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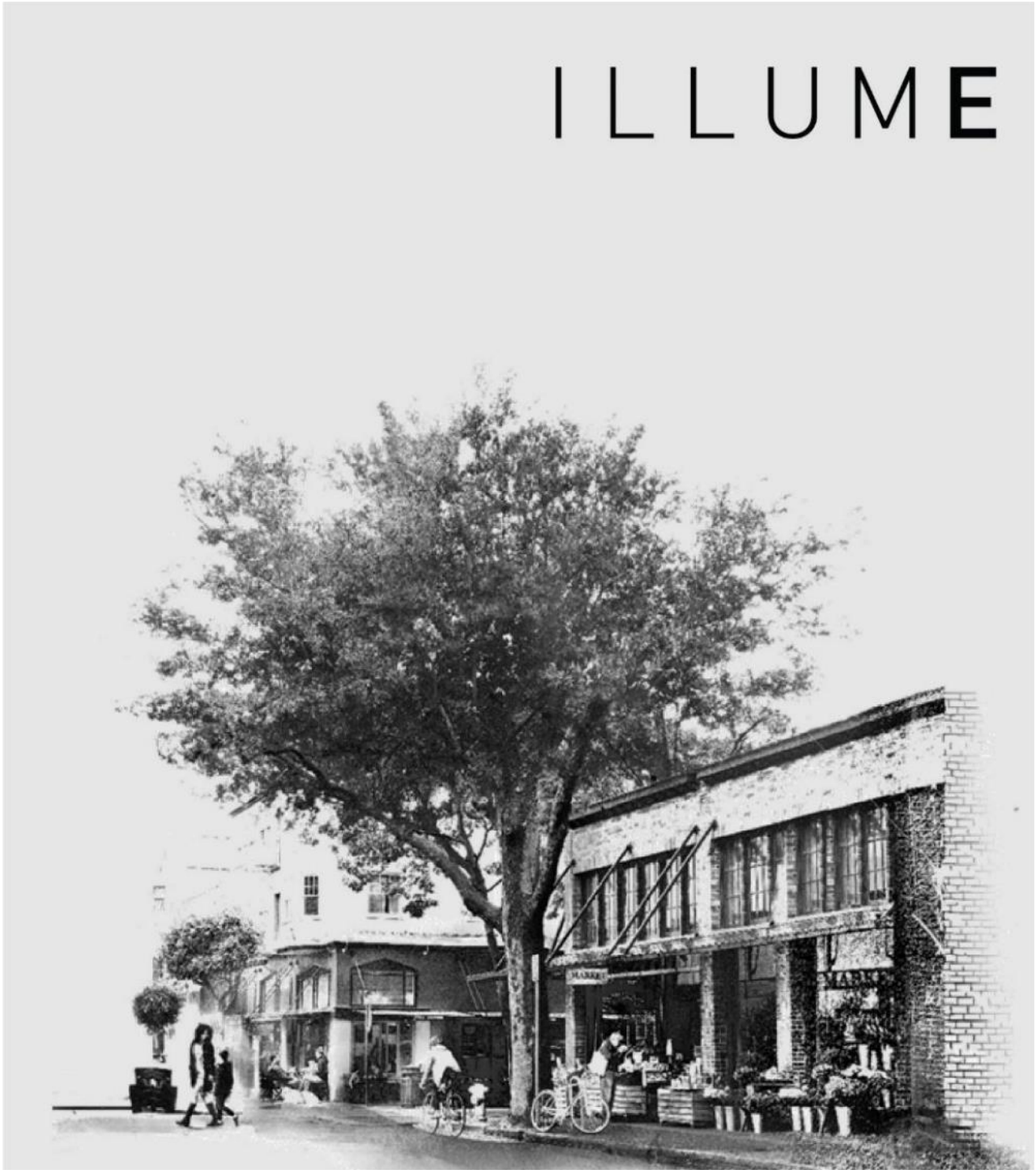

PROJECT:

Rhode Island Statewide Behavioral Evaluation: Savings Persistence Literature Review

PROJECT SPONSOR:

National Grid Rhode Island

ACKNOWLEDGMENTS

ILLUME Advising, LLC is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013 by industry thought-leaders Anne Dougherty and Sara Conzemius, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy future to enrich lives, improve global health, and ensure a more secure and sustainable future.

For this effort, we would like to acknowledge, first and foremost, National Grid Rhode Island. We would also like to acknowledge the ILLUME team member Allison T. Musvosvi.

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EXECUTIVE SUMMARY

ILLUME Advising, LLC is pleased to present National Grid with our literature review and analysis of behavioral program persistence studies with special consideration to the applicability of the studies to National Grid Rhode Island's Statewide Behavioral Program.

STUDY OBJECTIVES AND METHODS

The ILLUME team conducted a thorough search and review of research addressing the research question: ***What happens to energy savings when Home Energy Report (HER) recipients no longer receive reports or if they receive reports at a reduced cadence*?** The team reviewed research from 11 utilities involving, in total, 17 customer groups. Accounting for gas, electric, and dual fuel customers, and research studies conducted over multiple years, we reviewed 42 annual savings results. The team analyzed study results, paying particular attention to: fuel type, length of time customers received reports, climate/location, customer baseline energy use, and customer characteristics. Incorporating these comparisons, the team developed four predictive scenarios, suggesting the possible impact on savings if National Grid Rhode Island altered the report cadence of its Statewide Behavioral Program customer groups.

Notably, the customer groups in each study we reviewed differ from Rhode Island in one or more areas such as baseline energy use, demographics, housing stock, exposure to the program, and climate. Thus, we use the

results drawn from other studies to suggest possible impacts from altering report cadence, but we do not assume that results from other studies will accurately predict performance in Rhode Island.

KEY FINDINGS AND RECOMMENDATIONS

- *Finding 1: Across 15 study groups, the decay rate for first-year electricity savings ranges from 2 percent to 36 percent with a median of 20 percent*. The median remained around 20 percent even when the team subset the studies based on location, report cadence, and length of treatment period.
- *Finding 2. Most customer treatment groups have high baseline electric and natural gas energy use which may limit their applicability to Rhode Island*. Many programs specifically select high energy users, while on average, the Rhode Island customer treatment groups have moderate baseline energy use. Research literature suggests that customers with higher baseline energy use typically save more energy as a result of receiving HERs (Alcott, 2011). In the literature review, only one program had customers with moderate baseline energy use and that program had widely varying decay rates of 6 percent and 32 percent for its two study groups.
- *Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island should take into account the potential risks and rewards of over- or under-predicting savings*. For example, in this report we present scenarios showing 20 percent and 30 percent first-year decay rates. A lower decay rate assumption may over-predict actual savings while a higher decay rate assumption could cause a program to fail a benefit-cost screen and result in a missed opportunity.
- *Finding 3: Results from multi-year studies in Illinois and Connecticut suggest that decay rates may accelerate over time.*
- *Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island may want to model savings assuming a 40 to 80 percent decay in for electricity savings in years 2 through 4 after treatment stops.* However, any assumptions will also need to take into account the risks and rewards of over- or under-predicting savings.
- *Finding 4. Only 4 studies have examined savings decay in natural gas usage and they report widely varying results of 0 to 150 percent decay rates. The single study of natural gas decay over time, reports modest increases in decay rates from 7 percent to 38 percent over five years.*
- *Recommendation: For predictive benefit-cost modeling for natural gas savings, National Grid Rhode Island should model high and low savings decay scenarios while understanding the uncertainties of these assumptions.*
- *Finding 5. Approaches such as report timing, report cycling, electronic portals, and emailed reports may provide options for modifying the treatment approach to reduce costs, yet maintain more savings over completely stopping reports. However, these approaches have not been thoroughly tested and compared against the typical HER program.*
- *Recommendation: National Grid Rhode Island's Statewide Behavioral Program may benefit (from a benefit-cost perspective) from modifying the treatment approach. We suggest piloting new approaches when the current implementer contract ends. Two approaches that may merit further scoping and testing are:*

- *Report cycling: National Grid can test the effect on electricity savings from cycling reports with a one year on/one year off cadence. The pilot could split larger treatment waves (such as the March 2013 or January 2014 waves) so that a portion of each wave receives reports each year.*
- *Report timing: For natural gas, National Grid can test sending fewer reports and only send them during the heating season. For example, the program might send reports only in October and January.*

1. INTRODUCTION

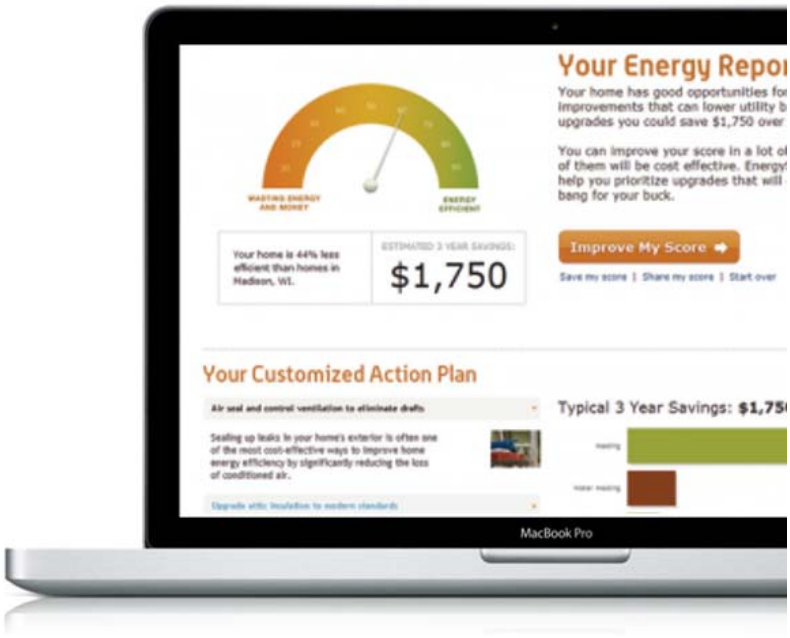
ILLUME Advising, LLC is pleased to present National Grid with our literature review and analysis of behavioral program persistence studies. Specifically, we reviewed Home Energy Report (HER) programs that encourage reductions in energy use by sending residential customers several paper reports per year that include normative comparisons of energy use along with energy saving tips. Generally, the industry accepts that HER programs typically save one percent to two percent of baseline energy use per year of treatment through a combination of equipment purchase behaviors, one-time behaviors, and habitual (recurring) behaviors (Khawaja & Stewart, 2014). Researchers are less certain about the persistence of these savings when programs reduce report cadence or stop reports altogether.

