Opower, Where Art Thou? Savings Estimates From a Pilot Program

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ABSTRACT

Opower is an innovative efficiency program that is generating significant interest in its potential for providing low-cost energy savings. The primary objective of this research was to develop impact estimates that were specific to an Opower pilot program implemented as part of the Hawaii Energy suite of efficiency programs. To accomplish this, we first tested the selection of the program treatment and control groups to verify that they had been matched properly. Next, we developed a fixed effects billing regression model that controlled for the potential effects of participation in other efficiency programs. Since Hawaii Energy is already claiming savings for those customers participating in other programs, care is needed to ensure sure that they are not also counted as part of the Opower savings.

The key finding of this research was the development of a fixed effects model specification that controlled for participation in other Hawaii Energy efficiency programs. When participation in other programs is controlled for, the savings estimate decreased by 29 percent (from 1.25 to 0.89 percent of annual energy use) relative to the model where the alternative program participation effect is not included. Our analysis also shows that the treatment group had higher participation rates in the Hawaii Energy programs prior to the Opower treatment being implemented, and that these differences were statistically significant. Since the difference in participation rates occurred prior to the Opower program being implemented, the incremental savings gain cannot be attributed to the Opower program.

Introduction

Opower is an innovative efficiency program that is generating significant interest for its potential for providing low-cost energy savings. Through the Opower program, households are provided information on how their energy use compares with a similar comparison group. The centerpiece of the Opower program is the Home Energy Report (HER), which provides personalized information about household energy use and tips on how to reduce energy consumption. The HER report also shows how household energy consumption compares with a group of neighboring homes. In mid-2011, Opower ran an American Recovery and Reinvestment Act (ARRA)-funded pilot program in the state of Hawaii using stimulus funds with 15,000 participating Hawaii state residents. The program was scaled up in 2011 to include 62,000 residential electric utility customers on Hawaii Island, Lanai, Maui and Molokai.

The HER is sent out regularly (approximately monthly) to participating households and shows personalized information about energy use in an individual home and compares this usage with neighboring households. The neighbors in the comparison control group are categorized into 'all' and 'efficient' neighbors. The 'all' neighbors are a group of about 100 neighbors whose homes are similar in size, near the participant's home, and appear to be occupied. The 'efficient' neighbors are the most efficient 20 percent from the 'all' neighbors group. Along with the comparison information, the HER also provides information on how the household can reduce its energy consumption.

The primary objective of this research was to develop savings estimates for the Opower program that was implemented through Hawaii Energy, the third-party energy efficiency program implementer retained by the Public Utilities Commission to provide energy efficiency services in the service territories of the Hawaiian Electric Companies. Evergreen Economics performed this analysis as part of its comprehensive evaluation of the Hawaii Energy efficiency programs for the Hawaii Public Utilities commission. Of particular interest was the issue of cross participation in other efficiency programs and how this participation may affect Opower energy savings estimates. To explore this issue, we developed a fixed effects billing regression model specification that explicitly controls for participation in other efficiency programs. Since the energy savings from these other programs are already being claimed outside of Opower, care is needed to ensure sure that they are not also counted as part of the Opower energy impacts.

A related objective was to confirm that an appropriate control group had been selected for the Opower savings analysis. To test this, we made comparisons between the control and treatment groups based on key characteristics to determine if there were any statistically significant differences across groups.

Both the analysis of treatment and control groups and the estimation of the modified fixed effects model specification are discussed in the remainder of this paper.

Evaluation Research Issues

Multiple impact evaluation studies have shown the Opower program to be an effective tool for reducing energy demand for participating households. The most rigorous of these impact studies rely on a fixed effects billing regression model to estimate energy savings. Ayres, Raseman & Shih (2009), for example, analyzed two field experiments conducted for the Sacramento Municipal Utility District (SMUD) and Puget Sound Energy (PSE) by Opower. Using an ordinary least squares regression model to estimate program savings, the analysis found statistically significant savings of 1.2 percent of annual household energy consumption for PSE and 2.1 percent for SMUD. An evaluation of the same SMUD pilot program conducted by Summit Blue Consulting used three statistical methods to estimate savings in the first year of the program, a difference-in-difference approach, a baseline ordinary least squares regression model and a baseline fixed effects model. Each method estimated savings between 2.1 percent and 2.2 percent of annual energy usage (Summit Blue Consulting 2009).

