Piloting Home Energy Reports: Testing both Paper and Electronic Messaging

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ABSTRACT

While paper home energy reports (HERs) are behavioral conservation interventions that have consistently been shown to be effective in reducing household energy use and demand, using electronic messaging in behavioral programs has yet to be fully explored. Sending neighborhood comparisons to customers through email has the potential to be a more cost effective way to reach a larger customer base and realize energy savings. Three behavioral conservation pilots were launched in 2014 in the Canadian province of Ontario to explore the energy and demand savings achievable with electronic and traditional HERs.

The first pilot included a school challenge component in addition to emails and a web portal, and was implemented as an opt-in program. About 3,400 customers elected to receive weekly emails. The second pilot was designed as a randomized control trial (RCT) in which 50,000 residential customers received weekly energy messages and access to a web portal, with the option to opt out. About 8,000 customers were randomly selected as a control group and were not invited to participate. The third pilot was also implemented as an RCT, where 50,0000 randomly selected high energy users received paper, rather than email, HERs through the mail and 20,000 randomly selected high energy users were assigned to a control group.

Using pre- and post-treatment individual customer hourly electricity usage data for all participants and control customers, energy and peak demand savings were measured for each pilot, where savings were estimated with fixed effects regression models. Each pilot was successful in achieving statistically significant savings, suggesting that electronic reports could be a viable alternative to traditional paper reports.

Background and Introduction

Over the past decade, social benchmarking programs, and most commonly HERs, have become ubiquitous as a key component of utility energy efficiency or conservation program portfolios. Social benchmarking programs leverage behavioral psychology and social norms to lower residential energy usage by sending paper or electronic reports to residential customers that compare their household's energy consumption to that of similar neighboring households. While the energy savings are small, they can produce substantial aggregate energy savings because such programs typically reach a large number of customers. As of 2014, no social benchmarking programs were yet implemented in Ontario, Canada, and the Independent Electricity System Operator (IESO) determined that the opportunity for developing this conservation resource should be explored by piloting the program concept. In the fall of 2014, Hydro One Networks, Inc. (HONI), Horizon Utilities, and Milton Hydro each launched separate social benchmarking pilots. The overarching goals of the pilots were to:

- Learn about the behavioral responses of Ontarians to social benchmarking interventions and how data availability (and therefore program eligibility) may vary across high/medium/low electricity usage customers;
- Uncover lessons around deploying social benchmarking programs that maintain compliance with Ontario's privacy legislation;

- Respond to market interest in behavioral-based conservation programs; and
- Take a first step towards a market transformation that will provide residential electricity customers with access to near real-time information about their energy usage through in-home devices or social benchmarking tools.

Milton Hydro's Simple Energy program, called the Community Energy Challenge (CEC), launched on September 23, 2014. In this pilot, customers at Milton Hydro were invited to subscribe to the Simple Energy Engagement Platform (SEEP) through a combination of outreach channels, including email messages and outreach through students, teachers, and faculty in local schools.

The Horizon Utilities pilot also used Simple Energy's weekly Energy Insights emails, but was offered as an opt-out program. This pilot, named Take Charge • Save Energy • Earn Rewards, launched to nearly 50,000 customers in October 2014.

The pilot conducted at HONI delivered Opower paper HERs to more than 50,000 customers starting in November 2014. Table 1 summarizes all three pilots with notes about each pilot's experimental design.

Table 1. Summary of social benchmarking pilot designs

Pilot	Design	Treatment Customers	Control Customers	Delivery	Pilot Launch	Notes
Milton Hydro Simple Energy	Opt-in with matched control group	3,198	3,198 (matched control group)	Energy Insights emails	Sep. 2014	Additional school competition component
Horizon Simple Energy	RCT	42,000	8,000	Energy Insights emails	Oct. 2014	Additional treatment customers added later in pilot
HONI Opower HERs	RCT	52,000	20,000	Paper HERs	Nov. 2014	Focused on high energy users

Load Impact Estimation Methodology

The same methodology was used to estimate energy and demand savings for all three Social Benchmarking pilots. Horizon and HONI's programs were both RCTs, making impact estimation relatively consistent across the two pilots. Milton Hydro's pilot, the Community Energy Challenge, was opt-in and as such a randomly selected control group was not available. To estimate energy and demand savings for the Milton pilot, a control group was developed using propensity score matching. The fundamental idea behind the matching process was to find customers who did not participate in the program that have similar characteristics to those who did participate. In this procedure, a probit model was used to estimate a score for each customer based on a set of observable variables that were assumed to affect the decision to join Community Energy Challenge. A probit model is a regression model designed to estimate probabilities—in this case, the probability that a customer would choose to join the program. Each customer in the program is matched with a customer in the non-participant population that has the closest propensity score. The observable variables used in the matching process were monthly kWh consumption and daily load shapes.

