata. The strata and sample sizes are displayed below in Table 3-5 and Table 3-6.[6] Customers were assigned to strata based on the date that they signed up, and the average number of alerts they received per month, per season. If the average number of alerts fell above the 50th percentile they were classified as "High" for that season and if it fell below the 50th percentile they were classified as "Low" for that season. We excluded participants who received no alerts during the program year because we expect the savings for these participants to be zero. We assigned a minimum of 350 sample points to each of the eight cells in order to allow us to draw conclusions about each stratum individually. The total energy Alerts sample size is 3,674.

Table 3-5 shows the number of sample customers in each stratum. Table 3-6 shows the number of customers in the participant pool classified by strata. Similar to the results for the CWP analysis, for the cells were we expect the least amount of savings, the sampling frequency is relatively small, while in cells where we expect to see the most savings the sampling frequency is much larger.

Table 3-5 EA - Sample Matrix with Sample Sizes

Number of Alerts	Participation Start Date	
	Prior to 5/2011	After 5/2011
High Summer & High Winter	588	856
High Summer & Low Winter	357	350
Low Summer & High Winter	350	466
Low Summer & Low Winter	350	357

Table 3-6 EA - Participant Pool Classified by Strata

Number of Alerts	Participation Start Date	
	Prior to 5/2011	After 5/2011
High Summer & High Winter	8,001	4,024
High Summer & Low Winter	3,641	632
Low Summer & High Winter	1,725	6,522
Low Summer & Low Winter	10,798	4,665

3.2.1 Dual Participants in the Energy Alerts Sample

As with the CWP sample above, the level of dual participation between Energy Alerts and CWP is quite significant, so it is also not possible or appropriate to exclude dual participants from the sample. Therefore, we have allowed the dual participants to be selected into the sample at random from the participant population. As a result, we have a statistically valid sample which represents the population distribution of participants both singly enrolled in Energy Alerts and dually enrolled in Energy Alerts and CWP. Table 3-7 shows the number of dually enrolled participant in each stratum.

[6] Some cells have more than 350 cells because the alerts sample had to be post-stratified partway through the analysis. After the initial stratification the team discovered that the Energy alerts data contained anomalies which produced duplicate alerts for certain customers in a single day. These duplicate alerts invalidated the original stratification; we therefore post-stratified the participants, updated the stratum breakpoints and randomly selected additional participants to fill each cell with at least 350 sample points. The sample design, stratification, and counts are all shown for the final stratification and sample design.

Table 3-7 EA - Dual Participants by Stratum

Number of Alerts	Participation Start Date	
	Prior to 5/2011	After 5/2011
High Summer & High Winter	282	584
High Summer & Low Winter	163	287
Low Summer & High Winter	152	214
Low Summer & Low Winter	181	228

There are a total of 2,091 dual participants in the Energy Alerts sample or about 56%. Similar to the CWP sample, the proportion of customers that are dually enrolled in the sample is higher than in the general population, which is 43%. We see this result because the strata were not allocated proportionally and customers who are dually enrolled in CWP may also happen to be higher energy users, and therefore receive more alerts. This resulted in fewer dual participants in the low alert cells, and more participants in the high alert cells. We account for the dual participants in the estimation of the savings by estimating the savings in two pieces, namely the savings for Energy Alerts participants only and, the incremental savings for dually enrolled participants attributable to accessing their interval data through the portal.

3.2.2 Sources of Bias in the Sample

Similar to the CWP sample design, imposing any type of limitation on a sample of participants can introduce bias. In the case of the Energy Alerts sample, the participants were restricted based on the availability of historical interval and billing data which may have introduced some systematic differences between those participants included in the final pool and those who were excluded.

It is not possible to directly estimate the level of bias introduced into the sample due to these restrictions, but it is possible to get an idea of how much bias might be present my comparing the number of alerts sent to those customers who remained in the participant pool to those who were excluded. When we compare the distribution of the average number of summer alerts between these two populations we find that they are similar. Table 3-8 shows the quartiles for the average number of alerts sent per season, per month, during 2011 for both the excluded participants and the participant pool. In all cases the median number of times each month that participants received alerts was close to one. Similarly, 75% of the participants received less than 1.75 alerts on average each month, and so on.

Table 3-8 Average Number of Alerts per Season: Participants vs. Exclusions

Quartiles	Energy Alert Participants			
	Final Pool Summer (n=40,008)	Excluded Summer (n=19,036)	Final Pool Winter (n= 40,008)	Excluded Winter (n=19,036)
100%	4.00	4.00	4.00	4.00
99%	3.25	3.25	3.00	3.00
95%	2.75	2.75	2.33	2.25
90%	2.25	2.25	2.00	1.88
75% Q3	1.75	1.75	1.37	1.25
50% Median	1.20	1.00	0.85	0.66
25% Q1	0.50	0.50	0.33	0.28
10%	0.00	0.00	0.13	0.13

On average, the excluded customers did receive slightly fewer alerts per seasonal bill-month than the participants that remained in the final pool, especially during the winter months. Because the customers were limited based on availability of data, we expect participants who were excluded to have more missing data, and for the majority of the missing data to occur during the winter season. Furthermore, we expect the missing winter data to occur most often during the colder and darker months of January and February. Having more shoulder month data and less winter data will result in lower usage and lower numbers of alerts for those excluded customers as reflected in Table 3-8 above.

Because of these differences, the estimates obtained for the sample of participants may reflect participation with slightly higher overall usage, which may lead to a slight overestimation of savings from receiving alerts. Based on our initial comparison, it may be that the small differences in the two groups indicate a small amount of bias was introduced in this step. However, it is also possible that what appears to be bias due to differences in average usage may not actually influence savings. For example, customers who receive 2 alerts per month may be just as likely to save as those who receive 4 alerts per month.

Like with the CWP customers, the sample weights can be used to mitigate some of the differences between the included and excluded participants. To do this the stratum weights are calculated based on the entire participant population, rather than on the final participant pool. By basing the weights on the entire population, the fact that the participants remaining in the pool receive alerts slightly more often than those excluded, is reflected in the weight of each stratum.

3.3 DEFINING A CONTROL GROUP FOR BOTH PROGRAMS

The energy savings associated with these programs will be estimated by comparing energy use of participating customers with a carefully selected control group of non-participating customers. A stratified matching technique is used to construct a control group that is very similar to the participant group in all observable ways, except for being exposed to the program treatment. In a pilot setting it is often possible to use an experimental design with randomized assignment to treatment and control groups to control for self-selection bias. Self-selection bias is the presence of systematic differences between customers who volunteer for a program or treatment and those who do not. Self-selection bias is problematic because the estimates of savings cannot be separated from the systematic differences between treatment and control customers. Matching participants to the control group can help eliminate bias for any observable characteristic, and using interval data will be the most powerful way to ensure that the two groups have similar pre-treatment usage characteristics. Using only those customers who have accessed My Energy for the CWP control group also helps reduce bias, since this captures some of the unobservable characteristics of online users. However, because we cannot fully duplicate the results of a designed experiment through matching, the matches will necessarily have some level of bias, and the estimates will also have some level of uncertainty.

3.3.1 Creating the Control Group Pool

In order to create a matched control group for the treatment group for each of the two programs, the first step is to select a pool of non-participants as potential matches. While there are dually enrolled customers in both samples, we chose to select customers for the control groups who do not participate in either program. We chose not to attempt to control for dual participation through the matching strategy due to highly variable levels of engagement with each program and different distributions of engagement among dual participants and single program participants.

In an ideal situation, we would be able to use the entire non-participant population as a potential pool. However, because we incorporated interval data into the matching process, the volume of data necessitated that the pool be reduced significantly in size. Therefore, we first selected only customers who have an interval meter installed (regardless of the timing), and then we pre-matched potential control group customers into buckets using filters. This pre-matching allowed us to use the method described below to ensure that each participant had enough control group pool customers to allow for a good match, without needing to process hundreds or thousands of customers.[7] The entire non-participant population and the treatment customers were both classified into buckets using the following filters: 5 digit zip code, SmartAC participation[8], AC propensity[9] ("high", "medium", "low") and electric or non-electric heat. The combination of the four filters created a bucket for each customer in the treatment group and the non-participant population. After the treatment customers and non-participants are classified, we can then use the number of treatment customers in each bucket for each program to determine the number of potential control group customers to select for the pool. We simply multiplied the number of treatment customers in each bucket by 10 to determine the number of corresponding control pool customers to select from the non-participant population.[10] We employed multiplier of 10 because 10 is considered to be a sufficient ratio of treatment to control customers for quasi-experimental design within the industry. Additionally, we are limited by the number of customers within each bucket in the population, and often the buckets were so refined that the number of

[7] We did not restrict customers to a specific amount of interval data because the meters were rolled out geographically, and we are matching customers to others in their zip code, so control and treatment customers are likely to have about the same amount of interval data available.
[8] PG&E's Demand Response program where Air Conditioners are cycled on and off in a coordinated fashion to reduce loads at times of system peak.
[9] AC propensity refers to the probability that a particular customer will have CAC, the propensity scores were developed in 2010 by FSC based on geography house type and other factors.
[10] There were cases where the number of non-participants in specific buckets was less than 10 times the number of treatment customers in the same bucket. In those cases, all of the non-participant customers were selected for the control group pool.

customers within each bucket in the population was fewer than 10. After determining the number of control customers required for each bucket, that number is randomly selected from the non-participant population. This approach allows us to select a very targeted group of non-participant customers to serve as the control group pool. There were 1,318 different buckets created for the CWP treatment group and 938 buckets created for the Energy Alerts treatment group.