Navigant Consulting conducted an impact evaluation for the second year of the SMUD Opower pilot program in 2011. A fixed effects regression model was used to estimate program savings. In this analysis, separate estimates were developed for high and low usage households. Second-year savings were estimated at 2.9 percent of annual energy consumption for high use households and 1.7 percent for low use households (Navigant Consulting 2011). In 2010, Power Systems Engineering evaluated the Connexus Energy, Opower Pilot Program in Minnesota launched in March 2009. Three estimates were developed using used a difference-in-difference analysis, an ordinary least squares regression model and a linear fixed effects model. Estimated savings from both methods was approximately 2.1 percent of annual usage (Power Systems Engineering 2010).

Hunt Allcott (2011) estimates the impact of 17 Opower experiments across the nation prior to 2009 using a fixed effects regression model. The estimated savings from this analysis range from 1.4 percent to 3.3 percent of annual energy consumption, with a mean estimated savings of 2 percent. The Environmental Defense fund analyzed 12 Opower interventions across 11 utility service areas. Using a fixed effects regression model the analysis finds savings estimates ranging from 0.9 percent to 2.9 percent of annual energy consumption, with an average estimated savings of 1.8 percent (Davis 2011). An analysis of 13 Opower cohorts across three utilities in Massachusetts encompassing both electric and gas customers. For electric customers estimated savings ranging from 1.32 percent to 2.06 percent of annual consumption were found using a fixed effects regression model (Opinion Dynamics Corporation 2012).

After reviewing this literature, there were some remaining questions regarding how the methodology for selecting treatment and control groups is actually applied, since Opower typically runs its program with little or no involvement from outside parties. Without an independent party verifying that the control and treatment groups are selected properly, there is a possibility of bias due to using mismatched control and treatment groups in the regression model. This was of particular concern with the Hawaii Opower program, as the process used to select the treatment and control groups was not sufficiently documented to allow for an independent entity to recreate their results.

As demonstrated in the literature, evaluations of the Opower program using the fixed effects model specification have resulted in savings estimate ranging from approximately 1 to 3 percent of annual energy consumption. In the studies we reviewed, however, the models were not constructed to control for the effect of participating in other energy efficiency programs. This raises the possibility of double-counting savings, since Opower is typically implemented in areas that have active upstream and downstream efficiency programs that may draw additional participation from Opower participants. While Opower's standard methodology ensures that they only count savings that happen above and beyond what is observed by the control group, savings at the portfolio level may be double counted if household savings from other efficiency programs are also attributed to Opower.

Methods

For the evaluation of the Hawaii Opower program, Opower initially selected the treatment and control group samples from four zip codes in the Honolulu area.[1] Once the treatment and control groups were selected, Opower began sending out the HERs to the treatment households in May 2011. As discussed above, the treatment group received regular energy reports comparing their energy usage to a peer group of neighbors, while the control group did not receive any information from Opower.

To estimate savings for this program and explore the issue of potential double counting of savings, we completed the following analysis tasks:

1. **Statistical analysis of Opower treatment and control groups.** We conducted a series of statistical tests comparing the treatment and control groups originally selected by Opower to determine if there were any significant differences on key variables of interest (including participation in other Hawaii Energy efficiency programs).

2. **Billing regression models.** A fixed regression model was developed to estimate realized savings from the Opower program while controlling for any effect of participation in other Hawaii Energy efficiency programs. Evergreen Economics received data on the 24,772 customers (both treatment and control groups) from Opower. These data included the participant electric service account number and a variable that flagged whether the participant was in the treatment group receiving the home energy report or the control group.

   Hawaii Energy provided monthly electricity billing data and information identifying whether customers had participated in other energy efficiency programs offered by Hawaii Energy, and if so, the date they first participated in the program. Billing data and other Hawaii

[1] The program was later expanded to include households in the neighboring islands. For this analysis, only the initial pilot group had sufficient post-participation billing data available to estimate a billing regression model.

Energy program participation data from April 2010 to June 2012 were matched with the Opower Pilot Program participant data using the customer's electric service account number. The resulting dataset contains 12 months of pre-program billing data and 12 months of post-program billing data.

In the following section, we first discuss the results of the analysis of treatment and control groups based on a Chi-squared test of key parameters across samples. Following the discussion of the treatment and control groups, we next present results of the billing regression model that provides estimates of program savings while controlling for participation in other efficiency programs.

Results and Discussion

Analysis of Treatment and Control Group Selection

In order to determine if the selected Opower control group is an appropriate match with the treatment group, we conducted a Chi-squared test to compare the characteristics of the two groups to determine if there were any significant differences on key characteristics. Based on the results of a Chi-squared test, the analysis indicates that the control and recipient groups are statistically similar in terms of allocation to zip code and energy use.