In the sections that follow, we review the existing research on the persistence of savings generated by HERs with particular attention to the applicability of each study to Rhode Island considering climate, program maturity, fuel type, participant characteristics, report cadence, and other factors in National Grid Rhode Island's program. We also explore persistence longer-term and reference the research on reducing the cadence of reports (rather than wholly eliminating) considering strategies to optimize reporting cadence.

1.1 OVERVIEW OF HER BEHAVIORAL PROGRAMS

Behavioral programs usually deliver HERs as a single page, double-sided report that includes the following components:

- similar home comparison
- feedback indicators of this comparison
- historical use data
- suggestions to lower home energy use by way of structural modifications or behavioral changes that reduce electricity or natural gas usage
- promotion of energy efficiency programs and rebates offered by the customer's utility.



Some programs deliver feedback via email either in place of or in addition to paper reports. Many programs use an opt-out experimental design by randomly selecting a treatment group and a control group from a screened group of eligible residential customers. The treatment group customers automatically receive the HER monthly, bi-monthly, quarterly, or other cadence while the control group customers do not receive the report. Program implementers and evaluators measure the impact of the reports on energy use by comparing the change in energy use from a pre-period to the treatment period between the treatment group and the control group.

HER programs with an experimental design differ from other energy efficiency programs in that all eligible participants are included in the intervention. Treatment customers must opt-out of the program if they do not want to receive the report. Consequently, even unwilling participants will receive the treatment. The randomized control trial design eliminates the effect of other biases such as self-selection and free-riders. As such, measured differences in energy usage or other program uplift is the result of receiving the HERs.

HERs apply the theory that providing normative information and feedback will result in changes in behavior and ultimately reduce energy consumption. Essentially, when customers receive positive feedback about their home energy use compared to other homes, they will be motivated to maintain their lower energy use. Similarly, households who receive feedback that they are using more energy than their similar neighbors will be motivated to reduce their energy use (Alcott & Rogers, 2012).

1.2 HER MEASURE LIFE AND SAVINGS PERSISTENCE

Many utilities adopt a one-year measure life for HERs by assuming the effects of HERs last only so long as customers receive reports (Hoffman et al, 2015). However, since some savings result from equipment changes and/or habituated behaviors, savings likely do not cease when the reports stop. A fuller understanding of how HER savings persist and decay in different scenarios can have the following benefits:

- By assuming a one-year measure life, savings that should be attributed to HER programs may be unclaimed if the program stops sending reports.
- Using the results from a single program year as the estimate for annual savings incorrectly assumes that measured savings are independent of previous year's activities. Understanding the persisted savings as well as the incremental savings that result from multiple years of HER treatment increases the accuracy of cost-effectiveness calculations (Khawaja & Stewart, 2014).
- Accounting for the shape of the savings decay over time (linear or curved) and the aspects of the program design that may affect savings decay (e.g. length of program, cadence of report delivery, delivery methodology, etc.) can increase the accuracy of long-term assumptions about HER program savings (Jenkins & Weaver, 2017).
- Understanding persistence and lifetime savings when a program sends fewer reports helps programs optimize and balance the costs of sending HERs with energy savings generated by HERs to improve cost effectiveness.
- Applying a more accurate measure life to HER programs may affect the prioritization of HER programs in relation to other efforts in a utility's energy efficiency portfolio (Hoffman et al., 2015).

1.3 NATIONAL GRID RHODE ISLAND'S STATEWIDE BEHAVIORAL PROGRAM

National Grid Rhode Island's Statewide Behavioral Program launched in March 2013 with dual fuel, electric only, and gas only groups of customers. These first groups of customers have now received reports for over four years. The program included additional gas-only customers in October 2015, and additional electric-only customers in September 2016 and March 2017. For each wave, the program implementer, Oracle (formerly Opower), randomly assigned qualifying customers to treatment and control groups. Treatment group customers received paper Home Energy Reports (HERs) that compare their usage to a group of similar homes, show trends in usage over time, and provide energy saving tips.

Annual savings from all customer groups combined comprise 31 percent of the residential electric portfolio in the 2018 plan.[1] The Behavioral program has the second largest planned annual electric savings in the residential sector. In National Grid Rhode Island's 2018 gas plan, the behavioral program comprises 53 percent of annual residential gas savings (largest program). Benefit-cost analysis ratios are 1.88 using the RI test for the electric portion and 3.08 for the gas portion.

TABLE 1.. NATIONAL GRID RHODE ISLAND BEHAVIORAL PROGRAM*

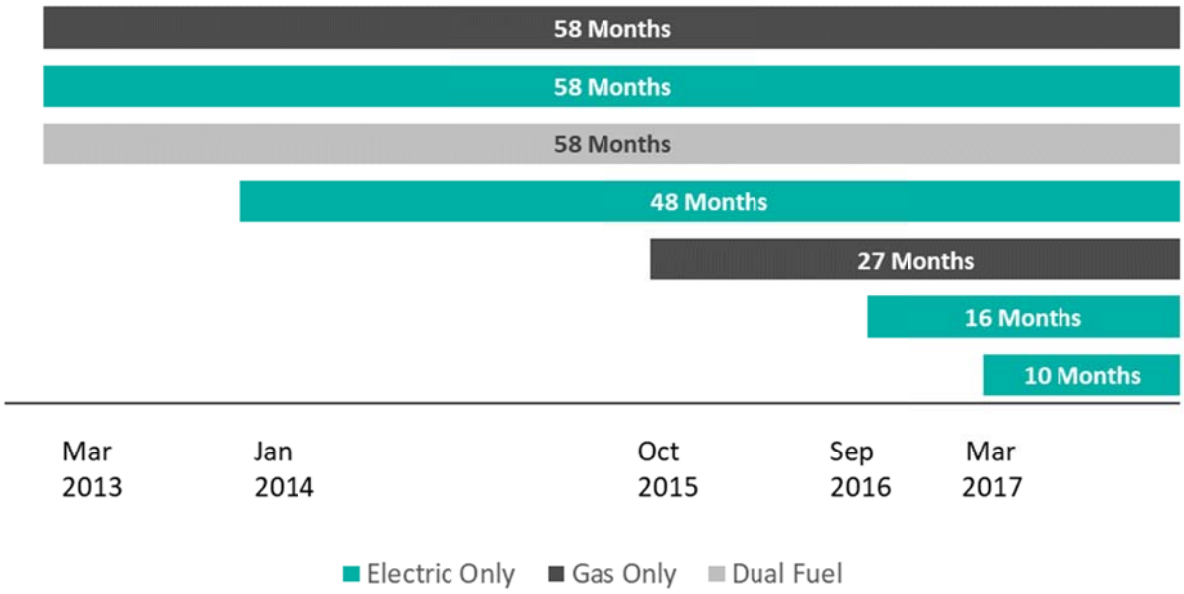
Fuel type	Start month	Average energy usage of treatment and control	Number of treatment customers (as of December 2016)	Number of control customers (as of December 2016)	Number of print reports in 2016
DUAL FUEL	March 2013	7,081 KWH, 803 therms	87,513	9,567	7
ELECTRIC ONLY**	March 2013	9,746 KWH	88,426	8,298	7
	January 2014	6,826 KWH	40,279	7,295	7
	September 2016	4,964 KWH	13,265	13,302	3
GAS ONLY	March 2013	767 therms	13,518	5,920	2 in early 2016 and 3 in later 2016
	October 2015	730 therms	11,429	2,867	2 in early 2016 and 3 in later 2016

*This table does not include the New Mover waves. New Movers are customers that recently activated service. Since the studies we reviewed do not address this population, we do not include the Rhode Island New Movers in our comparisons.

**An additional wave of Electric-only customers started in March 2017.

[1] All plan values are from Docket 4755, Annual Energy Efficiency Plan for 2018 submitted by The Narragansett Electric Company d/b/a National Grid, November 1, 2017. Retrieved online: http://rieermc.ri.gov/wp-content/uploads/2017/11/4755-ngrid-eepp2018_11-1-17.pdf

FIGURE 1: NATIONAL GRID RHODE ISLAND PROGRAM TREATMENT PERIODS



National Grid Rhode Island serves nearly 99 percent of residential electric customers in Rhode Island[2] and combined, the HER treatment and control group electric only and dual fuel customers account for about 80 percent of residential customers. Given the saturation of the program in Rhode Island, the team referenced U.S. Census data to describe the characteristics of participating Rhode Island customers.[3] While few of the reviewed studies included demographic information, we characterize Rhode Island since differences in household characteristics may correlate with overall energy use and energy conservation opportunities (O'Neill and Chen, 2002; Brounen et al, 2012; Fredericks et all, 2015).[4]

[2] Based on data retrieved from the U.S. Energy Information Administration: www.eia.gov

[3] The team requested and received demographic data by wave from the program implementer. However, so much of the data for many households were not available (e.g. 41 percent of the Dual Fuel – March 2013 customers did not have an indicator for age of home) that we felt using statewide Census data would give a more accurate picture of Rhode Island residential customers.

[4] While the direction of the relationships in the research literature is not clear cut, the research team includes demographics to help the reader assess how Rhode Island customers may be similar to, or different from, other study populations. The research team also includes this information to encourage future studies to consider these factors.

Rhode Island homes are older than the US average, with nearly half (49 percent) of homes built before 1960 and only 7.5 percent built since 2000. In the US overall, 28 percent of homes were built before 1960 and 18 percent since 2000. Rhode Island homes also tend to be smaller with 85 percent of homes having three or fewer bedrooms while nationally 77 percent of occupied housing units have three or fewer bedrooms. Fifty-four percent of Rhode Island homes are heated with gas while 10 percent are heated with electricity.

Most households are smaller than the US average with 66 percent of households comprised of one or two persons with 27 percent including children. In the US overall, 61 percent of households are comprised of one or two persons while 32 percent have children. The median age of households in Rhode Island is 40.2 compared to 37.9 for the US overall. Statewide, the median household income is $60,596 though household income for home-owners is higher: $84,246.

2. METHODOLOGY

The ILLUME team searched evaluation reports, conference proceedings, academic journals, industry research, and reached out to professional contacts to find research related to the persistence of HER program savings. We examined research from 11 utilities involving, in total, 17 customer groups. Accounting for gas, electric, and dual fuel customers, and research studies conducted over multiple years, we reviewed 42 annual savings results. In all the studies, researchers took a group of customers that had received HERs for some length of time and either stopped all reports or reduced the quantity of reports. Researchers then used the experimental design to estimate changes in energy use during the period of report cessation.

