What Do We Know About Comparative Energy Usage Feedback Reports for Residential Customers?

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Abstract

This paper gathers and organizes findings from all publicly available large-scale, independent evaluations of comparative energy use feedback programs in the United States to assess how they have worked and the extent to which those studies validate underlying program theories. Comparative feedback programs such as Opower and Efficiency 2.0 provide monthly or quarterly reports to customers that compare their metered energy use to average consumption among their neighbours. These comparisons are meant to stimulate attention to energy use and adoption of energy efficiency measures and behaviours. The design of the reports relies on theories of behavioural influence that identify validation of recommended actions through reference to the actions of others in a similar situation– "social norming" -- as an effective strategy.

Assessment of evaluations reviewed here yields the following key conclusions:

- Customers assigned at random to receive comparative feedback reports reduce their annual consumption by a measurable amount, usually in the range of 1 – 3 percent, compared to counterparts who do not receive the reports.
- Savings persist and often grow through the second program year, and continue to be positive in the third year.
- Savings increase with frequency of reports.
- Surveys of recipients and counterparts (control group members) do not yield large or consistent patterns of differences between them in energy-related behaviour.
- Recipients find the comparative aspect of the reports useful, but evidence on customer perception of program influence is inconclusive.

Introduction

Comparative Energy Use Feedback Programs

Beginning in 2008, energy efficiency program sponsors in the United States began to field comparative energy use feedback programs, generally as one element of a more extensive portfolio of programs to promote the adoption of energy-efficient products, services, and behaviours among residential customers. These programs were designed to provide information and advice to customers, with the object of inducing them to adopt one or more activities out of a range of potential energy saving behaviours.

Comparative feedback programs are generally operated by turnkey program vendors. Opower is the most visible of these vendors and has had programs in the field the longest. However, significant competition is developing from both start-up and established companies. The key elements of the program approach are fairly consistent from one vendor to another, and include the following.

- **Home energy reports with comparisons to neighbours' energy use:** Periodically, the program vendor processes the client utility's energy bills into individual home energy reports for the customers in the program. The report contains the following features:
  - A comparison of the customer's billed energy use in the prior month to average

use by neighbours, defined operationally as customers within a certain distance of the customer's home.
  - A chart showing the same comparison for the previous twelve months.
  - A verbal or graphic description of the recipient's performance such as "Great, Good, Below Average" or a happy or sad emoticon.
  - Financial costs or benefits associated with actual consumption versus the neighbours' average.
  - Tips for reducing energy use.

Figure 1 displays an example of a home energy report produced by the Opower system.