We also compared the treatment and control groups in terms of participation rates in other Hawaii Energy programs. The results of the Chi-squared test on this variable are shown in Table 1. As shown in the far right column, the treatment group participated in other Hawaii Energy programs at a rate of 14.17 percent, while the control group only had a participation rate of 13.40 percent. Based on the Chi-squared test, this represents a statistically significant difference between the control group and treatment group in the rate of participation in other Hawaii Energy programs at the 90 percent confidence level. Upon further investigation, we discovered that that the difference in participation rates between the two groups occurred *before* the Opower program was initiated. This test result indicates that there is only a 10 percent chance that the difference between the treatment and control groups occurred randomly.

In the period after the Opower program was initiated, there is no statistically significant difference in alternative Hawaii Energy program participation between the two groups. This finding is also important as it shows that the Opower program is not resulting in a relative increase in participation in Hawaii Energy programs, as the control group households are participating at the same rate.

Table 1: Opower Pilot Program Participants In Other Hawaii Energy Programs

Experimental Group	Total Number of Households	Participants in Other Hawaii Energy Efficiency Programs	% of Households
Treatment	14,862	2,106	14.17%
Control	9,910	1,328	13.40%
Total	24,772	3,434	13.86%

This finding is surprising since – if the control and treatment groups were appropriately matched – we would not expect to see a statistical difference in Hawaii Energy program participation rates between the treatment and control groups *prior* to the Opower treatment beginning. Consequently, given the low likelihood of this difference occurring by chance, it appears that treatment and control group selection processes violated the experimental design assumptions regarding equivalency of treatment and control groups, which is a cornerstone of the Opower intervention and analysis design. Since Opower (rather than the evaluation team) selected the treatment and control groups, we do not have any explanation as to why these two groups are different.[2]

As discussed in the billing regression models section, the difference in participation at the outset of the intervention has significant repercussions for estimating savings. Given the significant differences in participation in other energy efficiency programs, the billing regression models were designed to identify how much this difference is impacting the savings estimates for the program. If the difference in participation rates is not accounted for in the model, then the model estimates will significantly bias upward the savings attributable to the Opower program.

Billing Regression Models

In the second part of this analysis, we developed two fixed effects regression models to estimate the change in monthly household energy consumption before and after Opower began sending out the Home Energy Reports to treatment households. The entire population of control and treatment group households was used to estimate these models, although some households were screened out during the data cleaning process (discussed below) that removed outlier observations.[3]

The first model (Model 1), which we also refer to as the "Standard Opower Model", is based on the general model specification used in other independent evaluations of Opower programs discussed previously. This model estimates energy savings as a function of indicator variables for the pre- and post-program periods, the treatment and control groups, and weather data. The second model, which we refer to as the "Recommended Opower Model", is an innovative model that for the first time controls for alternative program participation within a fixed effects model specification. To accomplish this, the model includes additional variables indicating if a household participated in one or more of the other energy efficiency programs offered by Hawaii Energy.

Both models are estimated using household monthly panel billing data from April 2010 to May 2012. This time period enabled us to use an entire year of pre-participation and post-participation billing data to estimate the models. For both models, several data screens were employed to remove customers with incomplete billing data or that had possible billing data errors. The data screens removed observations according to the following criteria:

- Remove households with fewer than the full 24 months of billing data. These households have moved or changed accounts during the observation period.
- Remove individual household monthly observations with fewer than 20 days in the billing cycle.
- Remove observations with monthly energy consumption falling outside of three standard deviations of the mean monthly energy usage of the individual household.

Both model specifications and estimation results are discussed below.

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2 A recent study completed by LBNL researchers (Todd et al, 2012) on evaluating behavior-based programs like Opower specifically recommends that the evaluation researchers (or other independent third-party entity) do the sample selection for both the control and treatment groups to avoid potential conflicts of interest (pp. 22-3).

3 Additional models were estimated without any data screens and resulted in slightly higher savings estimate than in the Standard Opower Model discussed above (1.47 percent versus 1.25 percent). In order to focus this paper on controlling for other program participation (and due to page limit constraints), the unscreened data model is not presented here.