Although the process was identical for both control group pools, the non-participant population was different for each program. The control group pool for the Energy Alert treatment group was selected from the population at large. The population that served as a potential control group pool for the CWP customers was customers who had used My Energy, but had not viewed their interval data by visiting the My Usage tab. The reason that we used these customers as a control group was to control for other activities that customers might engage in through the web portal, such as on-line bill pay, or viewing billing data. These activities may encourage some customers to save energy, but are not enabled by SmartMeter™ data therefore this approach ensures that both the treatment and control groups have access to the same information and are as similar to each other as possible.

3.3.2 Matching Strategy

After selecting the control group pools for each bucket with treatment group customers the next step was to match each treatment customer with a similar control group customer. The control and treatment customers are grouped based on the buckets created in the previous step, defined by a combination of zip code, CAC propensity, SmartAC participation, and heating type. Then, within each bucket, treatment customers are matched with the closest control group customer in the bucket based on pre-treatment usage.

In order to determine how close each treatment customer is to a potential match we calculate a distance metric based on a combination of interval and billing data. For each customer in the treatment or control groups, we first calculate average daily usage from the billing data. We also calculate average daily usage from the available interval data. Then, we merge the daily usage from the billing data with the daily usage from the interval data, replacing billing data with interval data wherever it exits. This creates one set of daily usage values for each customer where those values calculated from interval data, which are more precise, are favored over those calculated from billing data.

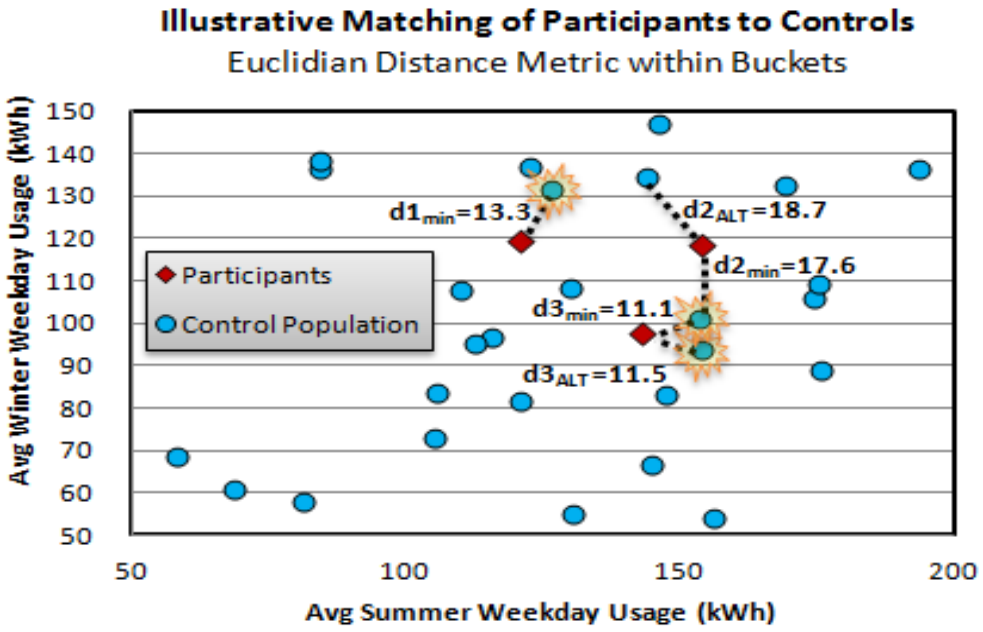
In the next step we calculate the variables that will be used in the distance metric algorithm from the daily data: average summer weekday usage, average summer weekend usage, average winter weekday usage, and average winter weekend usage. We then use a weighted Euclidian distance metric to determine how close or similar each potential control group customer is to any one treatment customer based on those four weighted variables.[11] Using a distance metric allows us to compare treatment customers with potential control customers based on their overall similarity as defined by average daily usage on weekends, and weekdays, in both summer and winter.

Within each bucket, the Euclidian distance is calculated between each treatment customer and all potential control customers, and then the control customer with the smallest distance is matched to the treatment customer in question. When we minimize the distance metric, we are in essence selecting the control customer who is the most like the treatment customer, in comparison to all other potential controls, across all four of the average seasonal daily usage values. The process is repeated until all the treatment customers in the bucket have a match. Situations often occur where the same control customer is the closest control customer to two different treatment customers. In these cases the distance is calculated between the two treatment customers and their second closest matches, and then the control customer is assigned to the treatment customer with the poorer alternate match (i.e. larger distance to their second closest match). This ensures that when a control is matched to two treatments, the treatment customer who is

[11] Euclidian Distance is defined as the square root of the weighted sum of the squared differences between the four variables and the weights are determined by the percent of weekend to weekdays in each season.

farthest from their second choice gets their first choice, minimizing the total overall distance between all treatments and controls. An example of the matching strategy is shown below in Figure 3-1 for two dimensions (average summer and winter weekday usage). This is done for illustrative purposes, but please note that the actual matching also considered summer and winter weekend usage for a total of four dimensions. Euclidean distances are a valid metric in any number of dimensions.

Figure 3-1 Illustrative Example of Matching Strategy



In the example above, Participant 1 finds its closest match in the control population to be a distance of 13.3 units away.[12] Participant 2 and 3, however, both have their minimum distance criteria satisfied by the same Control point. The next best alternative match for Participant 3 is 11.5 units away, whereas Participant 2's next best alternative match is 18.7 units away. Because Participant 3 can go a shorter distance to its alternative, it graciously steps aside to give Participant 2 its first choice of Control match, and it gets its second choice, 11.5 units away. Once every participant in the treatment group is matched with a unique customer from the control population, the comparison analysis can proceed.

There are two cases in which customers may be matched through a secondary process. The first case consists of CWP customers who began participating in the CWP program prior to May of 2010. These participants do not have enough pre-treatment data on which to match. Therefore, these CWP customers were matched based on the four filters plus the following additional demographic characteristics, tariff, house type, and care vs. non-care, and seven digit zip code (where possible). The second case could apply to either program and consists of participants who could not be matched in the first round of the matching process because the control group pool was too small within a given bucket. These participants, were matched in a second round of matching using the available pre-treatment data but removing all filters except the 5 digit zip code.

[12] The units here happen to be kWh, but it is more appropriate and easier conceptually to think of them as generic units of distance.

3.4 ESTIMATING THE ENERGY SAVINGS FOR BOTH PROGRAMS

As noted in earlier sections, in PY2010 FSC did not report statistically significant savings for either program at the program level. This year, we are able to incorporate the SmartMeter™ interval data, which was not available last year, and more detailed sample stratification which was designed to identify savings in the specific participants groups that are likely to save the most energy. To estimate savings, we use a direct comparison between the treatment and matched control group to estimate savings for both CWP and Energy Alerts. We repeat the direct comparison, both at the program level, and within subpopulations of highly engaged customers. We also use a regression model to estimate daily changes in energy usage for Energy Alerts participants only. Each technique is described below.

3.4.1 Direct estimation

Once the treatment customers have been matched to control group customers the treatment and control groups can be compared to each other during the treatment period. We conduct the comparison in two phases, first looking for statistically significant differences in daily usage between the two groups to determine if statistically significant savings may exist, and second by calculating the weighted average monthly savings for each program during the treatment period.

During the first phase we are simply trying to determine if we can detect savings on a monthly level. Because there is so much variation in energy use, small changes that participants make from day to day might be obscured by the natural variation in usage at the monthly level. However, such small changes might be more easily detected at the daily level. To look for savings at the daily level, we compare the average usage on each day of the year for each treatment stratum to each control stratum. For example, we subtract the average daily usage for the treatment stratum 1, from the average daily usage for the matched control group for stratum 1. We repeat this calculation for each day during the month. Then, for each day, we can determine whether the difference between the treatment and control is statistically significant at a 90% confidence level. If we determine that it is statistically significant, this indicates that we can be 90% certain that the actual savings for the population falls within the confidence interval and is not equal to zero. If fewer than 10% of the days have statistically significant differences then we can conclude that there is no difference between the two groups, indicating a savings of zero for that month.[13] On the other hand, if many more than 10% of the days have statistically significant differences, we can reasonably assume that savings were present, and it might be possible to detect the savings at the monthly level.