The left panel of Figure 1 illustrates how the treatment group and matched control group have nearly identical load profiles on hot pre-treatment weekdays, especially during the summer peak hours. The difference in demand between the two groups during peak hours is less than 0.07%. On the right, Figure 1 presents average monthly electricity consumption for the treatment and matched control groups during the pre-treatment period. The difference in consumption between the two groups is less than 1.01% in each month. Once again, this shows that the matched group serves as a good control for the treatment population.

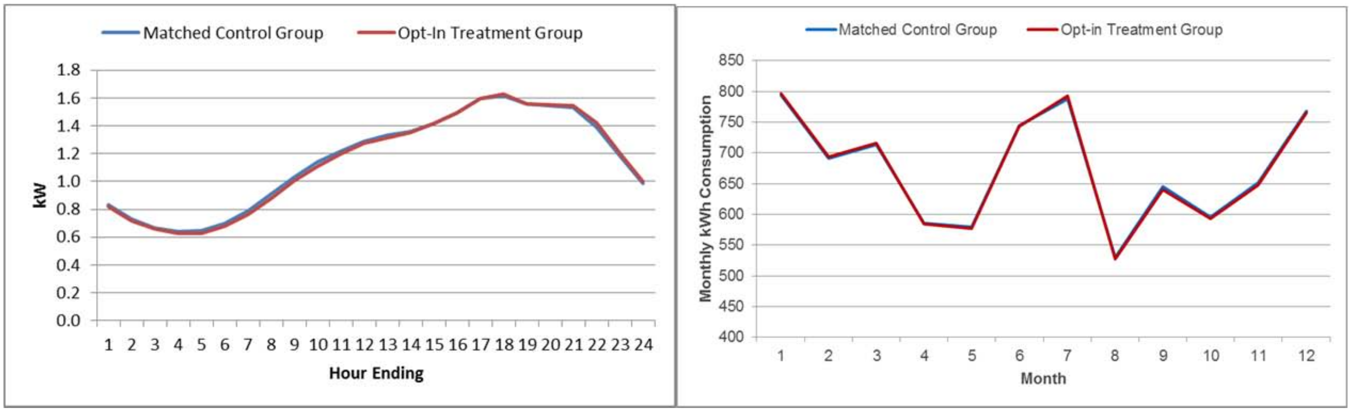

Figure 1. Pre-treatment August weekday load profile and monthly consumption

The impacts of the Simple Energy and Opower treatments on energy consumption can be estimated by comparing the energy consumption of treatment and control groups before and after they are assigned to comparison groups. In the case of HONI's Opower program, customers' monthly consumption data was provided by Opower. Hourly electricity usage data was used in the analysis of Milton and Horizon's Simple Energy programs. Impacts on electricity consumption were estimated using a monthly fixed effects model in which monthly energy consumption for treatment and control group customers is modeled using an indicator variable for month of the pilot, a treatment month indicator variable, and a customer-level indicator variable. The regression equation is presented here.

$$kWh_{it} = a + b * Treatment_i * Treatment\ Period_t + \sum_{cust=2nd\ cust}^{last\ cust} c_{cust} * C_i + \sum_{month=2nd\ month}^{last\ month} m_{month} * M_t + \varepsilon_{it}$$

Table 2. Energy savings model—variables and descriptions

Variable	Description
a	an estimated constant
b	the estimated impact
c and m	customer and month fixed effects
Treatment	a dummy variable indicating whether or not a customer is in the treatment group (=1) or not (=0)
Treatment Period	a dummy variable indicating whether the day is after program launch (=1) or not (=0)
C	a dummy variable indicating whether an observation belongs to that customer (=1) or not (=0)
M	a dummy variable indicating whether that observation belongs to that month (=1) or not (=0)
Cust	indexes all customers, both control and treatment customers.
Month	indexes each of the months, both pre-treatment and post-treatment.
ε	the error term

Demand savings were estimated for the IESO peak period using hourly electricity usage data. The summer peak period is defined to be weekdays from 1 to 7pm in June, July, and August. The winter peak period is 6 to 8 pm in December, January, and February. Demand savings attributable to the program were estimated using a difference-in-differences methodology. This methodology calculates the estimated impacts as the difference in average loads between treatment and control customers during peak hours minus the difference between the two groups during the peak period in the year prior to the program's launch.