Model 1: Standard Opower Model. The standard fixed effects regression model uses monthly panel billing data to estimate changes in household electricity consumption attributable to the Opower Home Energy Report. The billing regression model relates normalized household monthly electricity consumption by month to:

1. An indicator variable for observation months in the post Opower report period (after May 1st 2011)

2. An indicator variable identifying whether the household was in the treatment or control group

3. An interaction term between the post period indicator and the treatment indicator

4. Monthly dummy variables to control for external factors

5. Weather data to control for fluctuations in temperature

Model 1 is specified as follows:

$$KWHNorm_{it} = \propto_i + \beta_1 POSTPROG_{it} + \beta_2 (TREAT * POSTPROG)_{it} + \beta_3 CDD_{it} + \beta_4 (CDD * TREAT)_{it} + \beta_5 (CDD * POSTPROG)_{it} + \beta_6 (CDD * TREAT * POSTPROG)_{it} + \beta_k MONTH_k + \epsilon_{it}$$

Where:

$KWHNorm$ = Normalized household monthly energy usage (KWH)
$POSTPROG$ = Indicator variable for post report period observations
$TREAT * POSTPROG$ = Interaction term between the indicator for post report observations and treatment group indicator
CDD = Average cooling degree-days per month
$CDD * TREAT$ = Interaction between cooling degree-days and treatment group indicator
$CDD * POSTPROG$ = Interaction between cooling degree-days and post program indicator
$CDD * TREAT * POSTPROG$ =Interaction between cooling degree-days, treatment indicator and post-period indicator
$MONTH$ =Indicator variable for each month excluding December
i = Index for household (i = 1,2, …, n)
t = Index for monthly time period (t = 1,2, …, T)
$[\beta_1, \ldots, \beta_6]$ = Coefficients to be estimated in the model
ε = Random error term, assumed to be normally distributed

Table 2 shows the estimation results for Model 1. The coefficients of interest with respect to energy savings attributable to the Opower program are β_2 (the coefficient on the post-program*treatment indicator) and β_6(the coefficient on the CDD*treat*post-period interaction variable). Both coefficient estimates are of the expected sign (negative), with the estimate of β_2 not statistically significant and the estimate on β_6 only significant at the 20 percent level. The coefficient estimates on all other indicators are statistically significant at the 5 percent level (except for the monthly indicator variable for July), indicating that monthly changes in energy usage and changes in energy usage due to fluctuations in temperature are influencing energy use, as we would expect.

Table 2: Standard Opower Model Regression Results

Model Summary	
KWH Norm Mean	739.85
KWH Norm Standard Deviation	426.75
Number of Households	19,693
R-Squared	0.88
Adjusted R-Squared	0.87
Std. Error of Estimate	152.95

Variable	Coefficient (β)	t-statistic	Sig. (p-value)
(β_1) **POSTPROG**	-116.44	-30.85	< 0.01
(β_2) **TREAT * POSTPROG**	**-2.91**	**-0.62**	**0.53**
(β_3) **CDD**	0.265	15.925	< 0.01
(β_4) **CDD * TREAT**	0.028	2.879	< 0.01
(β_5) **CDD * POSTPROG**	0.211	20.853	< 0.01
(β_6) **CDD * TREAT * POSTPROG**	**-0.017**	**-1.339**	**0.18**
(β_7) January	17.92	14.95	< 0.01
(β_8) February	-16.44	-12.47	< 0.01
(β_9) March	-28.20	-25.40	< 0.01
(β_{10}) April	-54.29	-53.42	< 0.01
(β_{11}) May	-45.79	-32.28	< 0.01
(β_{12}) June	-22.00	-12.34	< 0.01
(β_{13}) July	-0.19	-0.09	0.93
(β_{14}) August	-7.71	-3.22	< 0.01
(β_{15}) September	10.50	4.78	< 0.01
(β_{16}) October	7.51	3.47	< 0.01
(β_{17}) November	7.73	5.72	< 0.01

The variables used for calculating energy savings attributable to the Opower program are the *treat*postprog* interaction variable and the *CDD*treat*post-prog* interaction variable. The coefficient on the *treat* post-prog* interaction variable (β_2) can be interpreted as the change in normalized monthly energy consumption attributable to a household being in the treatment group in the post report period. The coefficient on the *CDD*treat* post-prog* interaction variable (β_6) can be interpreted as the change in normalized monthly energy consumption attributable to a household being in the treatment group in the post report period due to a one cooling degree day increase.