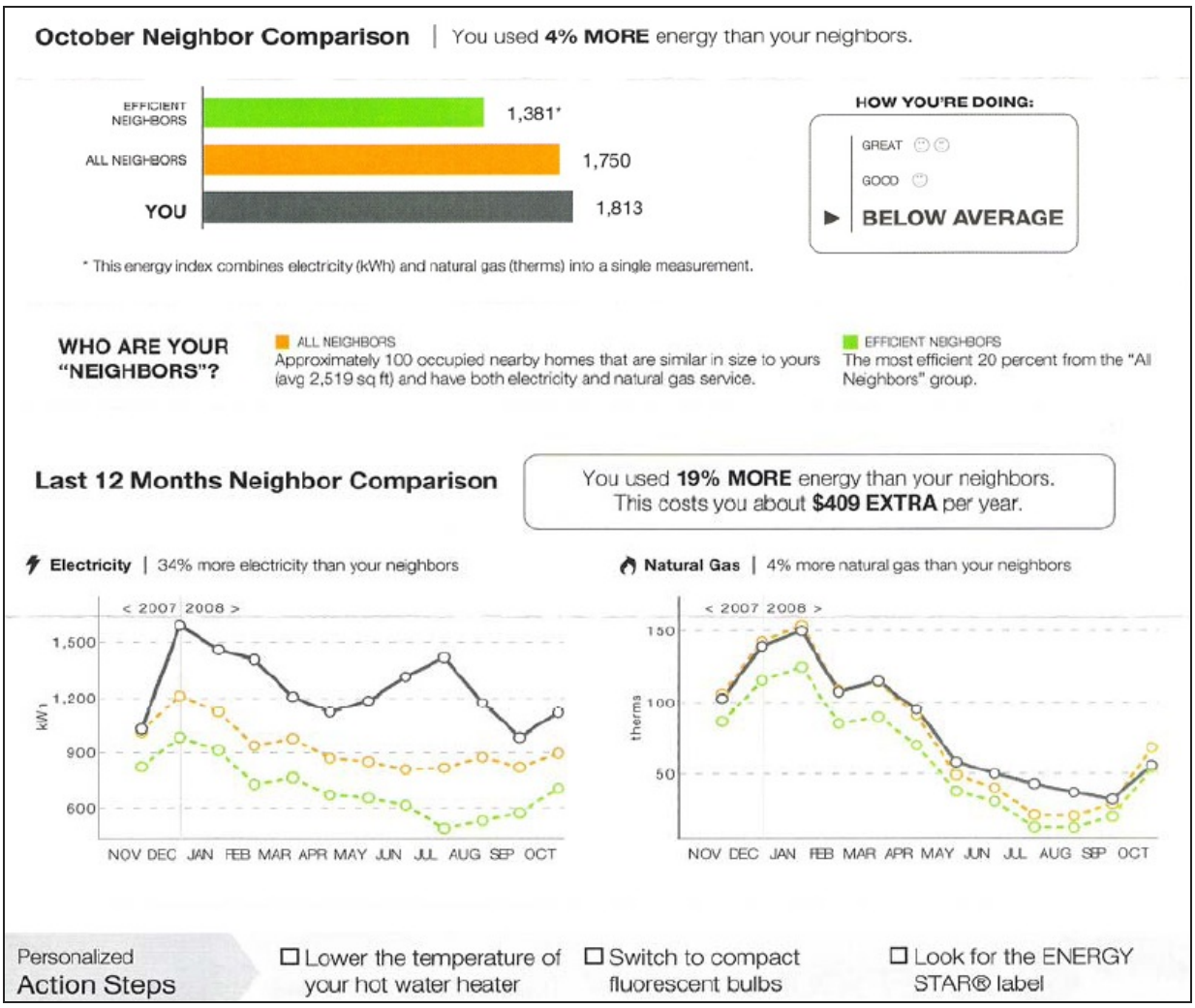


Figure 1. Example of a Home Energy Report

- **On-going feedback.** Most programs provide customers with monthly reports. Program vendors and sponsors have experimented with different periods of reporting, including quarterly, to assess whether the frequency of the reports affects. They have also monitored consumption patterns among customers whose reports have been suspended for a longer period to assess the persistence of savings over time.
- **Random assignment of customers to treatment groups.** The program design obviates the need for customers to make voluntary efforts to enroll, such as filling out an application, responding to a survey, or buying something. This feature enables random assignment of customers to a treatment group (those who receive the reports) and a

control group (those who do not), and thus the application of experimental designs in assessing program effects. The expected levels of average energy savings from the program are small in comparison to baseline consumption levels. Therefore, the use of experimental designs to control for the effects of potential influences on consumption other than inclusion in the treatment group is critical for discerning program effects through analysis of billed consumption over time.

Theoretical Underpinning for Comparative Feedback Program Designs

The design of comparative feedback programs is motivated to a large extent by findings of social psychology research and experiments on the relationships between social norms, messaging, and environmentally-responsible behaviour. Experiments reported in Cialdini (Cialdini 2003) point to the conclusion that focusing on social norms in messaging is an effective strategy to promote sustainable behaviour. According to Cialdini, social validation of recommended actions by a reference group of acknowledged peers is one of the six major mechanisms by which influence can be exerted over large groups. Other major mechanisms include appeals to authority, reciprocity, previous publicly-made commitments, scarcity, and fellow feeling. (Cialdini 2009)

Schultz et al. (Schultz et al. 2007) conducted an experiment that tested the efficacy of using social norms to stimulate energy efficiency behaviour. The researchers picked houses at random and then divided them into groups depending on whether their energy consumption was higher or lower than the average for that area. The researchers sent reports to a randomly-selected group of low-energy-use households containing only information about average energy usage in the neighbourhood, thereby setting the social norm. A second group of low-energy households received reports with a positive emoticon (happy face) positioned next to their personal energy use information, conveying approval of their energy footprint. A third group of households with higher-than-average consumption were shown their energy usage coupled with a negative emoticon (sad face), intended to convey disapproval.

The researchers then measured energy consumption in the following months. The over-consuming households reduced their energy use, but under-consuming households that had received only the social norm information increased their energy use. Importantly, though, the under-consuming households that had received positive feedback did not increase their consumption. Many of the messaging strategies examined in this and similar studies have made their way into Opower and similar products.

Proliferation of Comparative Feedback Programs

Utilities have responded strongly to the potential value offered by the comparative feedback report approach. Opower reports contracts with 60 utility companies in the United States and is currently initiating a pilot implementation with a company in the United Kingdom. Efficiency 2.0 reports contracts with several major utilities in New York and California. These companies and others have begun to introduce new features and approaches in response to competition and customer needs. These changes include provisions for voluntary participation outside of initial trials, detailed on-line audits customizable to the customer's home, and feedback points redeemable for discounts on merchandise. All of this activity will produce a rich set of results regarding the response of various sets of customers defined by geography, climate, housing type, and baseline consumption patterns to a wide range of offerings. In the meantime, the available independent evaluations of feedback programs can help us understand what they have achieved to date, and what questions we should be asking of them in the future.