The difference-in-differences model includes customer and day fixed effects to get the most statistically precise estimate possible given the data structure. Fixed effects are used to account for constant, unobserved differences for each subject. Customer fixed effects account for differences in usage between customers that are fixed across time, for example, some customers live in larger houses than other customers and always use more electricity than the customers in smaller homes. Time fixed effects account for differences in usage between time periods that are fixed across all customers. For example, time effects account for the fact that in general all customers use more electricity during hotter summer months than they do during cooler summer months. Only customers with complete data were included in the analysis.

$$kW_{it} = a + b * Treatment_i * Treatment\ Period_t + \sum_{cust=2nd\ cust}^{last\ cust} c_{cust} * C_i + \sum_{day=2nd\ day}^{last\ day} d_{day} * D_t + \varepsilon_{it}$$

Table 3. Demand savings model—variables and descriptions

Variable	Description
a	an estimated constant
b	the estimated impact
c and d	customer and day fixed effects
Treatment	a dummy variable indicating whether or not a customer is in the treatment group (=1) or not (=0)
Treatment Period	a dummy variable indicating whether the day is after program launch (=1) or not (=0)
C	a dummy variable indicating whether an observation belongs to that cust (=1) or not (=0)
D	a dummy variable indicating whether that observation belongs to that day (=1) or not (=0)
Cust	indexes all customers, both control and treatment customers
Day	indexes each of the days, both proxy days and event days
ε	the error term

It is possible that the Social Benchmarking pilots caused increased participation in energy efficiency programs sponsored by IESO and the local distribution companies (i.e., utilities). Because the energy savings estimate obtained by comparing the energy consumption of the treatment and control group contained the energy savings that resulted from increased participation in other energy efficiency programs, summing the energy savings from Social Benchmarking and other programs will result in double counting. To control for this phenomenon, it is necessary to adjust the savings obtained from the pilots by removing the energy savings from the social benchmarking pilot that are attributable to other programs.

Upstream programs, such as LED coupons, present a unique challenge in the estimation of double-counted savings because participation in these programs is not tracked at the customer level and therefore cannot be tied back to Simple Energy treatment and control homes for comparison. In response to this challenge, some assumptions have been made based on a similar HER program, IESO lighting coupon data, and the 2014 Consumer Program Evaluation, to facilitate an estimate of double-counting due to lighting.[1]

[1] http://www.powerauthority.on.ca/sites/default/files/conservation/2014-Evaluation-Consumer-Initiatives.pdf

In 2012, PG&E, a utility in northern California, conducted a home inventory survey of HER treatment and control customers. The survey analysis estimated that each HER recipient installed approximately one (0.95) more CFL than control group participants. In 2014, the consulting firm TRC Energy Services[2] used this estimate to estimate double counting of energy savings between the HER program and PG&E's Upstream Lighting Program (ULP). In TRC Energy Services' report, it is assumed that each HER customer purchases approximately one additional efficient bulb (LEDs and CFLs) compared to each control customer during the first year of HER treatment, with 1/12 of the bulbs being purchased each month. Additionally, TRC Energy Services assumes that 21% of the excess bulbs among treatment customers are attributable to the ULP. According to the 2014 Consumer Program Evaluation, 91% of specialty LEDs and 80% of general purpose LEDs purchased through the Coupon Initiatives program are installed and generating savings. All other data points and assumptions were provided to Nexant by the IESO. The assumptions and variables used to estimate the savings overlap from the Coupon Initiatives program and the pilots are presented in Table 4.

Table 4. Upstream savings overlap assumptions

Variable/Assumption	Source of Variable	Specialty LEDs	General Purpose LEDs
kWh savings per bulb	IESO coupon template	21.1	10.3
Extra efficient bulb per treatment customer	PG&E Home Inventory	0.95	0.95
Percent installed	2014 Consumer Program Evaluation (page 13)	91%	80%
Percent of excess bulbs attributable to coupon program	TRC Estimate (PG&E HER)	21%	21%

The savings overlap for each month is estimated using the following formula:

$$\begin{aligned}\text{Additional kWh savings attributable to coupon program} \\ &= \text{kWh savings per bulb } \times \text{additional bulb per treatment customer} \\ &\times \text{ percent of bulbs installed } \times \text{percent of bulbs attributable to coupon program} \\ &\times \text{percent of bulbs that are LEDs } \times \text{number of treatment customers}\end{aligned}$$

Simliarly, the social benchmarking interventions could have increased enrollment in the demand response program offering, peaksaverPLUS. The peaksaverPLUS program is open to residential and small commercial consumers who participate by allowing a one-way paging network to control either a programmable communicating thermostat (PCT) or load control switch to curtail electricity demand for central air conditioners, electric water heaters, or pool pumps during the peak period on high electricity demand days. peaksaverPLUS also offers participants an in-home display (IHD) that allows customers to monitor their electricity consumption and associated cost in real time. Ontario's LDCs are responsible for procuring the equipment offered and for jointly marketing the program with the IESO.