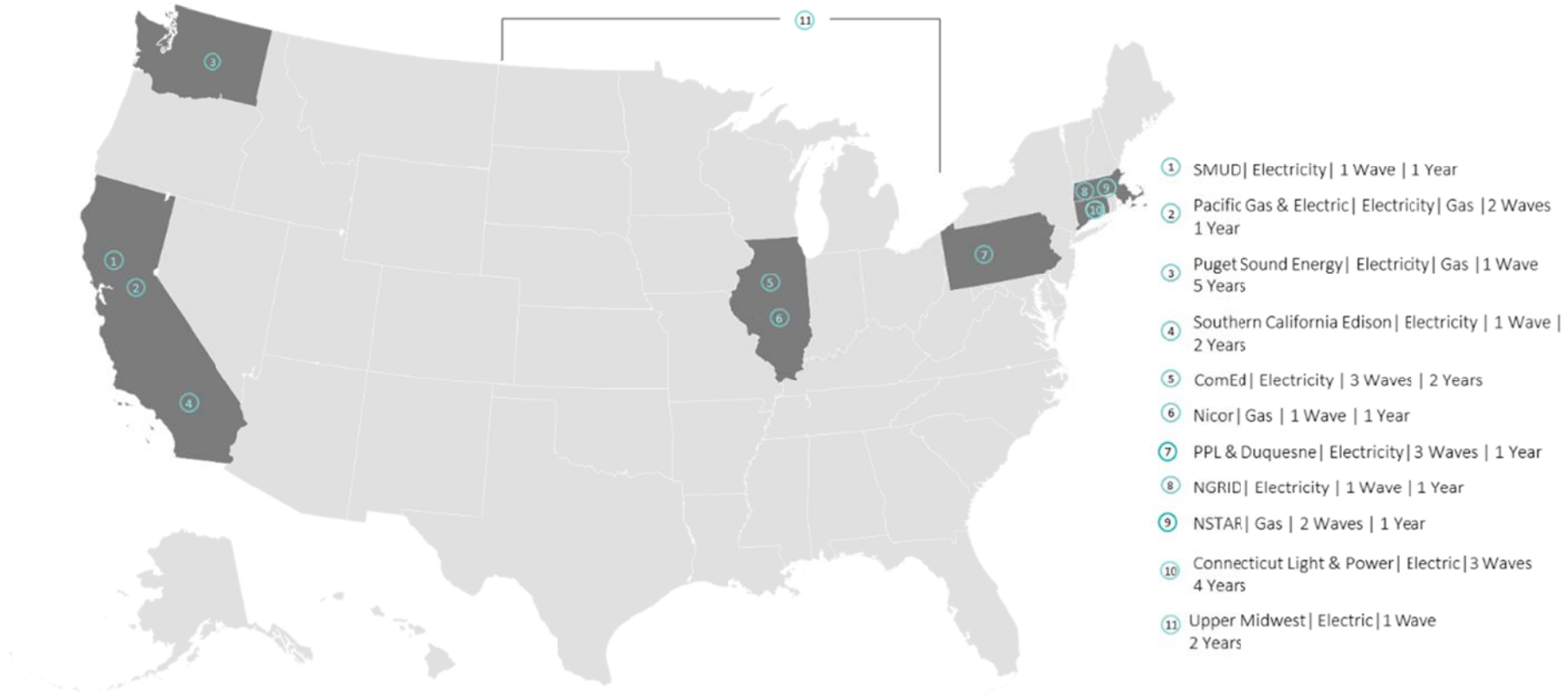
Figure 2 shows the locations, fuel-type, number of customer groups, and the number of years of results in the studies we reviewed. Details on each study group can be found in Appendix B. In Chapter 3 we look at subsets of studies to understand how results differ by:

- Geography/climate
- Length of treatment
- Baseline energy use
- Reduced report cadence rather than complete cessation
- Savings decay beyond the first year

The studies that we reviewed did not report savings decay or statistical significance consistently. We report savings from each study as a percentage showing how much savings declined compared to the savings experienced by customers before report cessation. Some studies only reported the statistical significance of the savings point estimate for time-period after report cessation. Other studies reported the statistical significance of the difference between savings in the time-period after report cessation and savings in the last year of report treatment. Some studies reported the statistical significance of the decay rate. Some studies reported standard errors, but not all. We provide notes on indicators of statistical significance in Appendix A. Since all these studies leverage an experimental design, point estimates are considered unbiased even if the estimates are too small or have standard errors that are too large to meet typical criteria of statistical significance.

In Chapter 4, we draw from these subsets of results to identify four scenarios to understand the possible impact of report cessation or report cadence reduction on National Grid Rhode Island's Statewide Behavioral Program savings. It is important to note that the scenarios are hypothetical scenarios to help define parameters for future planning. Customers' opportunities and barriers to saving energy can be affected by baseline energy use, demographics, housing stock, climate, energy knowledge, and exposure to messaging, among other factors. Rhode Island differs from each of the studies we reviewed on one or more of these factors. In particular, the Rhode Island behavioral program is a statewide program that includes customers with low and moderate baseline energy use while most HER programs target high energy users. Research suggest that high baseline energy users tend to save more as a result of receiving HERs (Alcott, 2011). These differences may also affect the persistence of savings after report cessation, though none of the studies that the ILLUME team reviewed specifically addressed the influence of baseline energy use on savings persistence. Thus, results from other studies are suggestive of what might happen in Rhode Island, but are not determinative and should be applied to Rhode Island cautiously.

FIGURE 2. STUDIES REVIEWED



3. ANALYSIS OF SAVINGS PERSISTENCE STUDIES

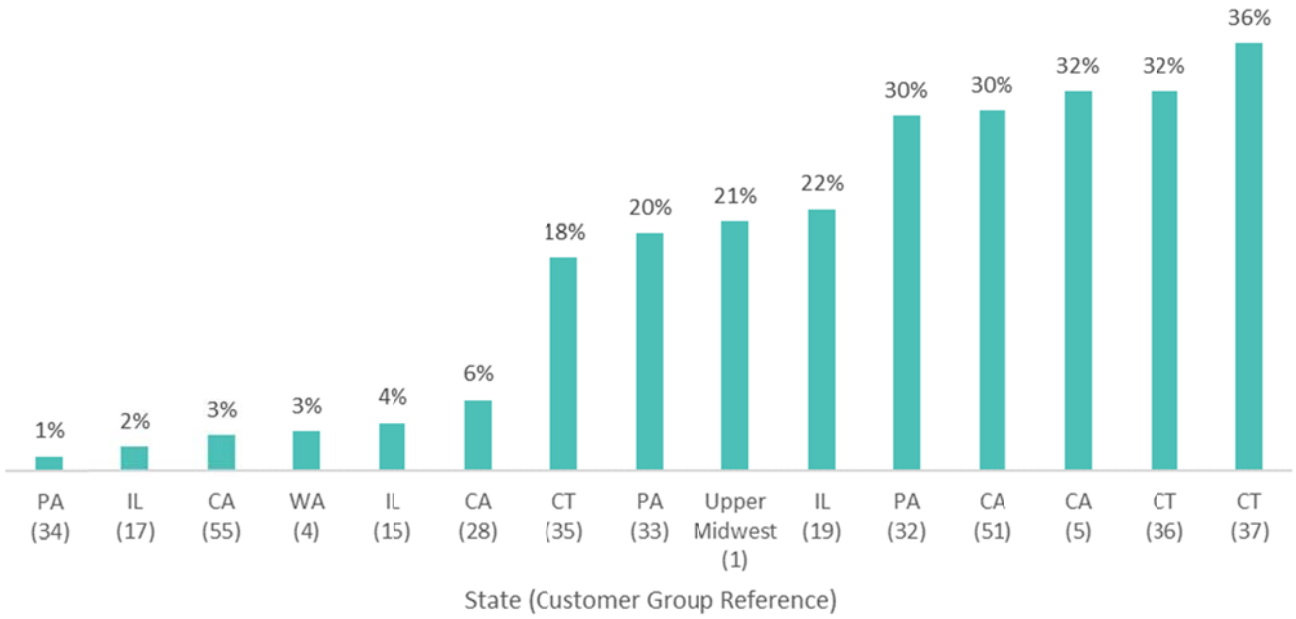
Below we analyze persistence study results from the literature, specifically looking at program delivery (report cadence), length of the treatment period, comparable geography, baseline energy use, fuel type, and multi-year results. In each comparison, the decay rate shows how much savings declined compared to the savings experienced by customers in the last year of report treatment. For example, a treatment group that has a decay rate of 20 percent after the first year of report cessation, had savings equivalent to 80 percent of the savings experienced in the year before report cessation. Savings persisted, but at a lower rate.

3.1 SAVINGS DECAY: ELECTRIC SAVINGS

Figure 3 compares the first-year[5] decay of electric savings across 15 customer groups. The median savings decay is 20 percent with a range between a low of 1 percent and a high of 38 percent. Results cluster into three groups: 1) six groups experienced savings decay of 1 percent to 6 percent; 2) four groups experienced decay of 18 percent to 22 percent; 3) five groups experienced decay of 30 percent to 36 percent.

[5] Some studies looked at time periods of longer than 12 months as the post-period. Unless the study breaks out decay rates by first year, second year, etc., we treat the results as "first year" decay rates.