In order to estimate the savings at a monthly level, we sum the daily energy for the treatment and control groups individually by month for each stratum. Then we look at the difference between the monthly consumption for each treatment and control stratum and test to see if that difference (savings) is statistically significant at a 90% confidence level. The initial monthly comparison is calculated for each stratum, and then the average per participant monthly savings can be calculated by applying the stratum weights. Finally, the statistically significant monthly estimates can be added together over the course of the year to estimate the annual per participant impact.

When we estimate the savings for each group, it is important to account for the dual participation within each sample. We do this by adding an additional stratification, so to speak, and estimating the savings in two pieces; first for the singly enrolled participants, and second for the dually enrolled participants. The savings from the singly enrolled participants represents the savings from the treatment program only. While the savings from the dually enrolled participants represents the additional savings attributable to the second program for the dually enrolled treatment customers. It is important to note that the estimate of savings for the secondary program is indicative of savings only for dually enrolled customers, since we cannot be sure if

[13] We use a threshold of 10% because given a 90% confidence interval, approximately 10% of the days would be statistically significantly different from zero based on randomness, since they would lie in the tails of the distribution. We would also expect those differences to be randomly up and down, and not systematically positive or negative.

their participation in the first program influences their savings from the second program and vice-versa.

3.4.2 Regression approach

For the Energy Alerts program, we also use a regression approach to estimate daily changes in energy use in response to alerts. It is likely that any savings or change in energy use resulting from receiving alerts will vary by time as follows:

- Energy use changes should be greatest shortly after the energy alerts are received
- Energy use changes should diminish as time passes after the alerts are received
- Energy use changes should be nonexistent in the days preceding the notice

The data used as an input to the regression model consists of daily kWh totals for Energy Alerts sample participants from SmartMeter™ data, participation indicator variables, weather data, and other demographic information. Because the data represents a cross section of participants over time, we use a typical panel data regression approach, the fixed effect model, to control for variation between cross-sections. The fixed effect model, also known as a least-squares dummy variable model, estimates an intercept for each participant. These individual intercepts capture the unobservable characteristics of each participant that we cannot include in the regression model such as, household size, appliance holdings, or tastes and tendencies dealing with energy use. Doing so allows us to get a better estimate of the variables of interest, primarily those associated with alerts and the days following alerts. Because so many of the sample participants are dually enrolled, we also include variables to estimate the impact of viewing usage data via the portal. As mentioned above, these variables will provide an estimate of the incremental savings attributable to CWP views for Energy Alerts customers.

IMPACT RESULTS

4.1 MATCHING RESULTS

Before estimating the savings, it is important to check the quality of the match between the treatment and control customers. We do this in two ways: first we look at the average distance between the treatment and control customers by stratum within each group. Recall that the distance is the square root of the weighted sum of the squared differences between each treatment and control customer for all four of the continuous matching variables.[14] We also look at the percentage difference between treatment and control for the four matching variables. These two measures give us a good idea of how well customers were matched. The subsections below include results for the CWP and Energy Alerts treatment and control groups.

4.1.1 Customer Web Presentment Matching Results

Table 4-1 explains the two guidelines used to stratify the participants: the participant's year of enrollment into the program and the number of times interval data was accessed in 2011.

Table 4-1 CWP Stratification Description

Stratum	Year of Enrollment	Number of Access in 2011
1	2008 – 2009	Once
2	2008 – 2009	2 to 6
3	2008 – 2009	7 to 15
4	2008 – 2009	> 16
5	2010	Once
6	2010	2 to 6
7	2010	7 to 15
8	2010	> 16
9	2011	Once
10	2011	2 to 6
11	2011	7 to 15
12	2011	> 16

We determined the closeness, or observable similarities, between the customers involved in the match by looking at the percentage distance between each day type, on average, for each stratum as shown in Table 4-2. In total, we matched 5,905 participants out of 5,925. We eliminated twenty participants from the sample because we were unable to match them with a reasonably similar control group customer.

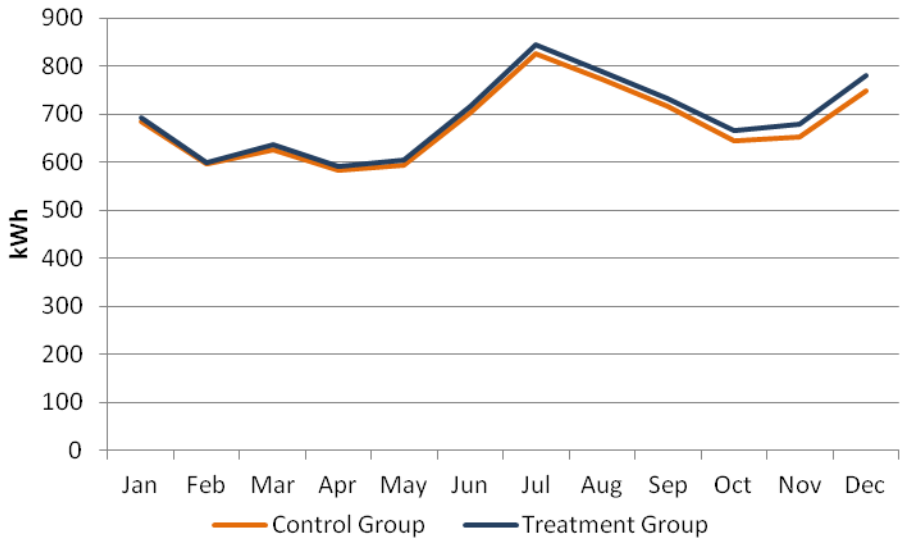
[14] Matching variables include: pre-treatment average daily usage on four day types, summer weekend, summer weekday, winter weekend and winter weekday.

Table 4-2 CWP: Percentage Difference in Closeness between Treatment and Control

Stratum	Number of Matched Pairs	Summer Weekday	Summer Weekend	Winter Weekday	Winter Weekend
5	490	5.16%	6.42%	6.93%	7.31%
6	495	3.38%	5.54%	5.18%	6.31%
7	489	5.48%	5.88%	7.83%	8.65%
8	495	3.10%	3.08%	5.21%	5.04%
9	497	1.97%	2.34%	1.84%	2.21%
10	497	2.18%	3.40%	1.79%	2.12%
11	493	3.18%	3.75%	4.75%	5.44%
12	493	1.76%	2.11%	4.11%	3.72%

On average, the percentage difference between the treatment and control customers is very small. It does not exceed 5.5% on any day-type for those customers who joined in 2011 (strata 9-12). The majority of the differences in this group are 3% or less. These participants had the most available pre-treatment data and therefore have a better match than participants who joined in 2010 (strata 5-8). It is also important to note that while within each stratum individual differences between matched treatment and control customers range from positive to negative, the average percentage differences between the treatment and control are all positive. This indicates that on average, the treatment group uses slightly more than the control group. Because of this, it will be harder to detect small savings in the CWP group, and will result in more conservative estimates of savings. The percent differences for participants who joined the program prior to 2010 (strata 1-4) are not reported in this table because participants in those strata did not have any pretreatment data. They were matched using demographic filters only.

Figure 4-1 CWP: Comparison of 2010 Monthly Usage Treatment vs. Control



To look at the quality of the match for the entire CWP sample at a high level, we present the weighted average monthly usage for the treatment and control groups during 2010 in Figure 4-1 above. Based on the figure, small differences are more apparent toward the end of 2010, with

the control group being on average lower than the treatment group. Still, overall the match between the treatment and control for CWP is very close.

4.1.2 Energy Alerts Matching Results

Table 4-3 explains the guidelines used to stratify the Energy Alerts participants: enrollment prior to or after May 2011 and high or low average summer or winter alerts.

Table 4-3 Energy Alerts Stratification Description

Stratum	Enrollment	Summer Alerts	Winter Alerts
1	After 5/2011	Low	High
2	Prior to 5/2011	Low	High
3	After 5/2011	High	Low
4	Prior to 5/2011	High	Low
5	After 5/2011	High	High
6	Prior to 5/2011	High	High
7	After 5/2011	Low	Low
8	Prior to 5/2011	Low	Low

Again, we determined the closeness of the match by looking at the percentage distance between each day type, on average, for each stratum as shown in Table 4-4. In the Energy Alerts sample we were able to select reasonable matches for 3,526 out of 3,598 participants.