It is possible that enrolment in the pilots motivated customers to enroll in peaksaverPLUS. To estimate any possible increases in program enrolment attributable to the pilot, pre- and post-treatment peaksaverPLUS enrolment was compared between pilot treatment and control customers. Using this difference-in-differences approach, Nexant was able to estimate the incremental enrolment in peaksaverPLUS among treatment customers in the Milton Hydro and Hydro One pilots. The peaksaverPLUS enrollment data necessary for this estimate was not available for Horizon pilot customers.

[2] TRC. Lighting Savings Overlap in 2014 IOU Residential Behavioral Programs.TRC (June 30, 2015). Revised TRC memo, Proposed Changes to Draft ULP HER Lighting Savings Overlap for 2014, (October 22, 2015).

Milton Hydro Community Energy Challenge

Milton Hydro's Simple Energy program— the Community Energy Challenge (CEC)—launched on September 23, 2014. In this pilot, customers at Milton Hydro were invited to subscribe to the Simple Energy Engagement Platform (SEEP) through a combination of outreach channels including email messages and outreach through students, teachers, and faculty in local schools. About 19,300 customers for whom Milton had email addresses received direct email invitations over the course of the pilot (about 12 months). Others, for whom Milton may not have had an email address, were also recruited through schools, social media, community events, and word of mouth. Ultimately, about 3,400 customers opted in to receiving weekly emails called Energy Insights, and 1,941 of those customers engaged with the SEEP website. Customers did not join the pilot all at the same time.

Those subscribed to the SEEP service received weekly energy messages with energy savings tips along with access to a web portal at which they could explore their energy use, set goals, and compete for rewards for committing to changing their energy consumption or signing up for utility programs. All subscribers received Energy Insights on a weekly basis unless they opted out of the pilot. Two kinds of rewards were offered to those who engaged with the website—rewards to schools for energy savings and participation of customers who elected to sponsor the school (as part of the enrollment process); and rewards to individuals for signing up for utility programs and saving energy. The rewards to the schools were substantial (ranging from $500 to $4,000 per school) while the rewards for individual actions were smaller (i.e., gift cards ranging in value from $5 to $10).

The fixed-effects regression model shows that treatment customers consumed between 0.1 kWh and 1.6 kWh less per day than control customers during the analysis period beginning September 2014 and ending August 2015. On a percentage basis, these energy savings range from 0.4% to 5.9%, varying by month, likely due to a combination of seasonal weather changes and duration of treatment. These savings are significant for 3 out of the 12 months presented in Table 5. During the analysis period, treatment customers consumed approximately 266.0 MWh less than control group customers, in total.

Table 5. Milton Hydro Simple Energy—energy savings by calendar month

Month	Treatment Customers	Days	Treatment Daily kWh	Control Daily kWh	Daily kWh Impact	95% Conf. Interval		% Impact	Aggregate MWh Impact	
2014m9	443	30	22.7	22.7	0.1	-0.90	1.06	0.4%	1.1	
2014m10	496	31	19.3	19.9	0.5	-0.29	1.37	2.7%	8.3	
2014m11	549	30	22.9	23.7	0.8	-0.08	1.60	3.2%	12.5	
2014m12	704	31	24.7	26.3	1.6	0.76	2.35	5.9%	33.9	*
2015m1	793	31	26.2	27.2	1.1	0.26	1.87	3.9%	26.2	*
2015m2	913	28	26.7	27.5	0.8	-0.21	1.76	2.8%	19.8	
2015m3	2,365	31	21.5	22.0	0.5	-0.04	1.00	2.2%	35.1	
2015m4	2,781	30	18.5	18.9	0.4	0.11	0.78	2.3%	37.0	*
2015m5	2,900	31	20.4	20.7	0.3	-0.07	0.65	1.4%	25.7	
2015m6	3,212	30	22.0	22.2	0.3	-0.17	0.67	1.1%	24.1	
2015m7	3,240	31	29.9	30.3	0.3	-0.12	0.79	1.1%	33.6	
2015m8	3,254	23	27.5	27.6	0.1	-0.33	0.56	0.4%	8.6	
Pilot	1,804**	29	23.7	24.1	0.4	0.13	0.69	1.7%	266.0	*

* Indicates significant energy savings
** Average number of customers throughout the course of the pilot

Demand savings were estimated for the IESO peak period. The summer peak period is defined to be weekdays from 1 to 7pm in June, July, and August. The winter peak period is 6 to 8 pm in December, January, and February. Demand savings attributable to the program were estimated using the difference-in-differences methodology described previously.