To calculate the average monthly energy savings for Opower recipients based on the regression results, the following equation is used:

$$Opower\ monthly\ kWh\ Savings = \beta_2 + \beta_6 * \overline{CDD}$$

Where:

$\overline{CDD}$ = Average monthly cooling degree-days in the post program period

Model 2: Recommended Opower Model. The alternative program fixed effects regression model uses monthly panel billing data to estimate changes in household electricity consumption attributable to the Opower Home Energy Report while controlling for participation in other Hawaii Energy programs. This is done by modifying the Model 1 specification to include a variable identifying months after a household participated in a Hawaii Energy efficiency program other than Opower.

Model 2 is specified as follows:

$$\begin{aligned} KWHNorm_{it} &= \propto_i + \beta_1 POSTPROG_{it} + \beta_2 (TREAT * POSTPROG)_{it} + \beta_3 CDD_{it} + \beta_4 (CDD * TREAT)_{it} \\ &+ \beta_5 (CDD * POSTPROG)_{it} + \beta_6 (CDD * TREAT * POSTPROG)_{it} + \beta_7 (ALTPROG)_{it} \\ &+ \beta_8 (ALTPROG * TREAT * POSTPROG)_{it} + \beta_9 (ALTPROG * TREAT)_{it} \\ &+ \beta_{10} (CDD * ALTPROG)_{it} + \beta_k MONTH_k + \epsilon_{it} \end{aligned}$$

Where:

$KWHNorm$ = Normalized household monthly energy usage (KWH)
$POSTPROG$ = Indicator variable for post Opower report period observations
$TREAT * POSTPROG$ = Interaction term between the indicator for post report observations and treatment group indicator
CDD = Average cooling degree-days per month
$CDD * TREAT$ = Interaction between cooling degree-days and treatment group indicator
$CDD * POSTPROG$ = Interaction between cooling degree-days and post program indicator
$CDD * TREAT * POSTPROG$ =Interaction between cooling degree-days, treatment indicator and post-period indicator
$ALTPROG$ = Indicator variable for months following participation in another Hawaii Energy program
$ALTPROG * TREAT * POSTPROG$ = Interaction between Hawaii Energy program indicator, treatment group indicator and post-period indicator
$ALTPROG * TREAT$ = Interaction between Hawaii Energy program indicator and treatment group indicator
$CDD * ALTPROG$ = Interaction between Hawaii Energy program indicator and treatment group indicator
$MONTH$ =Indicator variable for each month excluding December
i = Index for household (i = 1,2, …, n)
t = Index for monthly time period (t = 1,2, …, T)
$[\beta_1, \dots, \beta_{11}]$ = Coefficients to be estimated in the model
ε = Random error term, assumed to be normally distributed

Estimation results for Model 2 are shown in Table 3. The coefficients of interest with respect to energy savings attributable to participation in the Opower program are β_2 (the coefficient on the *post-program*treatment* indicator), β_6(the coefficient on the *CDD*treat*post-period* interaction variable) and β_8(the coefficient on the *alternative program*treat*post-period interaction variable)*. These coefficient estimates are also statistically significant at the 5 percent level, with the exception of β_2, which again is not statistically significant. The coefficients estimates on the monthly and weather variables are also statistically significant at the 1 percent level (except for July), indicating that monthly changes in energy usage and changes in energy usage due to fluctuations in temperature are statistically significant, as we would expect.

Table 3: Recommended Opower Model Regression Results

Model Summary	
KWHNorm Mean	739.85
KWH Norm Standard Deviation	426.75
Number of Groups	19,693
R-Squared	0.88
Adjusted R-Squared	0.87
Std. Error of Estimate	152.95

Variable	Coefficient (β)	t-statistic	Sig. (p-value)
(β_1) **POSTPROG**	-111.08	-29.363	< 0.01
(β_2) **TREAT * POSTPROG**	**1.78**	**0.379**	**0.704**
(β_3) **CDD**	0.26	15.631	< 0.01
(β_4) **CDD * TREAT**	-0.03	3.099	< 0.01
(β_5) **CDD * POSTPROG**	0.20	20.091	< 0.01
(β_6) **CDD * TREAT * POSTPROG**	**-0.02**	**-1.775**	**0.076**
(β_7) **ALTPROG**	-73.03	-17.029	< 0.01
(β_8) **ALTPROG * TREAT * POSTPROG**	**-29.45**	**-13.327**	**< 0.01**
(β_9) **ALTPROG* TREAT**	15.47	4.629	< 0.01
(β_{10}) **CDD * ALTPROG**	0.10	10.026	< 0.01
(β_{11}) January	18.21	15.208	< 0.01
(β_{12}) February	-15.89	-12.056	< 0.01
(β_{13}) March	-27.59	-24.87	< 0.01
(β_{14}) April	-54.52	-53.687	< 0.01
(β_{15}) May	-46.61	-32.85	< 0.01
(β_{16}) June	-23.29	-13.053	< 0.01
(β_{17}) July	-1.25	-0.609	0.543
(β_{18}) August	-8.57	-3.583	< 0.01
(β_{19}) September	9.84	4.479	< 0.01
(β_{20}) October	7.00	3.24	< 0.01
(β_{21}) November	7.46	5.519	< 0.01