FIGURE 3. SAVINGS DECAY AMONG ELECTRIC CUSTOMERS[6]



3.2 REPORT CADENCE PRIOR TO CESSATION: ELECTRIC SAVINGS

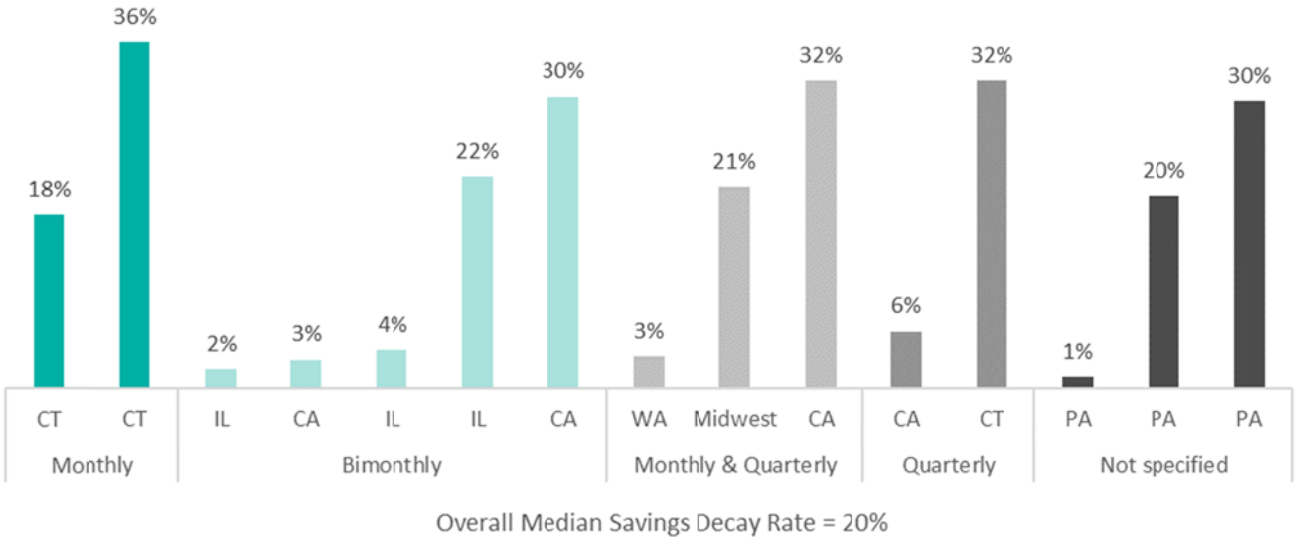
Among HER programs report cadence varies from monthly to bi-monthly to quarterly. The National Grid Rhode Island program sent seven reports to the dual fuel and electric cohorts in 2016. Overall, we see no clear pattern of differences in decay rates by report cadence prior to cessation (Figure 4).

The Connecticut study (NMR, 2017) included two groups that received reports monthly and one group that received reports quarterly. However, even within a single service territory, the decay rate for the quarterly group is very close to one of the monthly groups and less than the other monthly group. Similarly, the Puget Sound Energy (PSE) study (DNV GL, 2017) found that the group that received reports monthly prior to cessation had greater savings persistence after five years, but the difference was small and not statistically significant.

[6] In tables and figures throughout the report we provide "Customer Group Reference" and "Report Reference" codes to assist with cross-referencing with the Appendix and the reference list.

We should note that many programs have shifted report cadence over time, often starting with monthly reports and reducing the cadence after the first year or two. Consequently, among the persistence studies we reviewed, some of the customer study groups combined groups that received reports on differing cadences or involved a customer group that experienced a change in cadence before report cessation. We used the cadence in the year before cessation to describe the groups.

FIGURE 4. SAVINGS DECAY BY REPORT CADENCE (ELECTRIC CUSTOMERS)



3.3 LENGTH OF TREATMENT PERIOD: ELECTRIC SAVINGS

The National Grid Rhode Island Statewide Behavioral Program includes electric-only customer treatment groups that have received reports for 58 months, 48 months, 16 months, and 9 months (as of December 2017). Figure 5 compares first-year savings decay for electricity customers among groups that received reports for more than 24 months before cessation compared to those that received reports for fewer than 24 months before cessation.[7] Figure 6 shows a scatterplot of savings decay by length of treatment. The cadence of reports varies for each study group. We include the report cadence and other study details in Table 2.

[7] We chose 24 to have approximately equal-sized groups. Three study groups received reports for 24 months. If we modify the group definitions to be up to 24 months and more than 24 months then the median decay for the up to 24 months group is 20% and the median decay for the more than 24 months group is 18%.

We see no difference in median first-year decay rates based on length of treatment. Study groups that received reports for fewer than 24 months before cessation have a median first-year decay rate of 20 percent, as do the groups that received reports for 24 or more months. The maximum decay rate among groups with shorter treatment periods is 36 percent while the maximum among the group with longer treatment periods is 32 percent. Among all customer groups, all but one group received reports for at least 12 months before cessation, so we do not have good comparisons of very short treatment periods.

FIGURE 5. SAVINGS DECAY BY TREATMENT LENGTH (ELECTRIC CUSTOMERS)

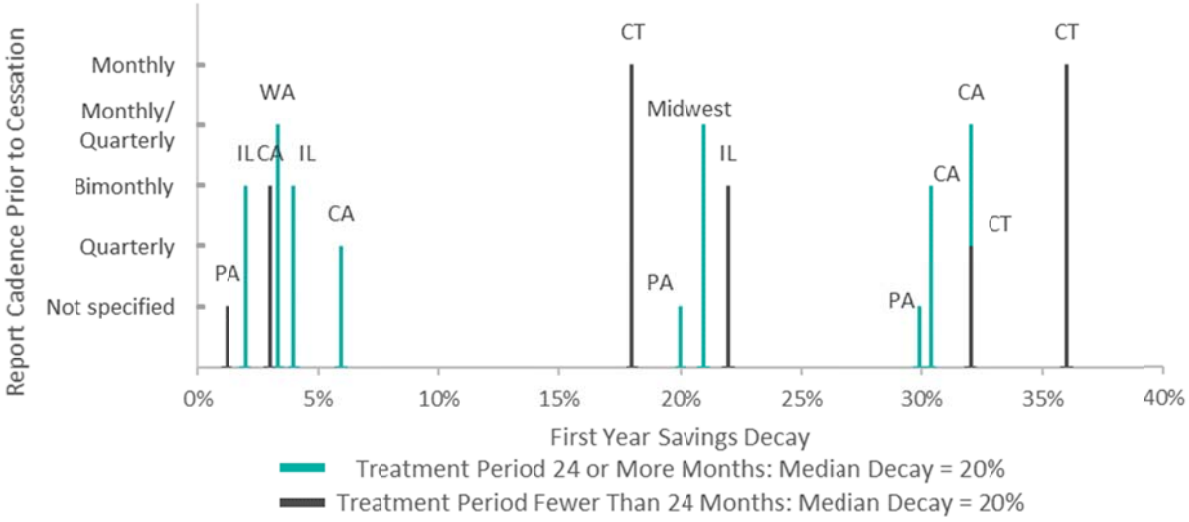


FIGURE 6. SAVINGS DECAY BY TREATMENT LENGTH (SCATTERPLOT OF ELECTRIC CUSTOMERS)

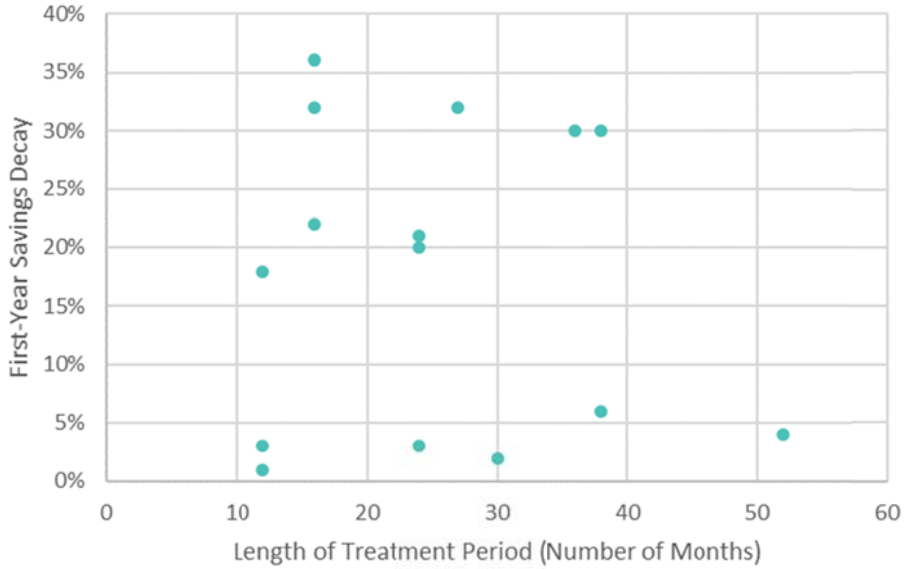


TABLE 2. SAVINGS DECAY BY TREATMENT LENGTH (ELECTRIC CUSTOMERS): STUDY DETAILS

CUSTOMER GROUP REFERENCE[8]	STATE	ANNUAL SAVINGS DECAY RATE	NUMBER OF TREATMENT MONTHS PRIOR TO CESSATION	ANNUAL ENERGY USE*	REPORT REFERENCE
24 OR MORE MONTHS OF TREATMENT					
17	Illinois	2%	30	Unknown	y
4	Washington	3%	24	More than 80 MBTU (electric and natural gas)	i
15	Illinois	4%	52	Unknown	y
53	California	6%	38	6,884 kWh	j
33	Pennsylvania	20%	24	Average more than 27,000 kWh	x
1	Upper Midwest	21%	24	More than 80 MBTU (electric and natural gas)	d,o
32	Pennsylvania	30%	36	Average more than 18,000 kWh	x
51	California	30%	38	6,884 kWh	j
14	California	32%	27	11,376 kWh	n,o
FEWER THAN 24 MONTHS OF TREATMENT					
34	Pennsylvania	1%	12	Average 13,500 kWh	x
55	California	3%	12	Unknown: "high energy users"	k
35	Connecticut	18%	12	Unknown: "high energy users"	ae
19	Illinois	22%	16	Unknown	y
36	Connecticut	32%	16	Unknown: "high energy users"	ae
35	Connecticut	36%	16	Unknown: "high energy users"	ae

*Annual energy use is based on data available in the reports. Some reports did not provide specific values, but only described the groups as “high energy users”. Other studies only provided combined gas and electricity usage. The later were dual-fuel programs. We include as much description as possible, even if imperfect, to help the reader assess the applicability of these study groups to other territories.

3.1 GEOGRAPHY/CLIMATE: ELECTRIC SAVINGS

Figure 7 shows results from savings persistence studies in territories with similar weather patterns to Rhode Island: warm, humid summers and cold winters. However, these programs vary by report cadence

[8] In this and in following tables we provide “Customer Group Reference” and “Report Reference” codes to assist with cross-referencing with the Appendix and the reference list.

(monthly, bi-monthly, quarterly) and length of treatment (8 months to 52 months). See Table 3 for study details. Figure 7 compares the first-year decay of electric savings among 10 customer groups in Connecticut, Illinois, Pennsylvania, and an unspecified "Upper Midwest" state. These study groups have a median savings decay of 20 percent with a maximum of 36 percent. Three customer groups experienced savings decay of less than 5 percent.

FIGURE 7. SAVINGS DECAY BY STATE (ELECTRIC CUSTOMERS)

These Midwest, Northeast, and Mid-Atlantic customer groups received reports for varying lengths of time from 8 months to 52 months. Customers had greater baseline electricity usage (where reported) than National Grid Rhode Island customer groups. Table 3 includes more details on the study groups included in this comparison along with details on National Grid Rhode Island customer groups for comparison.