Only 3,117 out of about 3,400 customers had complete interval data covering the pre-treatment and post-treatment peak periods. Only customers with complete data were included in the analysis and the pre- and post- periods vary by customer. On average, treatment customers' peak demand is 0.04 kW less than their counterparts in the winter and 0.02 kW less in the summer. This is an aggregate impact of 141.5 kW in the winter and 74.2 kW in the summer. These savings are statistically significant.

Table 6. Milton Hydro Simple Energy—peak demand savings by season

Season	Control Customers	Treatment Customers	Average kW Impact	Percent Impact	Aggregate kW Impact	95% Confidence Interval	
Winter	3,117	3,187	0.04	3.0%	141.5	51.8	231.2
Summer			0.02	1.6%	74.2	8.3	140.0

As indicated previously, it is possible that the Simple Energy pilot caused increased participation in energy efficiency programs sponsored by IESO and Milton Hydro. The savings overlap for each month is estimated using the following formula:

$$\begin{aligned} &Additional\ kWh\ savings\ attributable\ to\ coupon\ program \\ &\quad = kWh\ savings\ per\ bulb\ \times additional\ bulb\ per\ treatment\ customer\ \times\ percent\ of\ bulbs\ installed \\ &\quad \times percent\ of\ bulbs\ attributable\ to\ coupon\ program\ \times percent\ of\ bulbs\ that\ are\ LEDs \\ &\quad \times number\ of\ treatment\ customers \end{aligned}$$

Nexant estimates that the overlap in kWh savings between Community Energy Challenge and the Coupon Initiatives lighting program is approximately 3,937 kWh, which is an adjustment of about 1.5%. The adjusted kWh savings of Community Energy Challenge is 262,063 kWh. The demand savings overlap for the summer peak period is calculated in a similar way. The estimated kW overlap between Community Energy Challenge and the Coupon Initiatives lighting program is about 0.5 kW, or an adjustment of about 0.6%. The final adjusted kW savings of the pilot is 73.7 kW.

Horizon Take Charge • Save Energy • Earn Rewards

Horizon's Simple Energy program, Take Charge • Save Energy • Earn Rewards, launched on October 24, 2014. In this pilot, 50,000 residential customers at Horizon Utilities were presented with a combination of weekly energy messages called Energy Insights and access to a web portal at which they could explore their energy use, set goals, and compete for rewards by pledging to lower their energy consumption. All treatment customers received Energy Insights emails on a weekly basis unless they opted out. To view the web portal, customers had to voluntarily enroll in the web system. All residential customers for whom Horizon possessed email addresses were eligible for treatment with a small number of technical exceptions. In addition to the treatment group, a group of 8,000 customers was randomly selected from the pool of eligible customers and set aside as a control group. Assignment to treatment and control groups was carried out by Horizon after customers were screened from the pilot based on the email and technical eligibility criteria.

Treatment customers received a welcome email in late October 2014, explaining that they would be receiving Energy Insights weekly alerts and an invitation to the web portal. This was followed by three additional invitations to visit the web portal. Following the welcome message, customers received Energy Insights on a weekly basis. Once at the portal, participants could learn more about how they use energy over time, how their home energy use compares to that of others, and what actions could be taken to use less electricity. Participants who visited the portal were encouraged to save energy through drawings to win reward miles to be used for airline travel. Participants who were in the top 25% of energy savers on any day were eligible for the drawings.

Program impacts on electricity consumption were estimated using the panel regression described previously. Treatment customers consumed between 0.03 kWh and 0.45 kWh less per day than control customers during the analysis period, representing a range of 0.2% to 1.7% reductions in electricity use on a percentage basis. Excluding the first month of treatment, the lowest daily energy reduction is 0.1 kWh, occurring in the last three months of the pilot, translating to percentage impacts of about 0.4%. Energy savings vary depending on the month, likely due to a combination of seasonal weather changes and duration of treatment. These savings are significant for 8 out of the 12 months presented in Table 7. During the analysis period, treatment customers consumed approximately 3,028 MWh less than control group customers, in total.