Findings of Completed Evaluations

To date, the sponsors of three large comparative feedback programs have released the results of professional, independent evaluations to the public. The sponsors of these programs are Sacramento Municipal Utilities Department (SMUD), Puget Sound Energy (PSE), and a consortium of Massachusetts electric and gas utilities (MA).[1] Each of these programs used the Opower platform. In the paragraphs below, we summarize the methods and basic findings for these studies, focusing on results that address the following questions of interest to energy efficiency program administrators.

- To what extent do reductions in energy use observed in the first year of participation persist in later years?
- What effect do changes in details of program deployment, such as the frequency and format of reports, have on savings achieved?
- Which customer attributes are associated with high levels of savings through participation in feedback programs? Can these differences be reflected in strategies to increase program savings and cost-effectiveness?
- Through what specific actions do program participants achieve energy savings?
- To what extent does information and feedback received through the program stimulate recipients to participate in other energy efficiency programs? Are these savings incremental to what the other programs would otherwise have achieved?
- To what extent are customer responses to the program consistent with the theories of influence discussed above.

Study Methods

Table 1 displays information on the completed evaluations whose reports are available to the public as of this writing.

Table 1. Overview of Feedback Program Studies

Sponsor/ (References)	Region	Evaluation Period	Fuels	Data Collection & Analysis	Sample Sizes
SMUD (Summit Blue 2009; Navigant Consulting 2011)	Sacramento CA & environs	4/2008 – 9/2009	Electric only	Billing Analysis Treatment Control	 ~35,000 ~50,000
Massachusetts (MA) (Opinion Dynamics Corporation & Navigant Consulting 2011)	Massachusetts	10/2009 – 10/2010	Electric & Gas	Billing Analysis Treatment Control Customer Survey Cross participation records analysis	 ~25,000 ~25,000 1,002
Puget Sound Energy (PSE) (KEMA 2010; KEMA 2012)	Pacific Northwest	10/2008 – 6/2010	Electric & Gas	Billing Analysis Treatment Control Customer Survey Cross participation records analysis	 31,618 40,007 1,369

1 Academic researchers have also analyzed savings from the SMUD experiment (Alcott 2009; Ayers et al. 2009). Alcott had had access only to a relatively small number of treatment and control observations, but arrived at findings similar to the larger study. Ayers et al. appear to have had access to the full data set, but not to the same range of modeling facilities available to the professional evaluators. We draw on findings from these studies where relevant but do not present them in detail.

The studies contained the following elements.

- ***Analysis of bill data to estimate treatment effects.*** All three studies used analysis of billing data to estimate savings associated with assignment to the treatment group. Each study team applied a number of different methods, including simple comparisons between treatment and control groups of changes in average consumption over time ("difference of differences"), ordinary least squares regression to estimate consumption changes associated with inclusion in the treatment group, and pooled time-series cross-sectional approach, which, at least theoretically, controls most effectively for the effect on the savings estimate of potential systematic differences between the treatment and control groups that may persist after random assignment. In practice, the results of the difference of difference and pooled approaches were used most often to represent savings. ***Customer surveys.*** The PSE and MA studies included surveys of customers in the Treatment and Control groups, and focused on identifying the energy efficiency actions both groups took in the post-treatment period.
- ***Cross-participation analysis.*** The PSE and MA studies included analyses of participation in other energy efficiency programs by customers in the Treatment and Control groups, using the cross-referencing of account numbers from the billing analysis to databases of participants in other programs.

Estimates of Annual Savings

Table 2 summarizes the key findings of the three studies in regard to average annual savings associated with inclusion in the treatment group, and these are the savings after accounting for the energy use of the control group. Average annual electric savings associated with inclusion in the Treatment group ranged from 1.61 percent to 2.13 percent of pre-treatment use. The two programs with gas customers registered average annual savings of 0.77 percent and 1.33 percent. Given the large sample sizes, the confidence intervals around the average estimates were fairly narrow – ranging from 6 to 12 percent of the estimated savings.