TABLE 3. SAVINGS DECAY BY STATE (ELECTRIC CUSTOMERS): STUDY DETAILS

CUSTOMER GROUP REFERENCE	STATE	ANNUAL SAVINGS DECAY	NUMBER OF TREATMENT MONTHS PRIOR TO CESSATION	REPORT CADENCE PRIOR TO CESSATION	ANNUAL ENERGY USE	REPORT REFERENCE
34	Pennsylvania	1%	12	Not specified	Average 13,500 kWh	x
17	Illinois	2%	30	Bi-monthly	Unknown	y
15	Illinois	4%	52	Bi-monthly	Unknown	y
35	Connecticut	18%	16	Monthly	Unknown: "high energy users"	ab/ae
33	Pennsylvania	20%	24	Not specified	Average above 27,000 kWh	x
1	Upper Midwest	21%	24	Monthly & Quarterly	80 MBTU	d,o
19	Illinois	22%	16	Bi-monthly	Unknown	Y
32	Pennsylvania	30%	36	Not specified	Average above 27,000 kWh	x
36	Connecticut	32%	16	Quarterly	Unknown: "high energy users"	ab/ae
37	Connecticut	36%	8	Monthly	Unknown: "high energy users"	ab/ae
NATIONAL GRID RHODE ISLAND PROGRAM COMPARABLE GROUPS						
Dual Fuel 2013	Rhode Island	NA	58	7	7,081 kWh	
Elec 2013	Rhode Island		58	7	9,746 kWh	
Elec 2014	Rhode Island		48	7	6,826 kWh	
Elec 2016	Rhode Island		16		4,964 kWh	

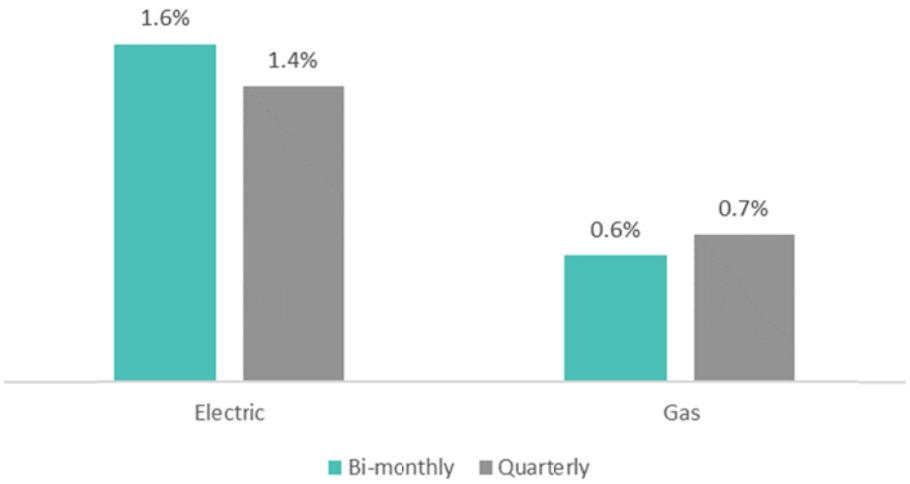
3.2 REDUCING REPORT CADENCE

While many programs have changed report cadence over time, few program sponsors have published studies that specifically examine the impact of changing the report cadence. We found two studies, one from Massachusetts (Opinion Dynamics, 2017), and one from California (PG&E: DNV GL, 2017), that addressed the impact of reducing report cadence.[9]

[9] The team is also aware of another reduced cadence study in the Midwest with results to be published in 2018. If the report is public, the team will send the report to National Grid RI.

The Pacific Gas & Electric (PG&E) HER program consists of several waves of customers that started receiving reports at different times. Early on, the program implementer split one of the waves into two groups with one group receiving bi-monthly reports and the other group receiving quarterly reports. The wave started receiving reports in November 2011. Results from 2015 (after about 4 years of reports) show that the reduced frequency (quarterly) group had about 15 percent lower savings, suggesting that the quarterly group generated much of the same savings as the bi-monthly group. For gas savings, the quarterly group had higher savings, although both groups had savings under one percent of baseline usage (see Figure 8).

FIGURE 8. SAVINGS BY REPORT CADENCE: PG&E GAMMA WAVE (2015 UNADJUSTED SAVINGS*)



*Savings shown are unadjusted for participation in other energy efficiency programs. The report did not include standard errors for these savings estimates.

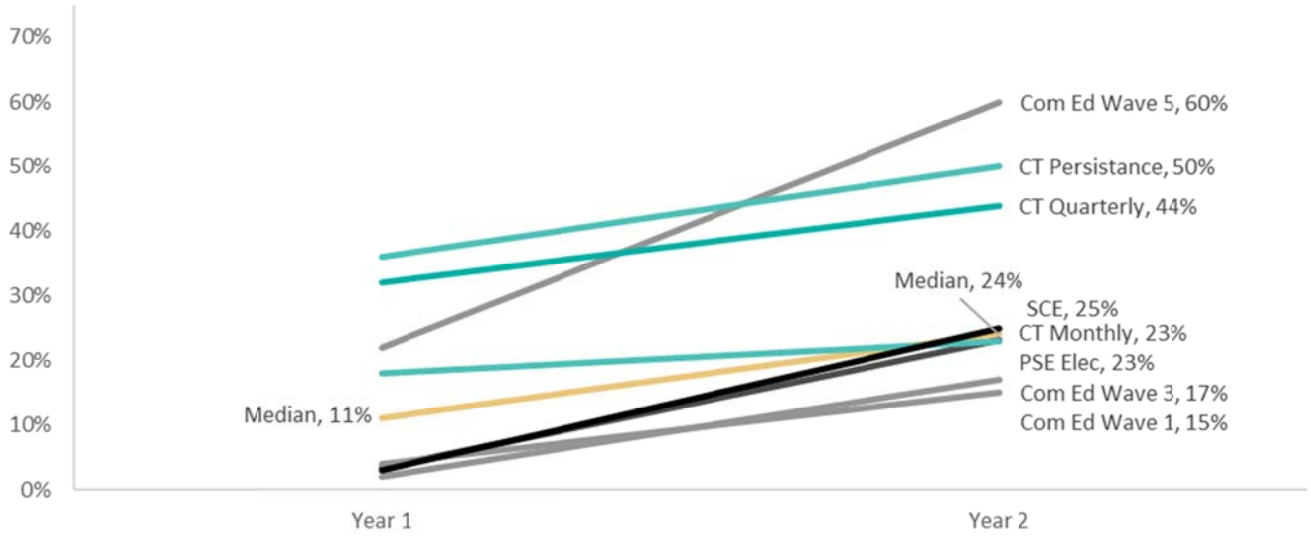
Source: Adapted from Table 15 from DNV GL. May 2017. *Review and Validation of 2015 Pacific Gas and Electric Home Energy Reports Program Impacts.*

The Massachusetts study authors (Opinion Dynamics, 2014) note that customers experienced inconsistent reductions in report cadence, the study had small customer groups, and that the study results were inconclusive. The study included multiple electric and gas customer study groups: 1) Customers with email addresses on file continued to receive emailed reports with no reduction in frequency and received paper reports at a reduced cadence; and 2) Customers without email addresses on file received paper reports at a reduced cadence. Electric customers received reports bimonthly for two years, followed by a 10-month cessation, followed by two monthly reports, followed by a final three-month gap. Gas customers received fall and winter reports for the first 15 months, followed by a gap, followed by reports in February and March, followed by an additional two reports (on average) in the following fall/winter. Reduced cadence groups experienced a less than one percent reduction in savings, but the results were inconclusive given the difficulties with the pilot design.

3.3 MULTI YEAR SAVINGS DECAY

Four studies provide multi-year results: SCE, Puget Sound Energy, ComEd, and Eversource (Connecticut Light and Power). Figure 9 compares decay rates among seven study groups for the first two years after treatment cessation. As noted, for each year post-cessation, savings are shown as a percentage of the savings in the last year prior to cessation. The median decay for the first year is 11 percent with a range of 2 percent to 36 percent. The median for this subset of study groups may be different from the larger subsets since it only contains study groups from three utilities. By year 2, the spread of decay rates had increased to a 45-percentage point difference between the lowest and highest with a median decay of 24 percent.

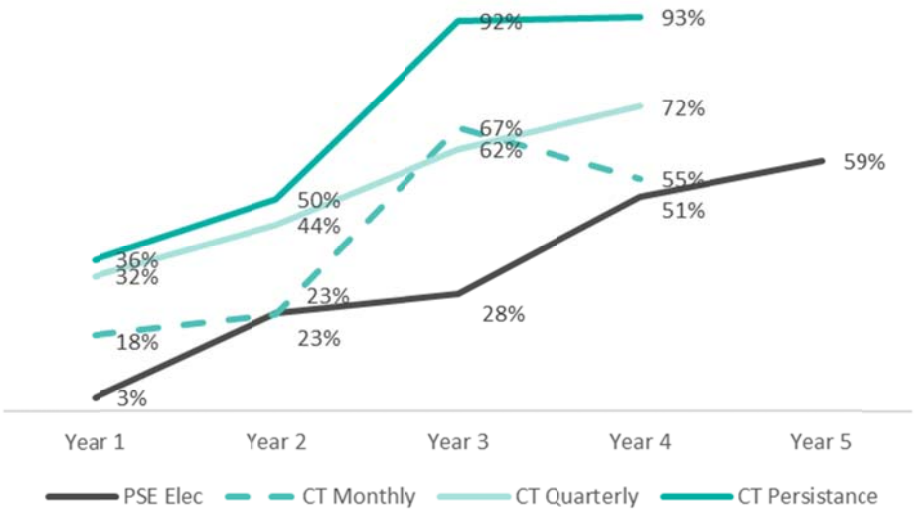
FIGURE 9. ESTIMATED ELECTRIC SAVINGS DECAY FOR YEAR 1 AND YEAR 2 POST-TREATMENT



The PSE and the Eversource (Connecticut Light and Power) studies include results from three to five years post treatment cessation. PSE shows fairly steady degradation each year with savings in year 5 decaying by 59 percent compared to savings from the last year before reports ended. In contrast, the Connecticut customer groups lose savings more rapidly with nearly all savings ending by year four for one of the customer groups.