Table 4-4 EA: Percentage Difference between Treatment and Control

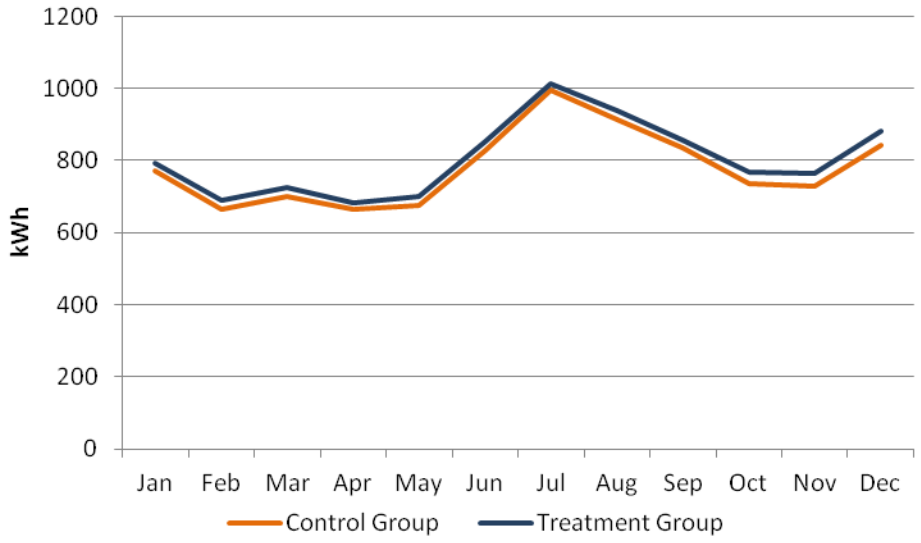
Stratum	Number of Matched Pairs	Summer Weekday	Summer Weekend	Winter Weekday	Winter Weekend
1	843	3.79%	4.82%	4.70%	6.20%
2	576	6.10%	7.09%	7.86%	9.05%
3	333	2.67%	5.10%	-0.54%	0.59%
4	328	3.11%	4.03%	1.28%	1.45%
5	457	4.87%	6.36%	7.47%	7.91%
6	327	1.00%	1.76%	6.51%	7.78%
7	323	1.54%	2.63%	1.84%	1.85%
8	339	-2.64%	-0.53%	-1.19%	0.20%

On average, the percentage difference between the treatment and control customers is fairly small. The majority of the differences are below 5%, and all of them are below 10%. One observation is that the match for the Energy Alerts participants is less consistent than the match for the CWP participants, with some cells being very close to zero and others being nearly 10% different. For the Energy Alert customers, some of the average percentage differences are negative, but the majority are positive. Again, this may make it more difficult to detect small changes in usage related to savings, and tend to overstate increases in usage.

To look at the quality of the match for the entire Energy Alerts sample at a high level, we present the weighted average monthly usage for the treatment and control groups during 2010 in Figure 4-2. For Energy Alerts, the treatment and control are close throughout the year, however the distance between the two groups increases in the winter, where the treatment groups is on average higher than the control group.

Both the percentage differences and the monthly usage comparison indicate that the match for the Energy Alerts program is less optimal than the CWP match. Having a less than optimal match makes savings difficult to detect, in this case because the treatment customers are consistently using more energy than the control group customers.

Figure 4-2 Energy Alerts: Comparison of 2010 Monthly Usage Treatment vs. Control



4.2 CUSTOMER WEB PRESENTMENT RESULTS

The impact analysis for the CWP program demonstrated savings for CWP customers within the subpopulation of customers who accessed the web portal more than 15 times during the program year. The savings was not detectable at the program level, for either singly or dually enrolled participants, or in subpopulations that viewed the web portal less frequently.

4.2.1 Direct Comparison Results

As discussed in the methodology section above, the first phase of the direct comparison was to compare the average daily usage for 2011 by stratum and dual participation in order to look for savings at the daily level. During this initial comparison, we found that many of the days did have statistically significant differences that indicated savings. These differences were especially notable within stratum 12, which contains participants who accessed the web portal more than 15 times in 2011. These initial results indicated that it may be possible to detect savings at the monthly level as well, particularly within the subpopulation of customers who accessed the web portal more frequently.

The most conservative estimate of savings is weighted average difference between the treatment and control group for the entire program. Table 4-5, and accompanying Figure 4-4, Figure 4-5, and Figure 4-6 show the weighted average difference for the total program, the singly enrolled participants, and the dually enrolled participants.

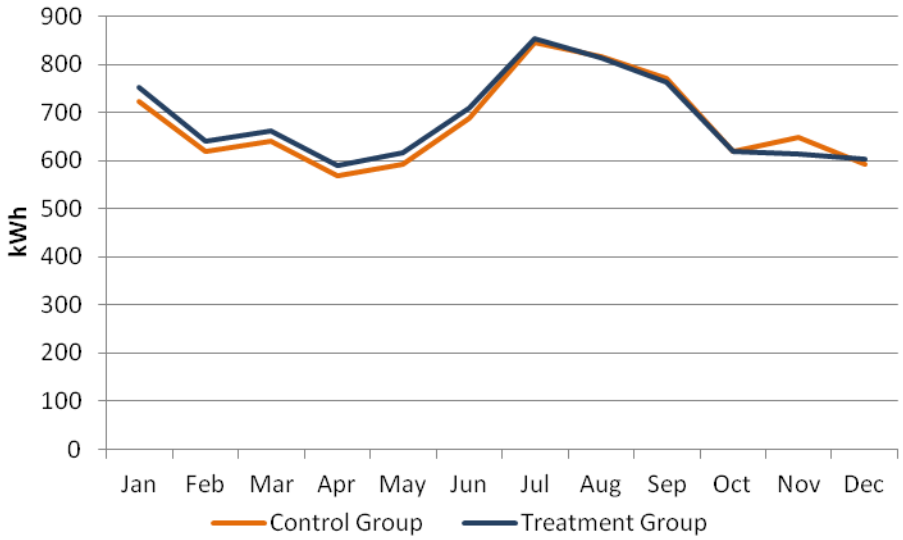
Table 4-5 below shows the weighted average per customer monthly differences between the control and treatment groups for all participants, singly enrolled participants, and dually enrolled participants. A positive difference indicates savings in the treatment group, and a negative difference indicates higher usage in the treatment group. Statistically significant differences are highlighted in blue. At the program level only three of the 36 months can be considered statistically different from zero, and only two of those differences are positive. While there appears to be a statistically significant savings in November, this difference results from an

anomaly in the control group during that month, rather than a reduction in the treatment group. This anomaly can be seen in the participant population in Figure 4-3 which compares the monthly average usage for the treatment and control groups during the program year.

Table 4-5 CWP: Difference between Treatment and Control – Program level

Month	All Participants n= 6,000	Singly Enrolled n= 4,462	Dually Enrolled n= 1,583
January	-26.82	-25.28	-35.74
February	-16.24	-17.58	-10.59
March	-9.54	-11.19	-2.60
April	-13.59	-11.19	-23.68
May	-13.46	-9.59	-29.78
June	0.38	4.19	-15.66
July	12.51	16.01	-2.26
August	4.47	4.04	6.25
September	10.62	10.21	12.33
October	-0.24	2.01	-9.77
November	33.65	41.31	1.35
December	-9.32	-5.66	-24.77

Figure 4-3 CWP: Comparison of 2011 Monthly Usage Treatment vs. Control



The three figures below illustrate the monthly difference between treatment and control groups graphically as presented in Table 4-5 including the upper and lower 90% confidence intervals. In each figure, for nearly all months the confidence intervals include zero, which indicates that statistically significant savings for CWP cannot be detected at the program level, for dually enrolled, singly enrolled, or all participants.