Table 2. Summary of First-Year Annual Energy Savings Estimates, with *Confidence Intervals*

Sponsor	**Average kWh/ Year Savings**	**Average % kWh Savings**	**Average Therm/ Year Savings**	**Average % Gas Savings**
MA Utilities	184 kWh	1.61%	9.93Therms	0.77%
90% CI	*26 kWh*	*0.23%*	*2.23Therms*	*0.17%*
SMUD	241 kWh	2.13%	n/a	n/a
95% CI	*+/- 18 kWh*	*+/- 0.16%*		
PSE	204 kWh	1.84%	12.8 Therms	1.33%
95% CI	*+/- 12 kWh*	*+/- 0.11%*	*1.3 Therms*	*0.13%*

To put these results in perspective, annual energy use reduction achieved through the installation of a CFL to replace an incandescent bulb is roughly 50 kWh per year. So, the annual electric savings associated with assignment to the Treatment group is equivalent to savings from replacing 3 – 4 incandescent bulbs with CFLs. Similarly, gas savings associated with assignment to the Treatment Group is roughly equivalent to the engineering-based estimate of savings achieved by installing a faucet aerator to reduce hot water use (VEIC 2011.

Customer Actions and Energy Savings

The findings on observed energy use reductions raise the possibility that feedback programs

could generate electric savings sufficient to fill at least a part of the gap left by diminishing opportunities in lighting. Before moving to such a conclusion, however, the persistence of savings achieved by feedback programs must be considered. For example, CFLs are accorded effective useful lives in the range of 5 to 8 years in the technical documents used to support program planning in the United States. To assess the potential persistence of observed savings, we need to understand what measures customers installed and which behaviours they initiated as a result of exposure to the program. Moreover, we need to consider whether all of the savings observed among the Treatment Group was achieved due to the influence of the feedback program, or whether some portion was due to participation in other incentive-based programs in the sponsors' portfolios.

Within the framework established by the experimental design, consumers in the Treatment group can generate savings through three mechanisms:

- ***Incremental participation in other efficiency programs.*** Customers in the Treatment group participate more frequently, earlier in the program cycle, and/or implement more measures through other efficiency programs offered by the feedback program sponsor than their counterparts in the Control group.
- ***Incremental installation of efficiency measures outside of other sponsor programs.*** Customers in the Treatment group install a greater number of energy efficiency measures on their own, without program assistance, than their counterparts in the Control group during the program period.
- ***Incremental adoption of efficiency and conservation behaviours.*** Customers in the Treatment group adopt efficiency and conservation behaviours(such as lowering thermostat settings or unplugging power supplies for small electronic appliances) to a greater extent than their counterparts in the Control group.

In this section, we review findings from the evaluations to assess the nature and magnitude of savings generated by these mechanisms.

Savings from incremental participation in other efficiency programs. Both the Massachusetts and PSE studies contained analyses of participation by members of the Control and Treatment groups in other energy efficiency programs offered by the feedback program sponsors. Essentially, both studies used data merges to identify which Treatment and Control group members had participated in other programs offered by the sponsors. These programs included promotions of energy-efficient appliances, energy-efficient heating and cooling equipment, and thermal measures such as added insulation. The evaluators then used information in the program files to estimate annual savings from these measures and the date of installation. Savings were adjusted to reflect the portion of the evaluation period for which the measure was installed and, for measures that affected thermal end uses, the portion of annual heating and cooling loads included in the installation period. Using this information, the evaluators were able to estimate the incremental level of participation in other programs associated with assignment to the Treatment group, as well as the level of energy savings associated the incremental participation. In the case of PSE, evaluators estimated savings from purchase of CFLs separately as a program measure, using the results of the customer survey. PSE pays incentives for CFL sales directly to manufacturers. Program records, therefore, do not link CFL purchases to individual customers. The evaluators of the Massachusetts program did not attempt to adjust savings for incremental purchase of CFLs. Table 3 summarizes these findings.

Table 3. Incremental Participation in Other Programs and Savings Associated with Assignment to the Treatment Group

	Massachusetts Utilities		Puget Sound Energy	
	Electric	**Gas**	**Electric**	**Gas**
Participation Rate in Other Programs: Treatment*	4.22%	3.85%		4.15%
Participation Rate in Other Programs: Control	3.86%	3.21%		4.11%
Δ in Participation Rate	0.35%	0.64%		0.04%
Average Savings in Program Year**	184 kWh/Yr	9.93 Th/Yr	278 kWh/Yr	12.9 Th/Yr
Average incremental savings from measures taken in other programs	--	0.61 Th/Yr	2.0 kWh/Yr	1.3 Th/Yr

* Results available only for combined fuels.
** Program Year 1 in Massachusetts; Program Year 3 in the PSE Territory

The findings summarized in Table 3 show that assignment to the Treatment Group had only a small effect on levels of participation in other energy efficiency programs and no significant effect on electric savings. For gas participants, incremental savings achieved through measures installed with the assistance of other programs accounted for 6 percent of total savings in Massachusetts and 10 percent of total savings in the PSE territory. Some portion of these savings should be subtracted from savings observed via the billing analysis to estimate the unique of the feedback program. Following regulatory advice, PSE allocates all joint savings to the incentive programs. The Massachusetts study deducts only a portion that reflects the incremental effect of assignment to the Treatment group on incentive program participation.