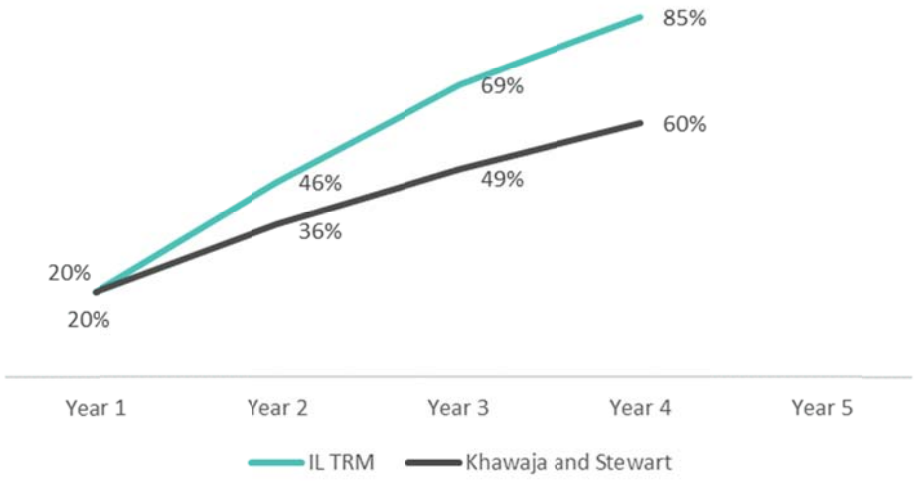
While most reports did not provide detailed descriptions of customer characteristics, DNV GL (2014) does provide more detail on PSE treatment customers. Like Rhode Island, the program services dual fuel single family homes. However, PSE customers are younger with an average age of 30.9, their households are larger with an average of 2.2 occupants, and their homes are larger with an average of 3.6 bedrooms. As noted in Section 1, customer characteristics may correlate with energy use and energy conservation opportunities. While the direction of the correlation is not straightforward from the research, by comparing PSE and Rhode Island demographics we see that customer characteristics between the two areas differ considerably. To the extent that younger and larger homes may have more opportunities to save energy, savings decay after report cessation in PSE may differ from Rhode Island.

FIGURE 10. ESTIMATED ELECTRIC SAVINGS DECAY RATES OVER TIME



In a meta-analysis published in 2014, authors Khawaja and Stewart concluded that savings decay about 20 percent per year after the cessation of reports. However, as shown above, some studies suggest that the decline may accelerate each year. Based on the experience of ComEd (Navigant, 2016), the IL TRM recommends decay rates that increase over time (see Figure 11).

FIGURE 11. ESTIMATED ELECTRIC SAVINGS DECAY RATES OVER TIME



3.4 NATURAL GAS SAVINGS DECAY

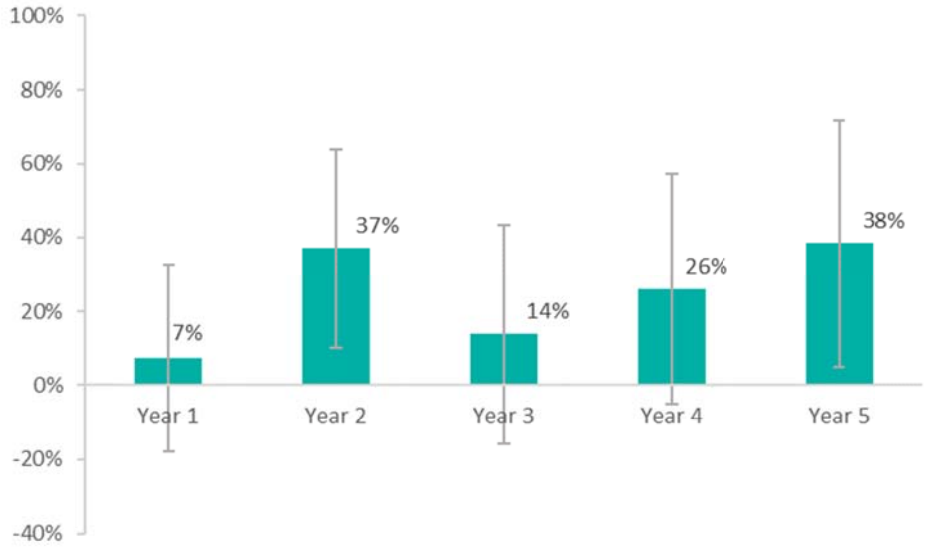
Only four studies have addressed the decay of natural gas savings when customers stop receiving HERs. Table 4 displays the widely varying results of these studies. Natural gas savings from HER programs are often smaller and more seasonally sensitive than electric savings (Sussman and Chikumbo, 2016). As such, savings persistence may be more sensitive to seasonal factors, baseline energy use, and other customer characteristics. The unusual value of 150 percent for PG&E indicates that customers actually experienced higher savings in the year after report cessation than in the year before report cessation.

TABLE 4. SAVINGS DECAY FOR NATURAL GAS CUSTOMERS: STUDY DETAILS

CUSTOMER GROUP REFERENCE	STATE	ANNUAL SAVINGS DECAY RATE	NUMBER OF TREATMENT MONTHS PRIOR TO CESSATION	BASELINE ANNUAL ENERGY USE	REPORT REFERENCE
9	Washington	7%	12	More than 80 MBTU (electric and natural gas)	i
22	Illinois	46%	52	2,848 therms	t, ac
52	California	150%	24	381 therms	j
54	California	0%	24	381 therms	j

Only one study (PSE in Washington; DNV GL, 2017) has analyzed gas savings decay over time. PSE customers show moderate reductions in savings each year after report cessation (Figure 12). In year 2, customers experienced 37 percent decay of the savings they experienced in their last year of receiving reports. Savings then re-bounded in year 3 before steadily decaying again. However, given the limited studies on natural gas savings and PSE's generally low electric savings decay compared to other studies, we are reluctant to generalize PSE's natural gas results.

FIGURE 12. PUGET SOUND ENERGY NATURAL GAS SAVINGS DECAY RATES



3.5 ADDITIONAL CONSIDERATIONS

Several additional factors may affect savings decay rates, though these have not been well-studied:

Online portals: Many utilities provide online portals that help customers track their energy use and provide energy-saving tips. Utilities often make these portals available to all customers, including HER recipients. These portals could provide an alternative information source for former HER recipients to help maintain savings. The reports we reviewed did not address the impact of customer use of online portals either while receiving reports[10] or after reports stop, nor did they look at the impact of portal availability on savings decay after reports stop.

Electronic HERs (eHERs): Some programs send customers both paper reports and emailed HERs. SDG&E (DNV GL, 2017) compared the efficacy of paper reports to email reports by comparing customers who received only one type of report.[11] Customers who received paper reports saved more electricity than customers who received email reports. However, the impact of paper compared to email on savings decay has not been thoroughly explored. Only one study (SMUD – study group 14) specifically noted that customers received both paper and electronic reports and that the program stopped both report types. The Massachusetts study continued to email HERs for a subset of the study group, but the limitations of that study resulted in inconclusive findings. We do not know whether savings decay at different rates if customers receive both reports during the treatment period. Nor do we know whether savings persist more robustly if customers receive occasional or frequent eHERs after paper reports stop.

Report cycling: Hunt and Allcott (2014) noted patterns of "action and backsliding" when analyzing daily energy use in the days between reports. Customers appeared to reduce their energy use during the first ten days receiving a report, then those savings attenuated (but some savings persisted) in subsequent days. Customers again reduced their energy use after receiving their next report. This suggests a pattern of saving energy that could be tested on a larger scale. Can programs cycle reports over years, rather than months to gain more savings than those that might persist after stopping reports altogether? Programs may be able to leverage the "cueing" effect of reports while reducing program costs by cycling the program on alternate years. We found no studies that used this approach.

Report timing: In homes heated with natural gas, the bulk of natural gas savings occur during the heating season. Some programs time gas reports for delivery in November through March. Another variant on report cycling might be to send gas report only in November and December of each year. We did not find any research on this approach.

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[10] The impact of portals on customer savings while receiving HERs was outside the focus of this literature review. Such research may exist, but it does not overlap with the savings decay research on Oracle programs. Furthermore, there may be evaluations of programs from other vendors that address the efficacy of portals. For example, the authors are familiar with an impact evaluation of an opt-in online portal program (no paper reports).

[11] The question of whether email reports lead to more or less savings than paper reports, in general was also outside the scope of this project, but the authors are not aware of a large body of research on this topic. As noted, this comparison is not addressed in the savings persistence study reports.

4. SCENARIOS

Below we provide four scenarios that suggest how stopping reports for National Grid Rhode Island customers may impact savings in subsequent years. We apply the scenarios to the 2016 evaluated impact results with the following assumptions:

- Participant days is the number of days during a year that a treatment customer is in the program. That is, the number of days up until a move out date. Total savings for a year is the average savings per household per day for that year times the number of participant days in that year.
- Our scenarios adjust for both attrition (customers who move) and decay in savings per household. We do not adjust for new customers as the program typically adds new customers to a new wave.
- We assume a constant attrition rate based on average attrition in 2014 and 2015. We apply these attrition rates to each subsequent year.
- For each scenario, we assume Year 1 is 2018 and adjust for 2017 attrition.
- We based per household savings (before decay) on 2016 evaluated impact results.
- We provide scenarios for Dual Fuel 2013, Electric Only 2013, and Electric Only 2014. The most recent two waves (Electric Only 2016 and Electric Only 2017 do not have a full year of evaluated impact results).
- For comparison, we calculate total savings if reports continued. This calculation assumes savings continue at the 2016 level, but that the program continues to experience attrition.

As noted, many factors affect energy savings and none of the studies we reviewed match the customer characteristics or program structure of Rhode Island exactly. The scenarios below suggest the possible impacts from altering report cadence in Rhode Island by applying somewhat conservative assumptions to Rhode Island data. However, these scenarios should still be interpreted cautiously, and we recommend testing or piloting new approaches to assess the impact on Rhode Island specifically.

Furthermore, the scenarios below may increase cost effectiveness by reducing costs associated with sending reports, but they all result in less savings. Some approaches to program design may emphasize cost effectiveness while others (including Rhode Island) emphasize all cost-effective energy savings even if the program is only marginally cost effective. These factors warrant consideration when considering future program designs that alter the treatment report type and report cadence.

SCENARIO 1: MEDIAN SAVINGS DECAY INCREASES OVER TIME

For this scenario, we assume the median decay rate of 20 percent and assume that the rate of decay increases each year.