Figure 4-4 Average per customer difference – All participants

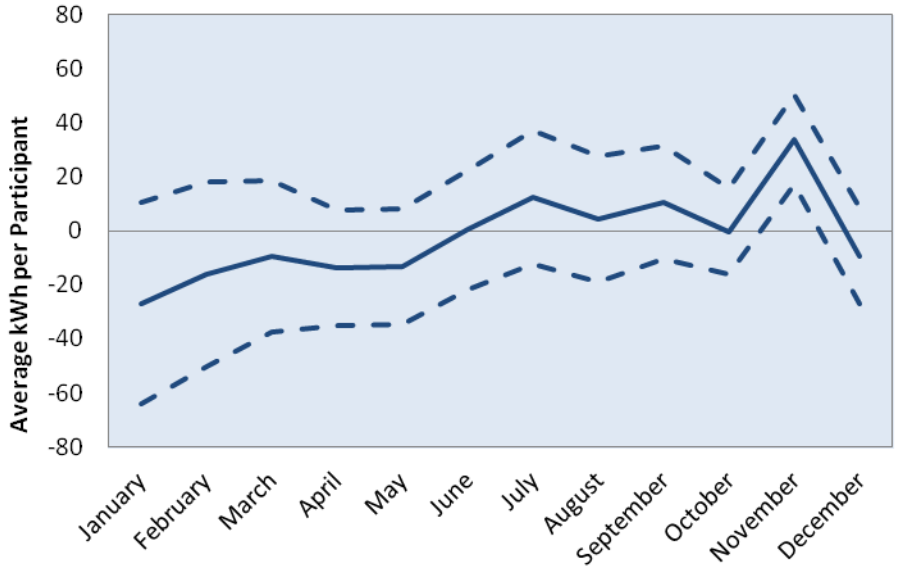


Figure 4-5 Average per customer difference – Singly Enrolled Participants

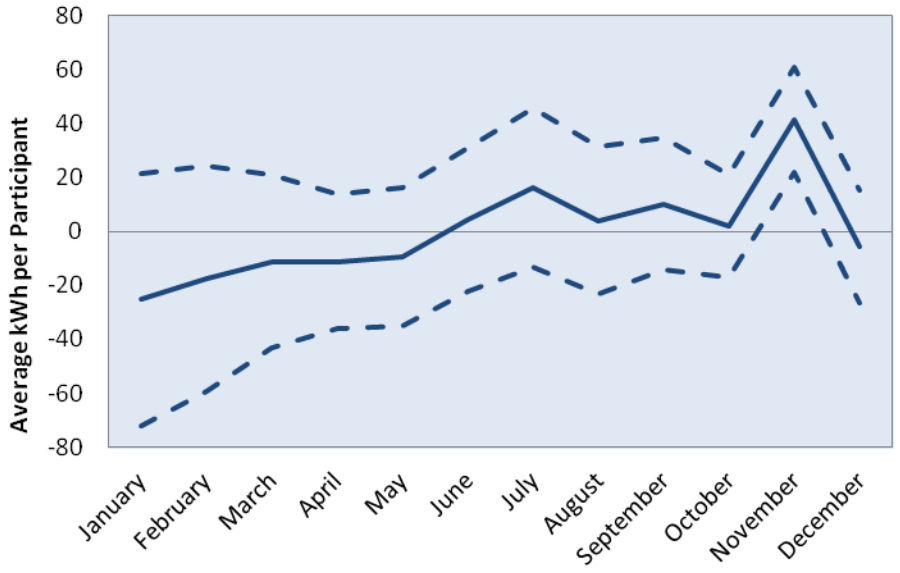
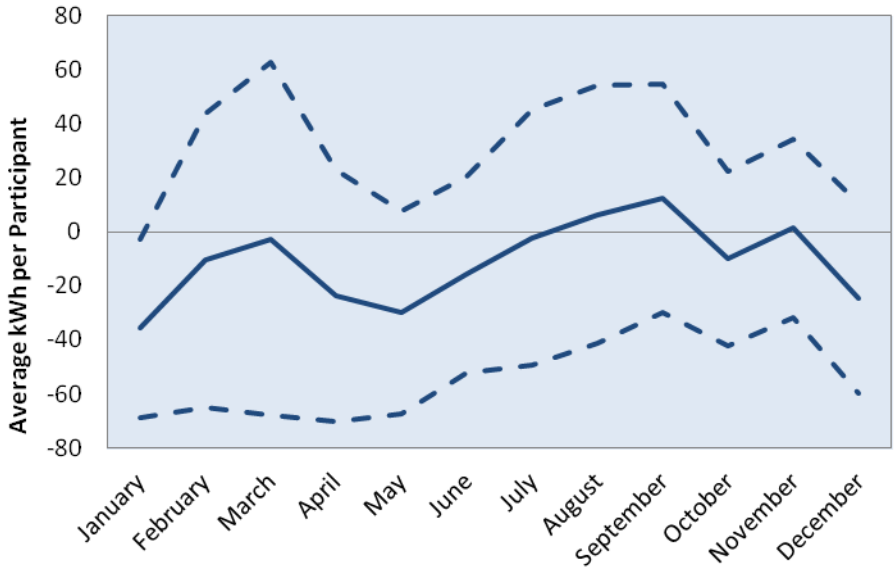


Figure 4-6 Average per customer difference – Dually Enrolled Participants



While we cannot detect statistically significant savings at the population level, our analysis of the daily differences does indicate that CWP participants are savings energy. Therefore we also estimate the monthly savings for three subpopulations:

- Participants who accessed the web portal more than 15 times in 2011 including Strata 4, Strata 8, and Strata 12.
- Participants who accessed the web portal more than 6 times in 2011 including Strata 3 and 4, Strata 7 and 8, and Strata 11 and 12.
- Participants who accessed the web portal more than once in 2011 excluding Strata 1, Strata 5, and Strata 9.

Of the three subpopulations we expect to see the most savings in those who accessed the web portal most often and the least savings, if any, when we include participants who accessed the web less often.

Table 4-6 shows the weighted average per customer monthly difference between treatment and control for the subpopulation of customers who viewed the web portal more than 15 times in 2011. Again, statistically significant differences are highlighted in blue. In this subpopulation we can clearly see a significant savings occurring in the treatment customers. The savings is approximately 40 kWh per statistically significant summer month and 30 kWh per statistically significant winter month. When looking at the difference between the singly and dually enrolled customers, it is apparent that while the savings estimates for dually enrolled customers are not dramatically different from the savings estimates for singly enrolled customers, their smaller sample size results in an inability to detect statistically significant results. This does not necessarily mean that dually enrolled customers are not saving energy, in fact Figure 4-10 suggests that they are conserving, however we are not able to separate the savings from the variation in the sample.

Table 4-6 Difference between treatment and control group: Viewed > 15 times

Month	All Participants n= 1,500	Singly Enrolled n= 1,007	Dually Enrolled n= 493
January	-26.34	-21.52	-35.21
February	-4.99	-7.88	0.34
March	-0.66	2.13	-5.79
April	1.37	6.38	-7.84
May	7.83	16.12	-7.41
June	26.20	35.30	9.46
July	46.67	52.96	35.09
August	46.77	53.46	34.46
September	55.48	57.79	51.23
October	24.64	30.67	13.54
November	31.82	38.00	20.46
December	-2.90	5.75	-18.83

Figure 4-7 2011 Monthly use treatment vs. control viewing > 15 times

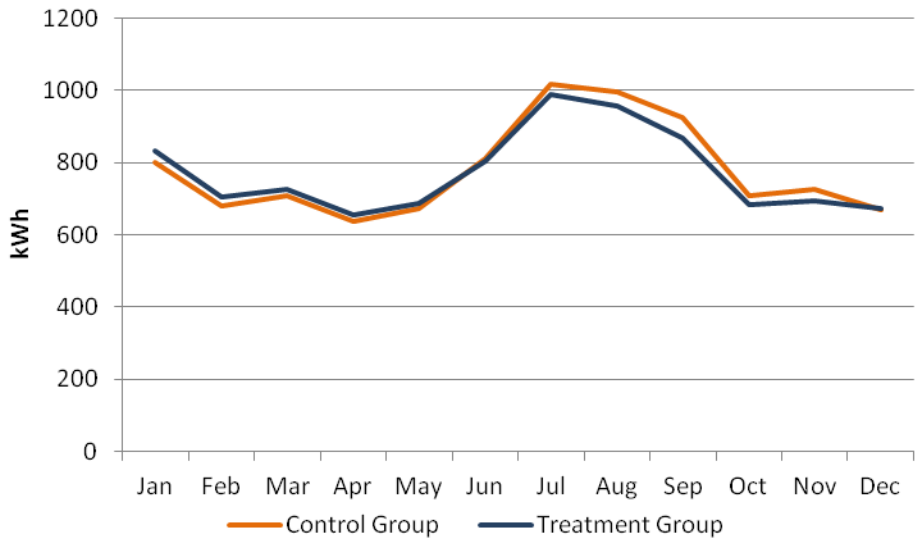


Figure 4-7 shows the weighted average monthly usage for both the treatment and the control group at the program level during 2011. During the winter months, the treatment is slightly higher than the control group and during the summer months the treatment is noticeably lower than the control group.

Figure 4-8, Figure 4-9, and Figure 4-10 show the differences in Table 4-6 graphically including the upper and lower 90% confidence intervals.