Savings from incremental installation of measures without assistance from other programs. Both the Massachusetts and PSE studies contained surveys of customers in the Treatment and Control groups designed to characterize the energy efficiency measures taken by those customers during the period of the experiment. Measures addressed by the survey included purchase of efficient appliances, physical improvements to the thermal shell, and changes in energy-related behaviours such as thermostat settings. The Massachusetts survey was fielded during the first year of the program. The PSE study first fielded a customer survey in the Program Year 3, and the sample included customers in an experimental group that had stopped receiving reports in the third year. This is referred to as the "Suspended" group. Table 4 displays data from the two studies on customer self-reports of energy-savings measures implemented during the study period.

Table 4. Self-reports of Energy Savings Measures Implemented during the Previous Year

	Massachusetts Utilities		Puget Sound Energy		
Measure Category	**Treatment**	**Control**	**Treatment**	**Suspended**	**Control**
Heating/Cooling	10.2%	8.4%	11%	11%	9%
Efficient Appliances	24.8%†	19.8%	n/a	n/a	n/a
Efficient Consumer Electronics	20.4%††	13.6%	n/a	n/a	n/a
Efficient Lighting (not incl. CFLs)	10.0%	7.8%	37%	40%	36%
Air Sealing	n/a	n/a	20%	20%	19%
Water Heating	n/a	n/a	34%	31%	30%
Discard Old Refrigerator	n/a	n/a	3%	5%	3%
Building Envelope	16.0%††	9.0%	n/a	n/a	n/a
Low-Cost Measures	45.3%	39.1%	n/a	n/a	n/a

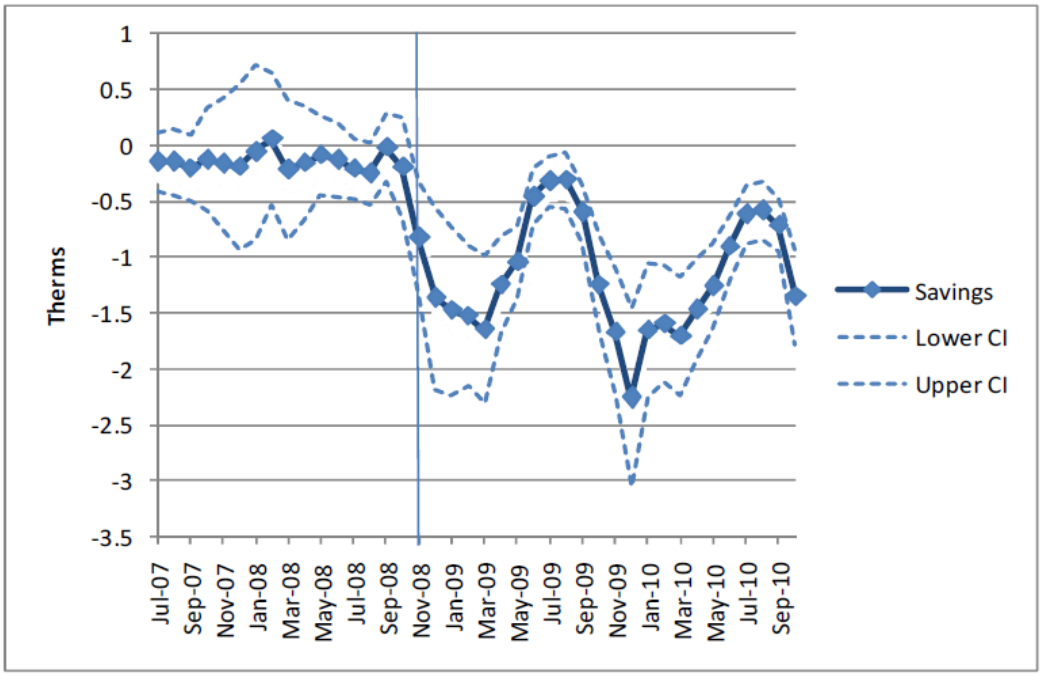
††Difference is significant at the 95% probability level; † Difference is significant at the 90% probability level.

Among Puget Sound customers, there were no significant differences between the Treatment, Suspended, and Control groups for any of the measure categories. Among the Massachusetts customers, there were small but statistically significant differences in rates of adoption in the following measure categories: efficient appliances, efficient consumer electronics, and building envelope. In no case was the difference in measure adoption rates between the Treatment and Control groups greater than 7 percent.