TABLE 5. SCENARIO 1 SAVINGS CALCULATIONS

	Dual Fuel – Electric 2013	Electric Only 2013	Electric Only 2014
First Report Date	13-Apr	13-Apr	14-Jan
Total Evaluated Participants (2016)	82,477	87,744	36,689
Baseline Usage: Average Daily kWh (Std Dev)	19.60 (11.6)	27.22 (13.9)	18.69 (12.8)
2016 Final Adjusted Net Savings (kWh per HH per day)	0.17	0.28	0.17
2016 Total Adjusted Net Savings (MWH)	5262	8914	2335
Average annual attrition	7%	5%	11%
Total Participant Days (2016)	31,188,965	31,614,291	14,127,061
Estimated Participant Days: Year 1 (2018)	26,975,336	28,531,898	11,190,045
Estimated Participant Days Year 2	25,087,062	27,105,303	9,959,140
Estimated Participant Days Year 3	23,330,968	25,750,038	8,863,635
Estimated Participant Days Year 4	21,697,800	24,462,536	7,888,635
Year 1 (20% decay) Total MWH	3,669	6,391	1,522
Year 2 (40% decay) Total MWH	2,559	4,554	1,016
Year 3 (60% decay) Total MWH	1,587	2,884	603
Year 4 (80% decay) Total MWH	738	1,370	268
Total MWH Savings During Years 1 to 4 of Report Cessation	8,552	15,199	3,409
Total MWH Savings if Reports Continued During Years 1 to 4	16,505	29,638	6,443

SCENARIO 2: HIGH SAVINGS DECAY RATE INCREASES OVER TIME

The PG&E study groups are most similar to National Grid Rhode Island waves in baseline energy use. The PG&E groups have a baseline electricity use of 6,884 and the customers are dual fuel electricity and natural gas customers, like the National Grid RI Dual Fuel 2013 group. Where specified, the customers in every other study group have high baseline electricity use. As noted in Section 2, baseline energy use tends to correlate with energy savings from HER programs (Alcott 2011), so we selected this scenario to hypothesize what savings might look like if Rhode Island follows a similar pattern to PG&E in the first year after report cessation with a 30 percent savings decay.

For subsequent years in this scenario, since we do not have four years of results from PG&E, we assume that the savings decay follows a trajectory similar to Eversource (Connecticut Light and Power) over time. We chose Eversource as it has more similar climate and building stock to Rhode Island compared to other multi-year study groups.

TABLE 6. SCENARIO 2 SAVINGS CALCULATIONS

	Dual Fuel – Electric 2013	Electric Only 2013	Electric Only 2014
First Report Date	13-Apr	13-Apr	14-Jan
Total Evaluated Participants (2016)	82,477	87,744	36,689
Baseline Usage: Average Daily kWh (Std Dev)	19.60 (11.6)	27.22 (13.9)	18.69 (12.8)
2016 Final Adjusted Net Savings (kWh per HH per day)	0.17	0.28	0.17
2016 Total Adjusted Net Savings (MWH)	5,262	8,914	2,335
Average annual attrition	7%	5%	11%
Total Participant Days (2016)	31,188,965	31,614,291	14,127,061
Estimated Participant Days: Year 1 (2018)	26,975,336	28,531,898	11,190,045
Estimated Participant Days Year 2	25,087,062	27,105,303	9,959,140
Estimated Participant Days Year 3	23,330,968	25,750,038	8,863,635
Estimated Participant Days Year 4	21,697,800	24,462,536	7,888,635
Year 1 (30% decay) Total MWH	3,210	5,592	1,332
Year 2 (50% decay) Total MWH	2,132	3,795	847
Year 3 (80% decay) Total MWH	793	1,442	301
Year 4 (100% decay) Total MWH	0	0	0
Total MWH Savings During Years 1 to 4 of Report Cessation	6,136	10,829	2,480
Total MWH Savings if Reports Continued During Years 1 to 4	16,505	29,638	6,443

SCENARIO 3: REPORT CYCLING

As noted, programs may be able to leverage the "cueing" effect of reports by cycling the program on alternate years. Alternating years that customers receive reports may help maintain more savings while still saving money for the program. For this scenario, we assume a decay rate of 30 percent during the years that reports are not sent, and assume that the interruption of reports reduces savings during the report years by 10 percent. We apply a decay rate to the years with reports to account for the ramp-up effect of receiving reports. Past research has noted that HER programs generally have lower savings at the beginning and savings ramp up over the first year or two (Alcott and Rogers, 2012). Since customers will not be receiving reports consistently, we hypothesize that savings during the years with reports may not be as large as savings during the year before the change to report cadence as there might still be a ramp-up effect. This is an assumption as we are unaware of research that has tested this scenario.

TABLE 7. SCENARIO 3 SAVINGS CALCULATIONS

	Dual Fuel – Electric 2013	Electric Only 2013	Electric Only 2014
First Report Date	13-Apr	13-Apr	14-Jan
Total Evaluated Participants (2016)	82,477	87,744	36,689
Baseline Usage: Average Daily kWh (Std Dev)	19.60 (11.6)	27.22 (13.9)	18.69 (12.8)
2016 Final Adjusted Net Savings (kWh per HH per day)	0.17	0.28	0.17
2016 Total Adjusted Net Savings (MWH)	5262	8914	2335
Average annual attrition	7%	5%	11%
Total Participant Days (2016)	31,188,965	31,614,291	14,127,061
Estimated Participant Days: Year 1 (2018)	26,975,336	28,531,898	11,190,045
Estimated Participant Days Year 2	25,087,062	27,105,303	9,959,140
Estimated Participant Days Year 3	23,330,968	25,750,038	8,863,635
Estimated Participant Days Year 4	21,697,800	24,462,536	7,888,635
Year 1: No reports (30% decay) Total MWH	3,210	5,592	1,332
Year 2: Reports (10% decay) Total MWH	3,838	6,831	1,524
Year 3: No reports (30% decay) Total MWH	2,776	5,047	1,055
Year 4: Reports (10% decay) Total MWH	3,320	6,165	1,207
Total MWH Savings During Years 1 to 4 of Report Cycling	13,145	23,634	5,117
Total MWH Savings if Reports Continued During Years 1 to 4	16,505	29,638	6,443

SCENARIO 4: GAS SAVINGS DECAY

As noted, we found fewer studies on the effects of stopping reports on natural gas savings than on electricity savings and only one study has looked at gas savings over multiple years. Consequently, for this scenario, we assume a conservative first-year decay rate of 30 percent with an identical trajectory as Scenario 2.

TABLE 8. SCENARIO 4 SAVINGS CALCULATIONS

	Dual Fuel – Gas 2013	Gas Only 2013	Gas Only 2015
First Report Date	13-Apr	13-May	15-Oct
Total Evaluated Participants (2016)	78,947	11,765	8,197
Baseline Usage: Average Daily therms (Std Dev)	2.30 (2.1)	2.19 (2.1)	2.09 (1.9)
2016 Final Adjusted Net Savings (therms per HH per day)	0.015	0.01	0.03
2016 Total Adjusted Net Savings (therms)	467,368	42,904	108,952
Average annual attrition	7%	11%	11%
Estimated Participant Days: Year 1 (2018)	26,948,419	3,776,038	2,975,882
Estimated Participant Days Year 2	25,062,030	3,360,674	2,648,535
Estimated Participant Days Year 3	23,307,688	2,991,000	2,357,197
Estimated Participant Days Year 4	21,676,150	2,661,990	2,097,905
Year 1: No reports (30% decay) Total Therms	282,958	26,432	62,494
Year 2: Reports (50% decay) Total Therms	187,965	16,803	39,728
Year 3: No reports (80% decay) Total Therms	69,923	5,982	14,143
Year 4: Reports (100% decay) Total Therms	0	0	0
Total Therm Savings During Years 1 to 4 of Report Cessation	540,847	49,218	116,365
Total Therm Savings if Reports Continued During Years 1 to 4	1,454,914	127,897	302,386

5. SUMMARY AND RECOMMENDATIONS

We reviewed 11 persistence studies that included 17 customer groups. These studies differed by state, climate, time-period, report cadence, treatment period, and fuel type.

Across 15 study groups, the decay rate for first-year electricity savings ranges from 2 percent to 36 percent with a median of 20 percent. Notably, the median remained around 20 percent even when the team looked at subsets of studies based on key characteristics. While this might suggest that a 20 percent decay rate is a reasonable assumption for a first-year decay rate, there are notable differences between Rhode Island treatment groups and treatment customers in other locations.

For example, Rhode Island houses are smaller and older than the national average with nearly half of homes built before 1960 compared to 28 percent nationally. In Rhode Island 85 percent of homes have three or fewer bedrooms compared to 77 percent nationally. These differences may affect the magnitude of possible savings in Rhode Island compared to other areas that may have different home and household characteristics.

In addition, most customer treatment groups in the studies that we reviewed have high baseline energy use, which may limit their applicability to Rhode Island. The Rhode Island behavioral program includes many customers with moderate and low baseline energy use.

Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island should take into account the potential risks and rewards of over- or under-predicting savings

Most of the studies that we reviewed included results for only one year after report cessation. One of the longest-running multi-year studies (PSE) shows steady decay in savings over time, but with customers still saving energy in five years after report cessation. However, results from multi-year studies in Illinois and Connecticut suggest that decay rates may accelerate over time. A lower decay rate assumption may over-predict actual savings while a higher decay rate assumption could cause a program to fail a benefit-cost screen and result in a missed opportunity.

Recommendation: In any predictive benefit-cost modeling, National Grid Rhode Island may want to model savings assuming a 40 to 80 percent decay rate for electricity savings in years 2 through 4 after treatment stops. However, any assumptions will also need to take into account the risks and rewards of over- or under-predicting savings.

HER programs have tended to show smaller and variable savings for natural gas than for electricity. Only four studies have examined savings decay rates in natural gas usage and they report widely varying results of 0 to 150 percent decay rates. The sole study of natural gas decay rates over time (PSE) reports modest increases in decay rates from 7 percent to 38 percent over five years.

Recommendation: For predictive benefit-cost modeling, National Grid Rhode Island should model high and low savings decay scenarios for natural gas savings while understanding the uncertainties of these assumptions.

Most of the studies we reviewed tested the effect of report cessation on savings. Approaches such as report timing, report cycling, electronic portals, and emailed reports may provide options for modifying

the treatment approach to reduce costs, yet maintain more savings over completely stopping reports. While there is limited research on these approaches, they merit consideration. However, the impact of these approaches on savings decay have not been tested robustly.