Figure 4-8 Average per customer difference – All participants viewing > 15 times

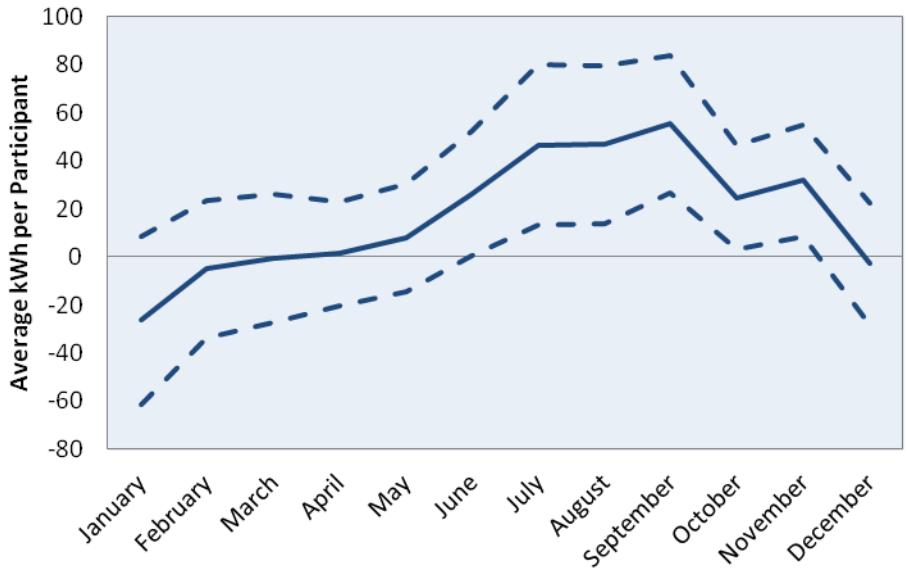


Figure 4-9 Average per customer difference – Single participants viewing > 15 times

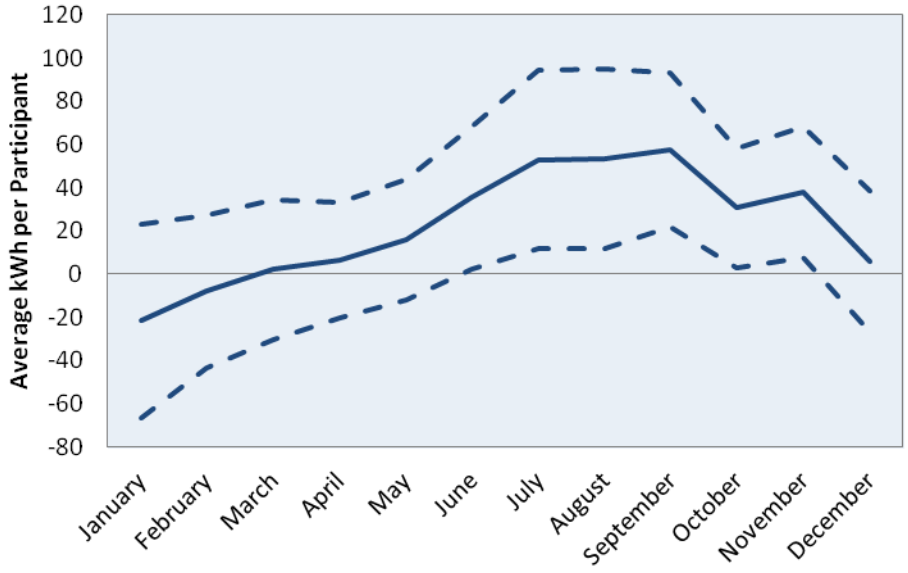


Figure 4-10 Average per customer difference – Dual participants viewing > 15 times

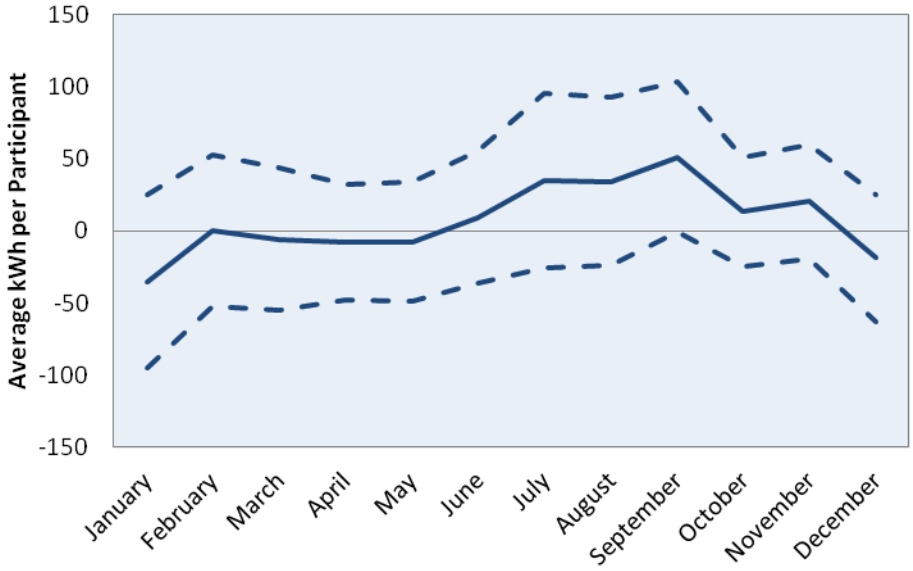


Table 4-7 shows the monthly difference between treatment and control for the subpopulation of customers who viewed the web portal more than 6 times in 2011 with the statistically significant differences highlighted in blue. By including participants who view the web portal less often we see a reduction in the number of months with significant savings. Overall, only four months show significant differences with savings occurring only in November and September. The savings in November based on Figure 4-3, is most likely an anomaly in the data rather than true savings. In addition, the actual savings estimates were cut nearly in half, from 40 kWh per month in the subpopulation of participants who viewed the data more than 15 times to about 25 kWh per month here. Based on these results, we suspect that the savings we see in this subpopulation, of all customers viewing their data more than 6 times, are driven largely by those participants viewing their data more often.

Table 4-7 Differences between treatment and control group: Viewed > 6 times

Month	All Participants n= 3,000	Singly Enrolled n= 2,062	Dually Enrolled n= 938
January	-28.03	-30.04	-23.95
February	-25.47	-22.58	-31.34
March	-20.05	-12.74	-34.92
April	-15.30	-15.34	-15.23
May	-13.82	-8.85	-23.92
June	-10.26	-1.09	-28.89
July	2.38	16.90	-27.15
August	5.78	8.52	0.22
September	23.94	26.24	19.26
October	8.09	12.10	-0.07
November	22.88	32.34	3.65
December	-8.48	-3.08	-19.45

Figure 4-11, Figure 4-12, and Figure 4-13 show the differences in Table 4-7 graphically including the upper and lower 90% confidence intervals.

Figure 4-11 Average per customer difference – All participants viewing > 6 times

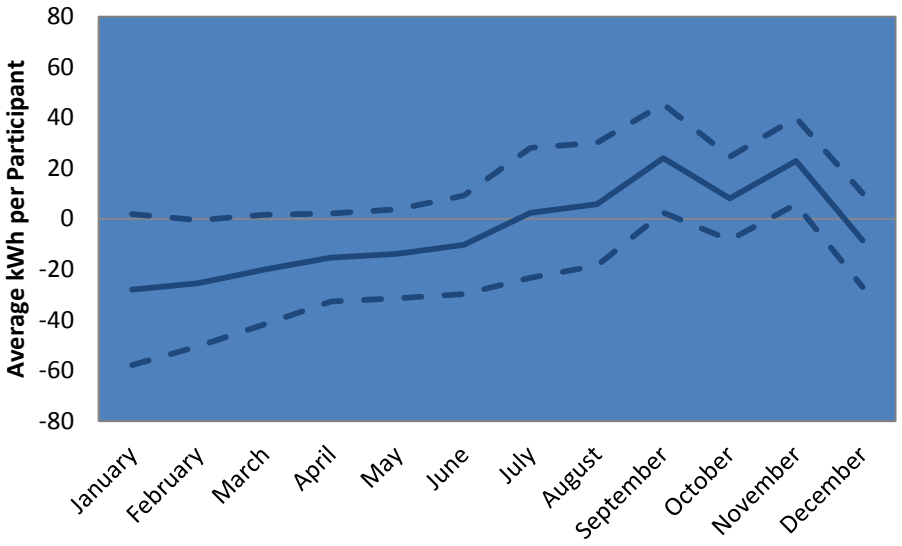


Figure 4-12 Average per customer difference – Single participants viewing > 6 times