Table 7. Horizon Simple Energy—energy savings by month

Month	Treatment Customers	Days	Treatment Daily kWh	Control Daily kWh	Daily kWh Impact	95% Conf. Interval		% Impact	Aggregate MWh Impact	
2014m10	42,335	31	19.7	19.8	0.03	-0.15	0.21	0.2%	39.6	
2014m11	41,931	30	22.6	22.8	0.20	0.03	0.37	0.9%	246.7	*
2014m12	41,555	31	24.4	24.7	0.23	0.03	0.44	0.9%	299.9	*
2015m1	41,292	31	26.0	26.3	0.28	0.05	0.51	1.1%	353.4	*
2015m2	41,034	28	26.7	27.2	0.45	0.21	0.70	1.7%	521.2	*
2015m3	40,817	31	22.9	23.1	0.27	0.07	0.47	1.2%	339.2	*
2015m4	40,577	30	19.7	20.0	0.26	0.11	0.41	1.3%	319.1	*
2015m5	40,260	31	20.6	20.7	0.18	0.01	0.34	0.9%	222.6	*
2015m6	39,910	30	22.7	23.0	0.25	0.07	0.43	1.1%	297.6	*
2015m7	39,491	31	30.6	30.7	0.10	-0.10	0.31	0.3%	125.2	
2015m8	38,981	31	27.8	28.0	0.12	-0.07	0.32	0.4%	147.8	
2015m9	38,565	30	26.7	26.8	0.10	-0.08	0.28	0.4%	115.9	
Pilot	40,562**	30	24.2	24.4	0.21	0.09	0.32	0.9%	3,028.1	*

* Indicates significant energy savings

** Average number of customers throughout the course of the pilot

Demand savings were estimated for the IESO peak period. The summer peak period is defined to be weekdays from 1 to 7pm in June, July, and August. The winter peak period is 6 to 8pm in December, January, and February. Demand savings attributable to the program were estimated using the difference-in-differences methodology described previously. On average, treatment customers' peak demand is 0.02 kW and 0.01 kW less than their counterparts in the winter and summer periods, respectively. This is an aggregate impact of 0.59 MW in the winter and 0.51 MW in the summer. These savings are significant.

Table 8. Horizon Simple Energy—peak demand savings by season

Season	Control Customers	Treatment Customers	Average kW Impact	Percent Impact	Aggregate MW Impact	95% Confidence Interval	
Winter	7,159	38,652	0.02	1.1%	0.59	0.18	1.01
Summer			0.01	1.0%	0.51	0.17	0.85

It is possible that the Simple Energy pilot caused increased participation in energy efficiency programs sponsored by IESO and Horizon. The savings overlap for each month is estimated using the following formula:

$$
\begin{aligned}
&\textit{Additional kWh savings attributable to coupon program} \\
&\quad = \textit{kWh savings per bulb} \times \textit{additional bulb per treatment customer} \times \textit{percent of bulbs installed} \\
&\quad \times \textit{percent of bulbs attributable to coupon program} \times \textit{percent of bulbs that are LEDs} \\
&\quad \times \textit{number of treatment customers}
\end{aligned}
$$

Nexant estimates that the overlap in kWh savings between the pilot and the Coupon Initiatives lighting program is approximately 49,446 kWh, which is an adjustment of about 1.6%. The adjusted kWh savings of the Simple Energy treatment is 2,978,654 kWh. The demand savings overlap for the summer peak period is calculated in a similar way. The estimated kW overlap between Community Energy Challenge and the Coupon Initiatives lighting program is about 5.3 kW, or an adjustment of about 1.0%. The final adjusted kW savings of the pilot is 503.4 kW.

HONI Opower Home Energy Reports

HONI's Opower HER pilot was launched in November 2014. In this pilot, 50,000 residential customers in the top two usage quartiles for HONI were presented with Opower HERs – periodic comparisons of their household electricity consumption with that of other similar households. In addition to the treatment group, another group of 20,000 randomly selected customers in the top two quartiles was set aside as a control group. Assignment to treatment and control groups was carried out by Opower after customers were screened from the pilot based on the eligibility criteria.

The first reports were sent in November 2014, and customers received five reports on average. Treatment customers generally received three monthly reports at the outset of the treatment—between late November and late January. Reporting resumed in July, after a pause in the spring, and customers were provided with reports for two more months.

Program impacts on electricity consumption were estimated using the panel regression described previously. Treatment customers consumed between 0.1 kWh more and 1.1 kWh less per day than control customers during the analysis period, November 2014 to October 2015. Excluding the first month of the pilot, the lowest impact occurs in December 2014: 0.2 kWh per day. Energy savings vary depending on the month, likely due to seasonal changes in weather. These savings are significant for most months presented in Table 9. During the analysis period, treatment customers consumed approximately 11,063 MWh less than control group customers, in total.