Recommendation: National Grid Rhode Island's Statewide Behavioral Program may benefit (from a benefit-cost perspective) from modifying the treatment approach. We suggest piloting new approaches when the current implementer contract ends. However, before piloting new approaches, we suggest running benefit-cost modeling to assess the potential impact on first year savings, lifetime savings, and cost effectiveness. Two approaches that may merit further scoping and testing are:

1. Report cycling: National Grid Rhode Island can test the effect on electricity savings from cycling reports with a one year on/one year off cadence. The pilot could split larger treatment waves (such as the March 2013 or January 2014 waves) so that a portion of each wave receives reports each year.
2. Report timing: For natural gas, National Grid Rhode Island can test sending fewer reports and only send them during the heating season. For example, the program might send reports only in October and January.

6. APPENDIX

In the tables that follows we provide more details on the study groups and references included in our review. We include “Customer Group Reference” and “Report Reference” codes to assist with cross-references with the report tables and the reference list. Appendix A describes the statistical significance of savings in the study group. Appendix B describe each study group in more detail and Appendix C provide a list of references.

APPENDIX A. NOTES ON STATISTICAL SIGNIFICANCE

CUSTOMER GROUP REFERENCE[12]	STATE & UTILITY (GROUP NAME)	ANNUAL SAVINGS DECAY RATE	STATISTICAL SIGNIFICANCE NOTES USING P<0.10	REPORT REFERENCE
		ELECTRICITY SAVINGS		
15	Illinois ComEd (Grp 1; YR 1)	4%	Point estimate of savings in Year 1 statistically significant	y
16	Illinois ComEd (Grp 1; YR 2)	15%	Point estimate of savings in Year 2 statistically significant	y
17	Illinois ComEd (Grp 3; YR 1)	2%	Point estimate of savings in Year 1 statistically significant	y
18	Illinois ComEd (Grp 3; YR 2)	17%	Point estimate of savings in Year 2 statistically significant	y
19	Illinois ComEd (Grp 5; YR 1)	22%	Point estimate of savings in Year 1 statistically significant	y
20	Illinois ComEd (Grp 5; YR 2)	60%	Point estimate of savings in Year 2 not statistically significant	y
33	Pennsylvania PPL (Expansion)	20%	Decay rate is statistically significant	x
32	Pennsylvania PPL (Legacy)	30%	Decay rate is statistically significant	x
34	Pennsylvania (Duquesne)	1%	Decay rate is not statistically significant, suggesting no decay in savings after report cessation	x
53	California PG&E (Gamma Reduced)	6%	Insufficient data to report statistical significance, though the report notes no statistically significant differences on a monthly basis between the groups that stopped receiving reports and the continued groups.	j
51	California PG&E (Gamma Standard)	30%		j
4	PSE (YR 1)	3%	Point estimate of YR 1 savings is statistically significant. Difference in savings between YR 1 and pre-cessation is not statistically significant	i
5	PSE (YR 2)	23%	Point estimate of YR 2 savings is statistically significant. Difference in savings between YR 2 and pre-cessation is statistically significant	i
6	PSE (YR 3)	28%	Point estimate of YR 3 savings is statistically significant. Difference in savings between YR 3 and pre-cessation is statistically significant	i
7	PSE (YR 4)	51%	Point estimate of YR 4 savings is statistically significant. Difference in savings between YR 4 and pre-cessation is statistically significant	i
8	PSE (YR 5)	59%	Point estimate of YR 5 savings is not statistically significant. Difference in savings between YR 5 and pre-cessation is statistically significant	i
35	Connecticut Eversource (Monthly YR 1)	18%	Point estimate of YR 1 savings is statistically significant	ab/ae
39	Connecticut Eversource (Monthly YR 2)	23%	Point estimate of YR 2 savings is statistically significant	ab/ae

[12] In this and in following tables we provide "Customer Group Reference" and "Report Reference" codes to assist with cross-referencing with the Appendix and the reference list.

CUSTOMER GROUP REFERENCE[12]	STATE & UTILITY (GROUP NAME)	ANNUAL SAVINGS DECAY RATE	STATISTICAL SIGNIFICANCE NOTES USING P<0.10	REPORT REFERENCE
43	Connecticut Eversource (Monthly YR 3)	67%	Point estimate of YR 3 savings is not statistically significant	ab/ae
26	Connecticut Eversource (Monthly YR 4)	55%	Point estimate of YR 4 savings is not statistically significant	ab/ae
26	Connecticut Eversource (Quarterly YR 1)	32%	Point estimate of YR 1 savings is statistically significant	ab/ae
36	Connecticut Eversource (Quarterly YR 2)	44%	Point estimate of YR 2 savings is statistically significant	ab/ae
40	Connecticut Eversource (Quarterly YR 3)	62%	Point estimate of YR 3 savings is statistically significant	ab/ae
44	Connecticut Eversource (Quarterly YR 4)	72%	Point estimate of YR 4 savings is not statistically significant	ab/ae
37	Connecticut Eversource (Quarterly YR 1)	36%	Point estimate of YR 1 savings is statistically significant	ab/ae
41	Connecticut Eversource (Quarterly YR 2)	50%	Point estimate of YR 2 savings is statistically significant	ab/ae
45	Connecticut Eversource (Quarterly YR 3)	92%	Point estimate of YR 3 savings is not statistically significant	ab/ae
24	Connecticut Eversource (Quarterly YR 4)	93%	Point estimate of YR 4 savings is not statistically significant	ab/ae
1	Upper Midwest	21%	Point estimate of savings is statistically significant	n,o
14	California SMUD	32%	Point estimate of savings is statistically significant	d,o
55	California SCE (YR 1)	3%	Point estimate of savings is statistically significant	k
55	California SCE (YR 2)	25%	Point estimate of savings is statistically significant	k
28	Massachusetts National Grid	NA	Decay rates not reported due to issues with study design	ad
			NATURAL GAS SAVINGS	
22	Illinois Nicor Gas	46%	Point estimate of savings is statistically significant	t, ac
52	California PG&E (Gamma Standard)	150%	Insufficient data to report statistical significance, though the report notes statistically significant differences on a monthly basis during winter months between the group that stopped receiving reports and the continued group.	J
54	California PG&E (Gamma Reduced)	0%	Decay rate is not statistically significant	J
9	PSE (YR 1)	7%	Point estimate of YR 1 savings is statistically significant. Difference in savings between YR 1 and pre-cessation is not statistically significant	i
10	PSE (YR 2)	37%	Point estimate of YR 2 savings is statistically significant. Difference in savings between YR 2 and pre-cessation is statistically significant	i
11	PSE (YR 3)	14%	Point estimate of YR 3 savings is statistically significant. Difference in savings between YR 3 and pre-cessation is statistically significant	i
12	PSE (YR 4)	26%	Point estimate of YR 4 savings is statistically significant. Difference in savings between YR 4 and pre-cessation is statistically significant	i

CUSTOMER GROUP REFERENCE[12]	STATE & UTILITY (GROUP NAME)	ANNUAL SAVINGS DECAY RATE	STATISTICAL SIGNIFICANCE NOTES USING P<0.10	REPORT REFERENCE
13	PSE (YR 5)	38%	Point estimate of YR 5 savings is not statistically significant. Difference in savings between YR 5 and pre-cessation is statistically significant	i
29	Massachusetts National Grid	NA	Decay rates not reported due to issues with study design	ad

APPENDIX B. STUDY GROUP TABLE

Customer Group Reference	Report Ref-erence	Utility or Service Area	State	Customer Group Name	Year of Results	Fuel Type	ASD %	Frequency of Reports	Number of Treatment Months Prior to Cessation	Number of Customers in 'No Reports' Group	Home Fuel Type	First Report Dated	Baseline Annual Energy Use
1	d,m	Upper Midwest	Upper Midwest		1	Electric	21%	Monthly & Quarterly	24	12,746	Dual fuel	Oct-08	80MBTU
4					1		3%						
5					2		23%						
6					3	Electric	28%	Monthly & Quarterly	24	9,674	Dual fuel		80MBTU
7					4		51%						
8		Puget Sound Energy	Washington		5		59%					Nov-08	
9					1		7%						
10					2		37%						
11					3	Natural Gas	14%	Monthly & Quarterly	24	9,674	Dual fuel		
12					4		26%						
13	i				5		38%					Nov-08	
14	n	SMUD	California		1	Electric	32%		27	9,965	Electric	Apr-08	11,376 kWH
15					1		4%			6,968			Not stated
16				Wave 1	2		15%		52	6,513		Jul-09	
17					1		2%			8,286			
18		ComEd	Illinois	Wave 3	2	Electric	17%	BiMonthly	30	7,704	Electric	May-11	
19					1		22%			5,663			
20	y			Wave 5	2		60%		16	5,224		Jul-12	
22	t/ac	Nicor Gas	Illinois		1	Natural Gas; heating season	46%	Heating Season only	6	287,718	Natural Gas	Oct-13	2,848 therms
28	ad	National Grid (MA)	Massachusetts		1	Electric	NA	BiMonthly & Quarterly	24	8,115	Electric		High baseline energy use

29					1	Natural Gas	NA	BiMonthly & Quarterly	24	6,953	Natural Gas		high use participants
32	x	PPL	Pennsylvania	Legacy	1	Electric	30%	Not specified	36	48,700	Electric	Apr-10	Average above 18,000 kWh
33	x			Expansion	1		20%		24	52,900		Apr-11	Average above 27,000 kWh
34	x	Duquesne		Low Income	1		1%		12	52,200		Jul-12	13,500 kWh
35		Eversource / Connecticut Light & Power	Connecticut	Monthly group	1	Electric	18%	Monthly	16	1,670	Electric	Jan-11	High baseline energy use
39					2		23%						
43					3		67%						
26					4		55%						
36				Quarterly group	1		32%	Quarterly (5 reports)	16	9,856			
40					2		44%						
44					3		62%						
25					4		72%						
37				Persistence group	1		36%	Monthly abbreviated	8	3,979			
41					2		50%						
45					3		92%						
24	ab/ae				4		93%						
51		Pacific Gas and Electric	California	Gamma Wave	1	Electric	30%	BiMonthly	38	28,000	Dual Fuel	Nov-11	6,884 kWh
52						Natural Gas	150%						381 therms
53						Electric	6%	Quarterly					6,884 kWh
54	j					Natural Gas	0%						381 therms
55		Southern California Edison	California		1	Electric	3%	BiMonthly	12	65,821	Electric	Dec-12	High baseline energy use
56	k				2		25%						

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