The interpretation of the coefficients on the *treat*postprog* interaction variable (β_2) and the *CDD*treat*postprog* interaction variable (β_6) remain the same as their interpretations under Model 1. The coefficient on the *altprog*treat*postprog* interaction variable (β_9) can be interpreted as the change in normalized monthly energy consumption attributable to a household in the treatment group that had also participated in a separate Hawaii Energy efficiency program.

For Model 2, Opower energy savings are calculated using the following equation:

$$Monthly\ kWh\ Savings = \beta_2 + \ \beta_6 * \overline{CDD} + \ \beta_8 * \overline{ALTPROG * TREAT}$$

Where:

$$\overline{CDD} = \textit{Average monthly cooling degree-days in the post program period}$$

$$\overline{ALTPROG * TREAT} = \textit{Average rate of other Hawaii Energy program participation by the treatment group in the post Opower period.}$$

This equation gives us the average change in monthly energy savings for Opower participants due to participation in the Opower program while controlling for the effect of participation in other Hawaii Energy programs.

To separate out the Opower savings from savings resulting from other programs, we set the average rate of participation in alternative Hawaii Energy programs to zero in the savings calculation equation. Setting this variable equal to zero removes that portion of total savings attributable to other Hawaii Energy programs from the calculation of the Opower savings. Since we have seen that these alternative program savings resulted from differences in participation prior to the Opower intervention (and thus cannot be attributed to the Opower program), their removal is appropriate. The remaining parameters provide an estimate of savings that is due solely to the Opower treatment effect.

Savings Estimates

The savings from both the Standard Opower Model and the Recommended Opower Model are calculated from the coefficient estimates as discussed above. The resulting savings estimates are shown in Table 4, along with 95 degree confidence intervals.

From the Standard Opower Model, the estimated savings is 1.25 percent of annual usage, which is consistent with estimates from other evaluations discussed in the literature review. The Recommended Opower Model, which controls for participation in other Hawaii Energy programs, results in a savings estimate of 0.89 percent, which is 29 percent lower than Model 1 that does not control for participation in other Hawaii Energy efficiency programs. This finding is a direct result of structuring the fixed effects model to allow for differences in Opower savings estimates due to differing participation rates in the other Hawaii Energy efficiency programs. From the earlier analysis comparing the treatment and control groups, we know that there is a significantly higher participation rate in other efficiency programs by the treatment group relative to the control group, and this difference is captured in the Recommended Opower Model results, but not in the Standard Opower Model. Since the difference in participation rates occurred prior to the Opower program commencing, Opower cannot claim any of the additional savings resulting from these programs.

Table 4: Annual Opower Savings Estimate Summary

	Annual Savings (kWh)	**Annual Savings (%)**	**95 % Conf. Interval LOWER BOUND**	**95 % Conf. Interval UPPER BOUND**
Standard Opower Model	110.61	1.25%	89.71 (1.01%)	131.51 (1.48%)
Recommended Model	78.78	0.89%	56.99 (0.64%)	100.57 (1.13%)

Conclusions

This paper presents an analysis of the Opower pilot program currently implemented in Hawaii. The analysis contains both a test of how well the treatment and control groups are matched, as well as a fixed effects billing regression model that accounts for differences between the treatment and control groups in the rates of participation in other efficiency programs.

This analysis demonstrates the importance of having appropriately matched treatment and control groups with respect to participation in other efficiency programs. Our analysis shows that in this particular Opower program, the treatment group had higher participation rates in the Hawaii Energy programs prior to the Opower treatment being implemented, and that these differences were statistically significant.

The difference across groups had a significant influence on the fixed effects billing regression model used to estimate savings. When the billing regression model specification is used that incorporates the potential effect of participation in other efficiency programs, the estimated savings for the Opower program decreases accordingly. Using the recommended model specification, the savings estimates decreased by 29 percent once the difference in alternative efficiency program participation rates are controlled for in the model. Since the difference in participation rates occurred prior to the Opower program being implemented, the incremental savings gain cannot be attributed to the Opower program.

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