Savings from incremental adoption of energy efficiency and conservation behaviours. The surveys conducted for both studies asked respondents whether they had adopted or increased the frequency of a long list of energy efficiency and conservation practices in the prior year. Categories of practices questioned included thermostat settings for heating, cooling, and water heating equipment, HVAC and refrigerator maintenance, unplugging idle electronics, cold water washing, and so forth. In none of these measure categories did evaluators find any significant differences in the rate of adoption between Treatment and Control groups. In fact, in most cases, the adoption rates were nearly identical.

The lack of apparent differences between the Control and Treatment groups in measure and practice adoption likely reflects the limitations of survey techniques as much as the underlying similarities between the groups. The billing analyses, supported by tens of thousands of observations were able to discern small differences in the groups on a single variable, namely annual consumption. In this case with 500 or fewer observations per group covering scores of variables, it is unsurprising that the surveys were unable to identify significant differences in patterns of behaviour.

Analysis of monthly differences in consumption between the Treatment and Control groups yields some insight into the behaviours that are likely to be driving savings. Figure 2 shows the average monthly gas savings for the PSE Treatment group during the first 20 months of the program, which was launched in November 2008. Clearly, savings were much greater during the winter months, which suggests that most gas savings were being achieved through heating-related measures, most likely lowering of thermostat settings. By contrast, monthly savings of electricity were nearly flat, suggesting that most were generated through reductions in non-weather related end-uses.



Source: KEMA 2010

Figure 2. Monthly Gas Savings in PSE Program, first 20 Months

Persistence of Observed Use Reductions in the Treatment Groups after Program Suspension

When feedback programs were first introduced, program sponsors and regulators expressed concern that savings achieved in early periods would not persist into the second and third years of participation. Both the PSE and SMUD evaluations contain findings on persistence of savings after the first year, and these findings suggest that savings realized in the first year persist and even increase in later periods (KEMA, 2012).The PSE program has three complete years of operating experience. In the third year, PSE stopped treatment to a subset of the Treatment group – that is, the company stopped sending reports to the Suspended group. Table 5 shows annual energy savings estimated for each program year using the fixed effects model.

Table 5. Annual Savings for Treatment Group by Program Year

	Electricity Savings		Gas Savings	
Program Year and Group	kWh/Yr	*95% CI*	Therms/Yr	*95% CI*
Program Year One- All Treatment	169.7	*+/- 23.9*	10.7	*+/- 1.7*
Program Year Two – All Treatment	234.5	*+/- 32.5*	13.5	*+/- 2.2*
Program Year Three- Continued Treatment	274.2	*+/- 43.1*	11.9	*+/- 2.8*
Program Year Three- Suspended Treatment	216.4	*+/- 55.6*	11.9	*+/- 3.6*

Table 5 contains the following important findings:

- ***Trends over program years.*** Average annual savings increased significantly between the first and second years of program participation for both electricity (38 percent) and gas (26 percent). For electricity, annual savings increased again from Year 2 to Year 3 for electricity, although the rate of increase fell to 17 percent. For gas, savings levels decreased by 12 percent from Year 2 to Year 3, although they remained at a higher level than was attained in Year 1. Analysis of the first four months of Year 2 experience among SMUD participants also found that energy savings increased.
- ***Effect of suspension.***Among customers in the Suspended Treatment group, electric savings declined by 8 percent from Year 2 – the final year of their participation – to Year 3. Compared to the group that continued to receive feedback reports, the Suspended Treatmentgroup's savings in Year 3 were 21 percent lower. However, electric savings (versus the Control Group) were still positive in Year 3 and higher than they were in Year 1 of participation. Among gas customers, Year 3 savings levels were identical for the Suspended Treatment and Continued Treatment groups. We also note that the confidence interval on the savings estimate is significantly wider for the Suspended Treatment group than it is for the Continued Treatment group. This suggests that the suspension of treatment is accompanied by reduced consistency in behaviour among the group, with some customers maintaining energy efficiency habits and others not.

It is difficult to infer trends or broad conclusions concerning persistence of savings from this relatively small group of observations. However, it is clear that savings achieved by customers in Treatment group persist beyond the first year of the program and, generally, increase in the second year. Savings remain positive after that, even if monthly feedback is suspended for a year.

Effect of Differences in Program Delivery

The random assignment capability inherent in the feedback report program model supports evaluation and comparison of the effectiveness of different implementation approaches as well as evaluation of overall program effects on consumption. The SMUD and PSE evaluations randomly assigned subsets of the Treatment group to receive reports quarterly versus monthly. Table 6

summarizes the comparison of savings between the groups that received monthly and quarterly reports during the first year of program operations. In all cases for which data are available, customers receiving monthly feedback reports achieved higher savings than those receiving quarterly reports, although the differences were small. The SMUD study tested differences in results associated with variations in graphic presentation, but these did not lead to statistically significant differences in savings levels.