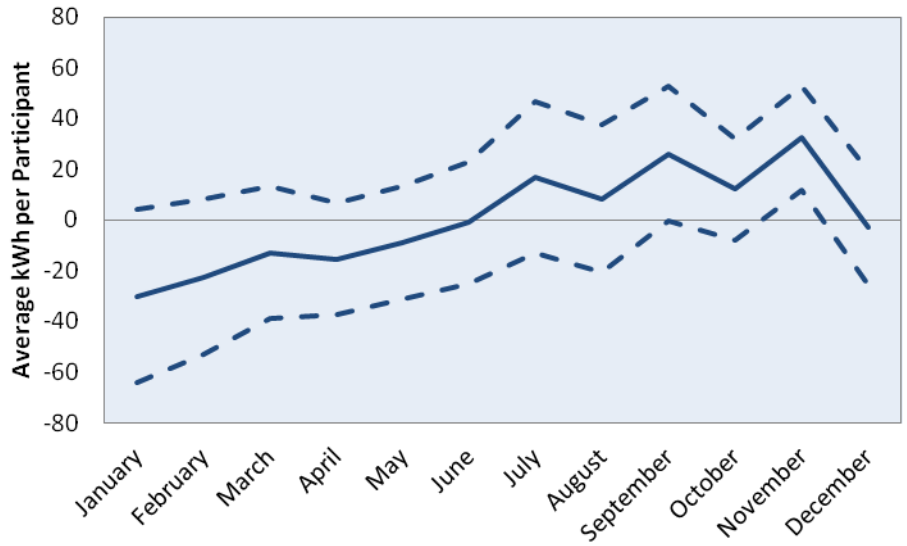
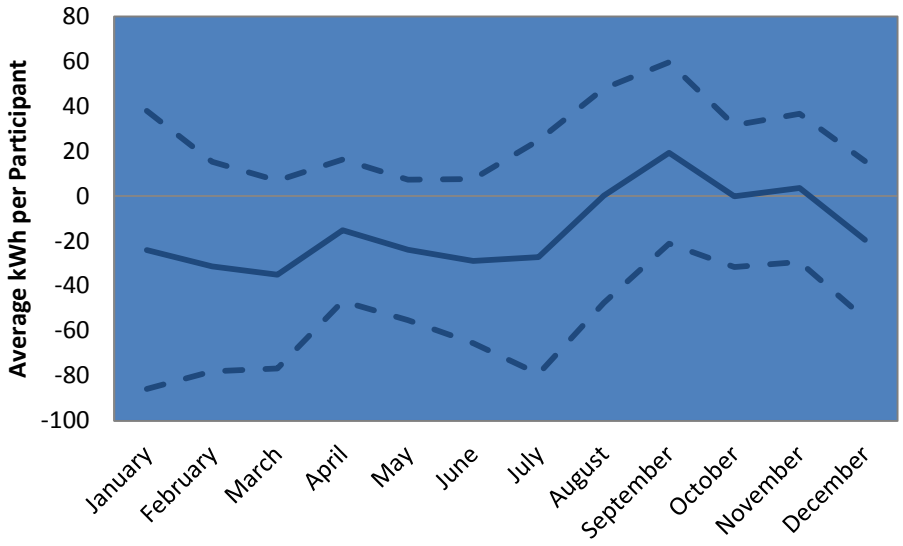


Figure 4-13 Average per customer difference – Dual participants viewing > 6 times



Finally Table 4-8 shows the weighted average per customer monthly difference between treatment and control for the subpopulation of customers who viewed the web portal more than once in 2011 with the statistically significant differences highlighted in blue. As expected, as we continue to include more participants who view the web portal less often we see an increasing reduction in the number of months with significant savings. In this case we can only identify three months of savings, with two of those months occurring in November. Again, the average savings remains small at approximately 33 kWh per month. We suspect that the savings we see in this subpopulation is driven largely by those participants viewing their data more often.

Table 4-8 Differences between treatment and control group: Viewed > 1 times

Month	All Participants n= 4,500	Singly Enrolled n= 3,160	Dually Enrolled n= 1,340
January	-22.43	-16.04	-40.54
February	-19.63	-18.46	-22.97
March	-12.97	-10.37	-20.32
April	-7.47	-6.39	-10.55
May	-8.42	-8.08	-9.36
June	3.10	2.39	5.09
July	12.71	13.69	9.90
August	9.24	-0.46	36.75
September	16.88	9.69	37.28
October	4.11	-1.81	20.90
November	29.25	31.24	23.60
December	-10.61	-11.33	-8.57

Figure 4-14, Figure 4-15, and Figure 4-16 show the differences in Table 4-8 graphically including the upper and lower 90% confidence intervals.

Figure 4-14 Average per customer difference – All participants viewing > 1 time

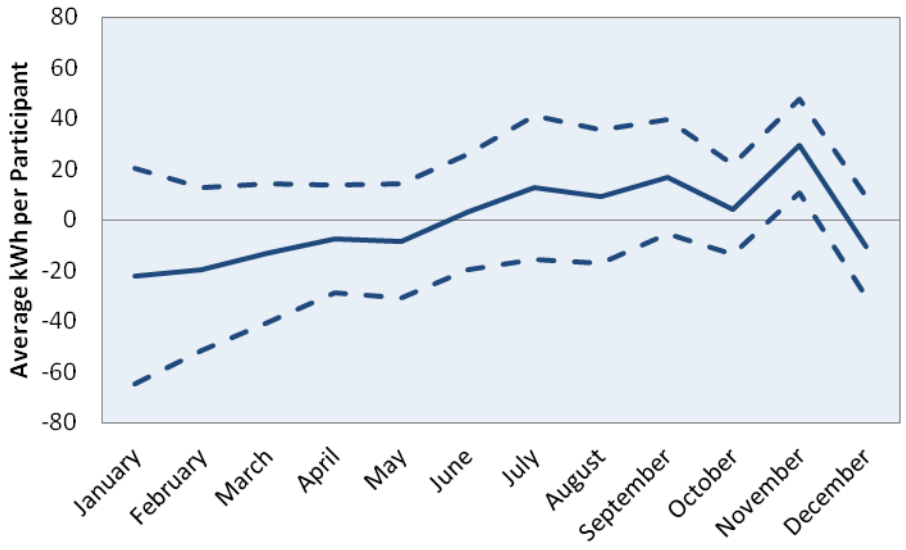


Figure 4-15 Average per customer difference – Single participants viewing > 1 time

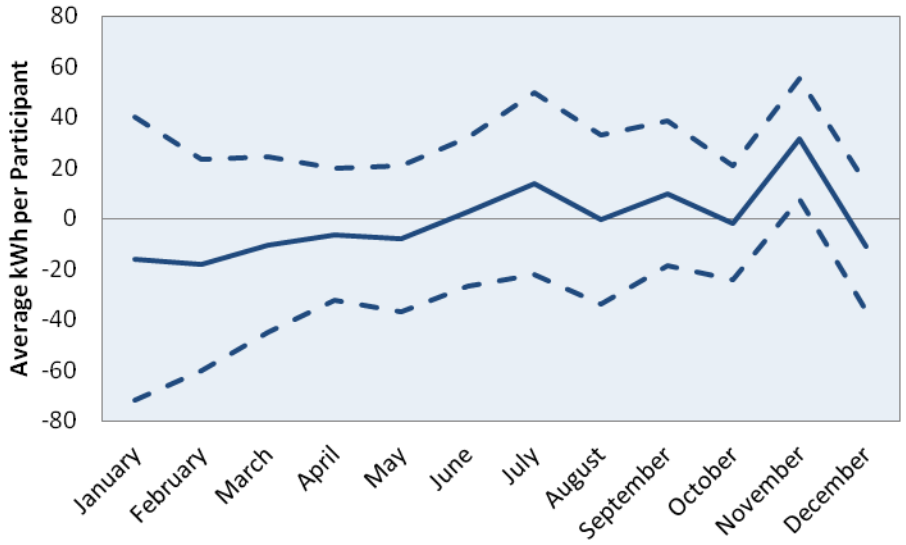
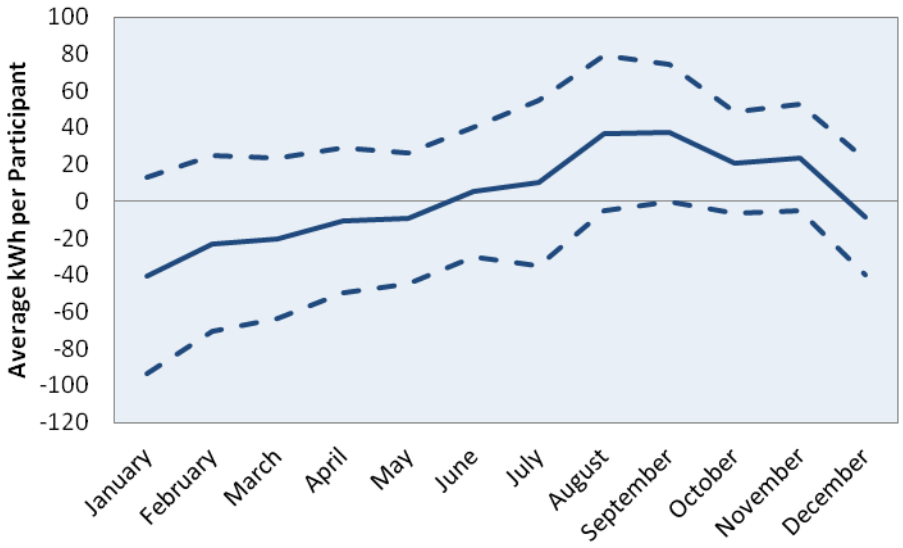


Figure 4-16 Average per customer difference – Dual participants viewing > 1 time



4.2.2 Estimating Program Level Savings

Based on the analysis of both the entire sample and the subpopulations presented above, the final step of the impact analysis is to present the cumulative CWP savings for the entire program. In order to do this we make an important assumption; customers who view the web portal less than 15 times per year are either not saving energy, or their savings is too small to be estimated given the variation in usage within the sample. The patterns we see in Figures 4-10 to 4-15, with positive differences in the summer and negative differences in the winter, do seem to indicate that those customers might be conserving. However, because the savings is not consistently statistically significantly different from zero we estimate savings for only the subpopulation of customers viewing the web portal most often, and assume that savings cannot be estimated for the remaining participants.