Table 9. Hydro One Opower—energy savings by month

Month	Treatment Customers	Days	Treatment Daily kWh	Control Daily kWh	Daily kWh Impact	95% Conf. Interval		% Impact	Aggregate MWh Impact	
2014m11	52,250	30	61.4	61.4	-0.1	-0.33	0.19	-0.1%	-106.3	
2014m12	51,967	31	72.8	73.1	0.2	-0.10	0.59	0.3%	398.7	
2015m1	51,830	31	82.2	82.9	0.7	0.33	1.07	0.8%	1,124.1	*
2015m2	51,653	28	84.8	86.0	1.1	0.73	1.53	1.3%	1,625.8	*
2015m3	51,504	31	68.7	69.6	1.0	0.64	1.29	1.4%	1,537.6	*
2015m4	51,322	30	51.7	52.4	0.6	0.40	0.87	1.2%	979.2	*
2015m5	51,090	31	42.5	43.0	0.5	0.33	0.69	1.2%	808.1	*
2015m6	50,817	30	43.6	44.0	0.5	0.29	0.63	1.0%	700.2	*
2015m7	50,469	31	46.9	47.4	0.5	0.32	0.67	1.1%	776.2	*
2015m8	50,031	31	47.2	47.8	0.6	0.43	0.78	1.3%	938.5	*
2015m9	49,610	30	43.7	44.4	0.7	0.54	0.89	1.6%	1,055.0	*
2015m10	49,257	31	43.3	44.1	0.8	0.62	0.99	1.8%	1,225.8	*
Pilot	50,983**	30	57.6	58.2	0.6	0.43	0.70	1.0%	11,062.7	*

* Indicates significant energy savings
** Average number of customers throughout the course of the pilot

Demand savings were estimated for the IESO peak period. The summer peak period is defined to be weekdays from 1 to 7pm in June, July, and August. The winter peak period is 6 to 8 pm in December, January, and February. Demand savings attributable to the program were estimated using the difference-in-differences methodology described previously. Only customers with complete data were included in the analysis. On average, treatment customers' peak demand is 0.03 kW less than their counterparts in both the summer and winter periods. This is an aggregate impact of 1,300 kW in the winter and 1,077 kW in the summer. These savings are statistically significant.

Table 10. Hydro One Opower—peak demand savings by season

<table>
<tr><th>Season</th><th>Control Customers</th><th>Treatment Customers</th><th>Average kW Impact</th><th>Percent Impact</th><th>Aggregate kW Impact</th><th colspan="2">95% Confidence Interval</th></tr>
<tr><td>Winter</td><td rowspan="2">19,839</td><td rowspan="2">49,613</td><td>0.03</td><td>0.7%</td><td>1,300.1</td><td>436.5</td><td>2,163.8</td></tr>
<tr><td>Summer</td><td>0.02</td><td>1.0%</td><td>1,076.5</td><td>647.4</td><td>1,505.6</td></tr>
</table>

As indicated previously, it is possible that the Opower pilot caused increased participation in energy efficiency programs sponsored by IESO and Horizon. The savings overlap between the LED coupon program was estimated using the methodology described previously and the following formula. The savings overlap for each month is estimated using the following formula:

$$
\begin{aligned}
&Additional\ kWh\ savings\ attributable\ to\ coupon\ program \\
&\quad = kWh\ savings\ per\ bulb\ \times additional\ bulb\ per\ treatment\ customer\ \times\ percent\ of\ bulbs\ installed \\
&\quad \times percent\ of\ bulbs\ attributable\ to\ coupon\ program\ \times percent\ of\ bulbs\ that\ are\ LEDs \\
&\quad \times number\ of\ treatment\ customers
\end{aligned}
$$

Nexant estimates that the overlap in kWh savings between the pilot and the Coupon Initiatives lighting program is approximately 63,539 kWh, which is an adjustment of about 0.6%. The adjusted kWh savings of the Opower treatment is 10,999.1 MWh. The demand savings overlap for the summer peak period is calculated in a similar way. The estimated kW overlap between HERs and the Coupon Initiatives lighting program is about 6.1 kW, or an adjustment of about 0.6%. The final adjusted kW savings of the pilot is 1,070.4 kW.

Conclusions

While the energy savings associated with social benchmarking programs are small, when introduced to large populations of residential customers, they can produce substantial aggregate energy savings. The three pilots implemented by HONI, Horizon Utilities, and Milton Hydro represent an important initial foray into this segment of residential conservation program offerings for the Canadian province of Ontario. The analysis conducted for these pilots represents outcomes associated with only a first year's implementation of social benchmarking programs. Evaluations of these pilots, if they continue into second or third years of implementation, may show maturation of energy savings, or changing attitudes or engagement with program incentives and gamification strategies.