Table 6. Savings by Treatment Groups with Quarterly v. Monthly Feedback

	Percent of Pre-Program Usage	
Sponsor/Fuel	**Monthly**	**Quarterly**
SMUD/Electric	2.3%	1.6%
PSE Electric	1.9%	1.3%
PSE Gas	1.2%	1.0%

The PSE study also found that customers receiving quarterly reports did *not* achieve increased electric savings in successive analysis periods whereas those who received monthly savings did increase savings from one period to the next. This difference in savings patterns over time did not occur among gas customers. That is, customers who received quarterly reports, as well as those who received monthly reports, increased their gas savings over time.

Relationship of Customer Attributes to Savings Levels

All three of the studies assessed the relationship between customer attributes and levels of savings associated with assignment to the Treatment Group. The range of attributes analyzed included: the presence of a pool, spa, or electric heat; square footage of the home (available from assessor's records for SMUD); the age of the residence; assessed value of the home; and pre-treatment level of consumption relative to other customers in the treatment group. Of all of these attributes, only the relative pre-treatment consumption level was found to have a strong relationship to absolute kWh and percentage savings in all programs. The Massachusetts study divided the Treatment group into three equal-sized cohorts based on the households' rank on pre-treatment consumption. Customers in the highest pre-treatment consumption category reduced electricity use by an average of 1.9 percent, compared to 1.4 percent for customers in the middle category, and 1.2 percent in the lowest category. Gas savings for the highest pre-treatment consumption group averaged 1.1 percent, versus 0.7 percent for the middle category, and 0.6 percent for the lowest category. In his 2009 study of the SMUD program, Allcott (Allcott 2009) identified a strong relationship between pre-treatment consumption, as indicated by the decile ranking of the customer, and levels of savings. These studies do not make it clear whether the savings in the three usage categories are being modeled against the Control group as a whole, or only those Control observations from the corresponding pre-program year consumption category. If the latter is not the case, then the comparison could be capturing some "regression towards the mean" by Treatment group households who used abnormally high amounts of energy during the pre-treatment year.

The PSE Year 3 study (KEMA 2012) addressed the issue of the relationship between pre-treatment consumption and savings levels by modeling savings for each pre-program year consumption quintile in relation only to the corresponding quintile in the Control group. Figure 3 shows savings as a percentage of pre-program weather normalized electric consumption by year and pre-program consumption quintile. In each year, the customers in the highest quintile (20 percent) ranked by pre-treatment weather normalized consumption accounted for roughly 50 percent of all program savings. The top two quintiles accounted for 75 percent of total program savings. These finding suggest that the cost effectiveness of the program could be increased by targeting customers with high levels of annual use relative to their peers. Except for the presence of spas, none of the

other customer attributes examined showed statistically significant effects on energy savings associated with assignment to the Treatment group.

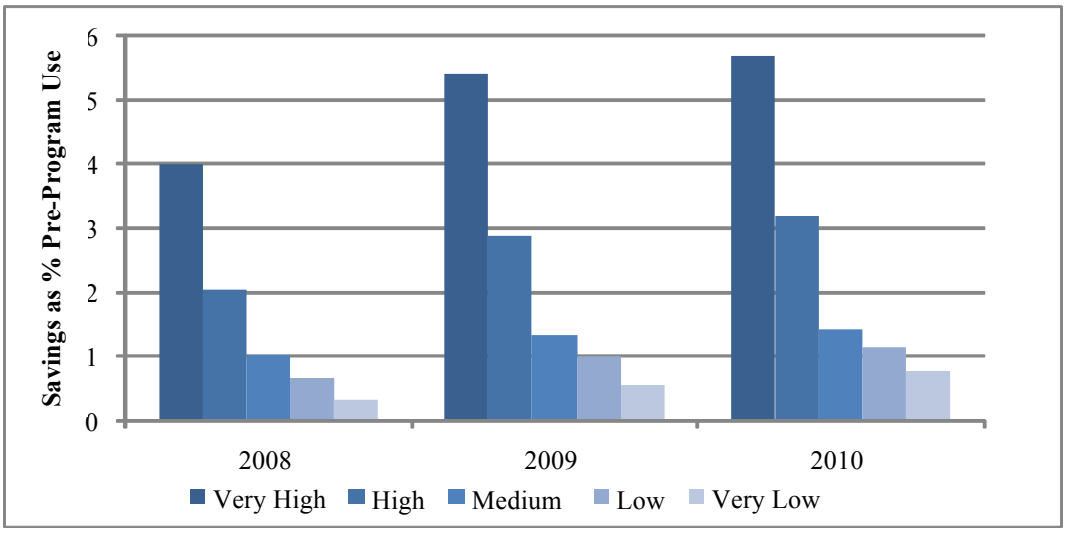


Figure 3. Percent Savings as a Percent Pre-Treatment Weather Normalized Consumption by Relative Pre-Treatment Consumption