Based on these assumptions the savings for the CWP program is presented in Table 4-9, for all participants, singly enrolled participants, and dually enrolled participants. We calculate the annual savings by summing all of the statistically significant monthly savings for a particular group over the course of the year. We do not include a calculation of annual savings for dually enrolled participants because we were not able to detect any savings in that subgroup.

Table 4-9 CWP Savings: Participants with > 15 views per year

	All Participants N=8,279	Singly Enrolled N=5,364
Annual Savings (kWh)	232	268
Average Annual Usage (kWh)	9,348	9,276
Percent savings	2.48%	2.89%
Total Savings (kWh)	**1,917,251**	**1,438,518**

The savings attributable to this subgroup are consistent with estimates of savings from other industry conservation programs, falling in the 1-3% range. However, because these savings were calculated as the sum of the statistically significant monthly savings, it is very difficult to establish a confidence interval for these estimates. We were able to detect these very small changes in usage because at the monthly level they were significant but if we were to estimate savings on an annual basis this small savings would almost certainly be swallowed up in the seasonal variation of the group. Recall also that because we used a quasi-experimental design,

rather than a true experimental design, there is a certain degree of uncertainty surrounding these estimates.

It is also very important to note that these percentages are only valid for those participants who view the website often. These participants represent a unique subgroup of about 4% of the CWP population that is likely to be eager to learn more about energy use and also likely to be actively looking for ways to manage usage. Because of their unique interest in energy, these customers likely respond to the information presented in a different way than others in the population, and as a result save more energy.

It would not be reasonable to conclude that encouraging other participants to use the web more often, would result in similar savings in those other participants. This type of participant is analogous to an early adopter, and it is not appropriate to extrapolate the savings estimates from this group to participants in other groups. The fundamental differences in preferences between participants who access the web portal only once and those who access the web portal on a regular basis result in fundamental differences in their response to the program and their resulting savings. This dichotomy of participants who are high responders and those who are low responders is often observed in utility programs, regardless of type, where a relatively small group is responsible for the majority of the savings.

4.3 ENERGY ALERTS RESULTS

The impact analysis for the Energy Alerts program was unable to demonstrate savings for Energy Alerts customers using either a direct comparison, or a regression method.

4.3.1 Direct Comparison Results

The first phase of the analysis compared the treatment and control average daily usage for 2011 by stratum and dual participation in order to look for savings at the daily level. During this initial comparison we found that many of the days did have statistically significant differences. However, there were a nearly equal number of positive and negative differences. The large number of both positive and negative differences indicated that we were capturing differences resulting from a less than optimal match, rather than differences representing actual savings.

While these initial results indicated a lack of savings for the Energy Alerts program, we looked for savings at the program level by calculating the weighted average difference between the treatment and control group for the entire program in Table 4-10 and illustrated graphically in Figure 4-17.

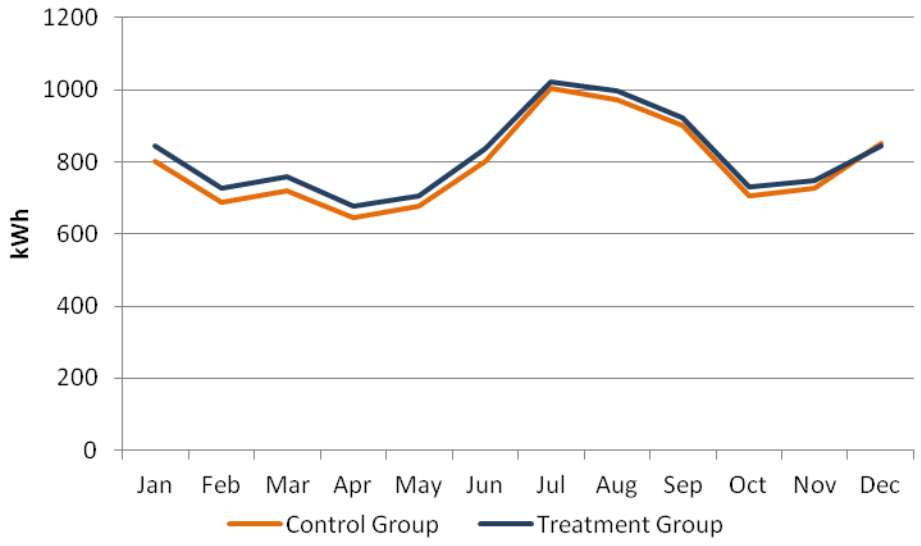
Table 4-10 below shows the weighted average per participant monthly differences between the control and treatment groups for all participants, singly enrolled participants, and dually enrolled participants. A positive difference indicates savings in the treatment group, and a negative difference indicates higher usage in the treatment group. Statistically significant differences are highlighted in orange. Contrary to the results in the CWP group, nearly all the statically significant differences between the treatment and control groups are negative. We believe that these differences are due to a less than optimal match in the pre-treatment period, not due to changes in the participant's usage as a result of the program.

Based on both the daily and the monthly results, we cannot identify any statistically significant savings resulting from the Energy Alerts program. In this program, the quality of the match may be an issue that is preventing us from identifying those savings.

Table 4-10 Differences between treatment and control group: All EA participants

Month	All Participants n= 3,674	Singly Enrolled n= 1,583	Dually Enrolled n=2,091
January	-20.93	-26.11	-14.21
February	-27.90	-28.34	-27.33
March	-29.29	-29.00	-29.66
April	-24.88	-23.10	-27.19
May	-22.79	-15.50	-32.24
June	-8.30	-4.82	-12.55
July	-2.40	-3.37	-1.20
August	-4.35	-2.52	-6.59
September	-11.70	-22.00	0.92
October	-19.09	-21.16	-16.56
November	-20.87	-30.57	-9.00
December	4.15	-17.21	30.32

Figure 4-17 Energy Alerts 2011 Monthly usage treatment vs. control



4.3.2 Regression Analysis Results

The daily regression analysis conducted for the energy alerts customers yielded results that were consistent with the results of the direct comparison. The regression approach was unable to detect any statistically significant changes in daily usage resulting from receiving an alert. Two different methods were used to attempt to detect savings. First we estimated a fixed-effect model, and second we estimated customer specific regression models for each participant during the pre and post-treatment periods. While we did see evidence of individual customers reducing their consumption in response to alerts, that proportion was very small relative to the entire population of participants, less than 5%. A proportion this small could be actual savings, but also falls within the realm of random variation. We must therefore conclude that any savings from the program, if they exist, are too small to be detected using the regression approach.

RECOMMENDATIONS

Our analysis of both the Energy Alerts and Customer Web Presentment programs has lead to three recommendations for future evaluation activities.

1. Due to the large number of dually enrolled customers, we recommend implementing an additional sample in future program years to analyze the effects of dual enrollment and single enrollment separately. This third sample would consist of only dually enrolled customers, and would examine the combined savings of both programs for participants who are enrolled in both programs.
2. Statistically significant results from the CWP analysis indicate that the CWP analysis may be enhanced through the use of a daily regression model to estimate the effect on daily usage of viewing the web portal information in the days immediately following a web portal view. We recommend developing such a model in future evaluation of the CWP program. A daily regression model may also allow for better detection of results than a matched control group method.
3. Marketing the CWP program to early adopters may increase program savings. As noted above, the subgroup responsible for the savings in this evaluation year was comprised of those customers who access the web portal often. These types of customers are eager to learn about and manage their energy usage. Ensuring that the program is marketed to this particular group of customers may encourage more of them to take advantage of the tools that PG&E offers and decrease their energy consumption.
4. Although enrollment in Energy Alerts has more than doubled from about 30,000 customers in 2010 to more than 73,000 in 2011, the current evaluation methods have not been able to detect electricity savings for the program participants. Offering some additional form of feedback for the Energy Alerts customers may help them to save more energy. Additionally, encouraging them to also use the CWP tools might help them to better manage their usage (and get feedback) in response to alerts.
5. We have noted in the report that the treatment group for both programs is on average, consistently higher than the control group. This indicates that we tend to match treatment customers with control customers that are too small for them. This makes it difficult to detect savings in the treatment customers, but it also indicates that there is some bias in the match. The bias could be related to self-selection bias, in that treatment customers tend to use more energy than their peers. The bias could also be introduced in the matching process itself, through either seasonal effects that are not being properly captured or the use of AC propensity in the matching strategy. AC propensity is an estimate, and subject to its own uncertainty, variance, and possibly bias. We recommend digging deeper into this issue in next year's evaluation to attempt to uncover the sources the bias and isolate it if possible.

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- Our Program Implementation team leverages EnerNOC's deep "behind-the-meter expertise" and world-class technology platform to help utilities create and manage DR and EE programs that deliver reliable and cost-effective energy savings. We focus exclusively on the commercial and industrial (C&I) customer segments, with a track record of successful partnerships that spans more than a decade. Through a focus on high quality, measurable savings, EnerNOC has successfully delivered hundreds of thousands of MWh of energy efficiency for our utility clients, and we have thousands of MW of demand response capacity under management.
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