The three pilots tested covered a range of delivery mechanisms and social benchmarking strategies, and were demonstrated by both large and small utilities. These pilots tested both paper mail delivery and email delivery of neighbor comparison reports and also tested varying gamification program design components—some pilots featured no rewards or competition components, and others did, where the reward components also varied: opportunities to earn community-based rewards were used in one pilot, while rewards directed at the individual customer were also used in two of the pilots. All three pilots were evaluated after one year of pilot duration. On a per customer basis, the HONI pilot yielded the most energy savings: each customer, on average, saved 0.6 kWh per day at HONI, as compared to 0.4 kWh per day at Milton Hydro and 0.2 kWh per day at Horizon. However, the HONI pilot specifically targeted customers that use more energy: the control customers at Milton and Horizon use about 24 kWh per day as compared with 58 kWh per day used, on average, by control customers at HONI.

The bottom line MWh yield of the pilots, representing the savings accrued by the pilots across the entire year, reflect the per customer savings that varied across the utilities in addition to the differing numbers of customers included in the pilots. Milton Hydro's pilot was the smallest, with about 1,800 customers participating, on average, across the year. The number of participants in the Milton Hydro pilot grew from an initial 500 customers to a total of 3,200 customers by the end of the pilot. Pilot participation at the other two LDCs was stable and much larger – about 40,000 participants received the treatment at Horizon and 50,000 participants received the treatment at HONI. Overall, 266 MWh of energy was saved at Milton Hydro, compared to 3,028 MWh at Horizon, and 11,063 MWh at HONI.

Comparing load impacts on a percentage basis, however, Milton Hydro's pilot resulted in the highest energy savings as a percentage of usage: Treatment customers at Milton Hydro saved on average 1.7% of their electricity usage per day. Horizon and HONI customers' electricity savings were lower: Horizon customers on average saved 0.9% in electricity usage per day and HONI customers saved 1% in electricity usage. Examining the energy savings on a percentage basis over time reveals some interesting points of departure among these three different approaches to social benchmarking program implementation. The HONI pilot demonstrates consistently statistically significant energy savings throughout the year, after first demonstrating a ramp-up of savings during the first couple of months of the pilot, and then settling into savings ranging between 1.0% and 1.8% each month, where the lower energy savings around 1% are clustered in the summer months. After the summer months, savings rebound to their highest levels of the pilot.

Horizon also demonstrates their lowest energy savings during the summer months (excluding the first month of the pilot), but the summer months also coincide with the last months of the pilot, which raises the question of whether customer engagement with the electronic comparative reports flagged with time, or whether dips in the summer months occur due to the seasonal change in household energy consumption. For example, If the pilot was strong in motivating reduced lighting energy consumption and weak in motivating reduced air conditioning consumption, the program may show larger impacts during winter months. In Horizon's case, the initial fall, winter, and spring energy savings range from 0.9% to 1.7% but the final summer months' savings fell dramatically to 0.3% to 0.4%.

Milton Hydro's pilot demonstrated far more volatility in monthly energy savings, with the highest energy savings occurring in the winter, topping out at 5.9% in December 2014. A centerpiece feature of the pilot at Milton Hydro was the school competition, which ended in the spring of 2015, and which is also when energy savings dropped below 2%, and fell to 0.4% in August 2015. Fall and winter energy savings ranged from 2.2% to 5.9%, suggesting that the school competition resulted in the highest levels of engagement among the three utilities.

Together, these three pilots produce an interesting first chapter as social benchmarking programs begin to be implemented in Ontario. HONI's traditional approach with paper comparative reports produced consistent energy savings where HONI can look to the future for the possible maturation of energy savings that typically comes in the second or third year of a successful HER deployment. Paper HER deployments have high costs and such a maturation may be necessary to achieve a cost-effective implementation. Horizon's electronic-only deployment may have lower delivery costs, but the continuation of the offering should address the very low impacts observed at the end of the pilot. Does an electronic offering have a short shelf-life or does the product that was deployed need to more effectively drive savings in the summertime? Finally, the Milton Hydro competitive, community-based challenge framework surrounding the electronic-only product generated compelling savings during the school year. But that success was of limited duration and the numbers of participants were quite small. Perhaps the success in high engagement was due in part to the emphasis on the local community and could not be replicated in larger service territories that don't enjoy the same level of local involvement. Further, how often would a school-based competition be replicable – how can maintenance, once new habits are formed and household electricity usage is lowered, be gamified? The long-term viability of social benchmarking programs in Ontario will depend on the extent to which large and small utilities can take advantage of the benefits, given the size of their customer base and strength of connection to their community, that can be achieved through different delivery modes, incentives, and gamification.