Participant Characterizations of Response to Home Energy Reports

The Massachusetts and PSE studies incorporated surveys of customers in the Treatment groups that elicited information on their response to the home energy reports. The surveys were fielded between 15 and 24 months after the respondents had begun receiving the reports. The sample sizes for the Treatment groups were 349 for the PSE Study and 501 in the Massachusetts study. The key findings from these surveys were as follows.

- **The majority of customers in the treatment group read and reviewed their home energy reports.** Ninety-two percent of sample Treatment group in the PSE territory recalled seeing the reports, as did 94 percent of the recipients in the Massachusetts sample. Among the Massachusetts customers, 59 percent reported that they read all of the reports they received; 29 percent reported reading most of them. In the PSE territory, 70 percent of respondents reported reading all of the reports; 14 percent reported read most of them.
- **Roughly one-half of home energy report recipients characterize them as useful.** The sample PSE customers were asked to rate how useful they found the home energy reports on a five point scale. Eighteen percent characterized them as "5 - Very useful"; 23 percent rated them as 4. The element of the report identified as most useful was the comparison of current monthly usage the respondent's own usage in the same month of the prior year (48 percent rated "Very Useful"). Only 25 percent rated the comparison to neighbours as "Very Useful". These findings might indicate a difference in the value customers accord to information that motivates action versus information that guides action. Among Massachusetts recipients, 41 percent found the reports useful for providing "new ways to save energy in [their] home[s]".
- **Relatively few respondents identified a causal link between receipt of the reports and energy use reduction actions they had taken.** Among PSE report recipients, 37 percent claimed that the reports stimulated them to adopt new energy conservation habits; 29 percent claimed that the reports stimulated them to purchase energy efficient

equipment. The Massachusetts study did not include questions on attribution in the telephone survey of report recipients. The study included set of in-home interviews with a small sample of customers (n=11), and the topic of causation was explored in those interviews. Only one of the respondents to the in-depth interviews drew a direct causal link between receipt of the reports and actions the household had taken to save energy.

Conclusions

As program administrators at scores of utilities across the U. S. and abroad prepare to launch feedback report programs, it is useful to consider the implications of the studies reviewed for program design and evaluation, and the strength of evidence behind those implications. First, the findings that can be stated with some certainty include the following:

- Customers assigned at random to receive feedback reports reduce their annual consumption by a measurable amount, usually in the range of 1 – 3 percent, depending on housing stock, climate conditions, and fuels.
- Savings persist and often grow through the second program year, and continue to be positive in the third year.
- Only a small portion of the savings realized by the Treatment group appears to be related to incremental participation in other energy efficiency programs. Overlap of program effects needs to be accounted for in evaluation, but it is likely too small to compromise the cost-effectiveness of the feedback report approach.
- Savings increase with frequency of reports.
- Savings persist if the frequency of reports is reduced or even if they are suspended entirely. However, the level of savings decreases under these circumstances.

Despite these encouraging early results, a number of uncertainties remain in regard to the value of feedback reports as their deployment expands. Future program design and evaluation work should address the following issues.

- **Identify savings mechanisms.** The mechanisms by which customers in the Treatment save energy remain unclear. Without a better understanding of customer actions in response to the feedback reports, it will be difficult to assess their persistence. To address this issue, evaluators and program administrators should consider fielding surveys of Treatment and Control Group members early and in each program year to track changes in behaviour. These surveys should have large sample sizes (over 1,000 per group) and focus only on a few behaviours that early research suggests are key to realization of savings. This will reduce respondent burden, improve response rates, and facilitate timely feedback into program design and management. Of course, the surveys should be designed to test specific theories of customer motivation.
- **Identify mechanisms to increase average savings per customer.** This issue has been explored in the evaluations summarized here. Most recommendations from professional evaluators and customers themselves focus of providing more customer-specific information to report recipients to guide energy use reduction activities.
- **Maintain elements of random assignment.** Clearly, comparative feedback programs, with their frequent and useful mode of contact, provide an excellent platform for providing customers with additional services and incentives to help them save energy. However, program sponsors should take care not to compromise the random assignment feature of feedback programs, particularly in early stages of deployment. The evaluation work to date demonstrates that large-scale bill analyses with experimental designs are required to discern savings with levels of certainty required in most regulatory settings. Any elements of the program that allow for voluntary enrollment must be clearly segregated from the experimental implementations.

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