

Keep the Change: Behavioral Persistence in Energy Efficiency Programs

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ABSTRACT

For years a key barrier to implementing behavioral energy efficiency programs has been uncertainty about how long any energy savings achieved may last, known as persistence. This uncertainty has led many jurisdictions to continue to hold behavioral programs to a one-year measure life, even though savings may last longer. Improving our understanding of the duration of persistence is crucial for both program and portfolio design, particularly due to the potential implications for cost-effectiveness, program credibility, and more accurate resource planning. This paper synthesizes and details recent findings on behavioral persistence from a variety of behavioral energy efficiency persistence studies. It sheds light on how rapidly savings from behavioral programs may decay after a program has ended, explores factors that may encourage or hinder that persistence, and offers a list of topics that are particularly ripe for future behavioral persistence research.

The scope of this secondary research effort was primarily restricted to Home Energy Report (HER) programs. This approach was used simply because HER persistence has been the most widely and rigorously tested to date relative to other behavioral program models. While some of these findings may be relevant as a starting point for beginning to understand behavioral persistence in general, it is important to note that these findings are not directly transferrable to other program types. Despite this limitation, the results provide an important foundation for future research in pursuit of a better understanding of behavioral persistence overall.

Introduction

Background

Program administrators have long found that one key barrier to implementing behavioral programs is the potential inability to demonstrate how long any energy savings achieved may last. In the face of this uncertainty, many jurisdictions continue to hold a measure life of one year for behavioral efforts. The ability to determine how rapidly or gradually energy savings erode after a program ends is vital, particularly due to the implications for cost-effectiveness, program credibility, and resource planning.

Recognizing the importance of this issue, there have been significant advances in knowledge about the persistence of behavioral savings in the energy efficiency realm in recent years, as more program administrators have opted to continue to measure the savings from their programs even after the intervention has ended. This paper provides an update on the state of knowledge about behavioral persistence made possible by recent program administrator research efforts.

Purpose, Methods, and Limitations of this Secondary Research Project

This paper has several main purposes. The first is to provide an update on the state of knowledge about energy efficiency behavioral persistence. A related objective is to shed light on some

examples of savings decay rates, and, inversely, the rates of savings persistence, in recent behavioral programs. A longer-term aim of this paper is to encourage program administrators and their evaluators to continue to track energy savings from behavioral persistence even after a program has concluded, despite the logistical challenges.

This document focuses primarily on the persistence of Home Energy Report (HER) programs. In these programs, residential customers receive a combination of mailed and emailed reports that provide information on how their household's energy use compares to similar other households, along with tips to help customers improve their relative rating. This paper's focus on this program type is not by design—rather, there are simply the most persistence studies completed to date about this type of program relative to other program approaches. As a result, one limitation of these findings is that they are likely only applicable to HER programs—the authors are not aware of research that suggests these findings would necessarily be transferrable to other types of behavioral programs.

The persistence information included in this report was provided primarily by Consortium for Energy Efficiency (CEE) member organization staff. New behavioral persistence studies, as well as evaluation reports that contain persistence findings, were solicited from CEE member organizations through a series of remote meetings. CEE staff also reached out via email to any CEE member staff who had indicated in a recent behavior-based program data collection effort that their organization had completed persistence research. Although this persistence overview was originally intended to focus specifically on CEE members, it also includes data from PPL Electric Utilities in Pennsylvania, which was a CEE member previously, as well as data from Duquesne Light Company, also in Pennsylvania. The persistence information for both of these Pennsylvania utilities was shared by another member from the same state, who directed staff to a public persistence report prepared for the Pennsylvania Public Utilities Commission.

The voluntary nature of the data collection and focus primarily on CEE member organizations all but ensures that there are other recent persistence findings that may not be included here. Additionally, given that the intention of the original data collection was for distribution only among CEE member organizations, one member organization that had provided persistence findings for the initial CEE overview requested not to be included in this paper. This approach yielded behavioral persistence findings from the following programs (see Table 1):

- Cape Light Compact, Building Operators Certification
- Commonwealth Edison, Home Energy Reports
- Duquesne Light Company, Home Energy Reports
- Eversource, Home Energy Reports
- National Grid, Home Energy Reports and Building Operators Certification
- Nicor Gas, Home Energy Reports
- PPL Electric Utilities, Home Energy Reports
- Puget Sound Energy, Home Energy Reports

Given this methodology, there are limitations to the conclusions and generalizations that may be drawn based on these initial findings. The programs described in this overview vary dramatically in terms of service territory and program implementation details. Consequently, the program information provided here is intended to serve primarily as an example and to spark future research in this area—it is by no means definitive on its own, nor is it intended to suggest that all programs would experience rates of savings decay similar to those described here. It is also important to note that no program to date has found a 100 percent persistence rate indefinitely after a program has ended—ultimately, continuing a program maximizes the chances that the energy savings will persist.

Definitions of Behavioral Persistence

There are many different types of behavioral persistence. Energy efficiency program administrators working together through the Consortium for Energy Efficiency to better understand behavioral persistence have identified a few different categories of behavioral persistence:

- **Ongoing Persistence:** persistence during a program intervention
- **Post-Intervention Persistence:** persistence after a program's intervention activities have ended (at least with one particular target group)
- **Maintenance Persistence:** persistence after the initial program period has ended but during which time some reduced, less frequent interaction with program participants continues to take place.

There is arguably the most energy efficiency research for ongoing persistence, given that many programs track energy savings throughout the overall program timeline. There is significantly less energy efficiency research for both post-intervention and maintenance persistence. (Maintenance persistence has been measured more often in other disciplines—especially public health—though a few energy efficiency programs have begun to experiment with this model.) That said, this paper will focus primarily on post-intervention persistence given that this was the area in which the authors were able to add the most value.

Recent Persistence Findings

Overview of Recent Persistence Findings

The overall finding of recent behavioral persistence research on Home Energy Report programs is that savings do decay with time, although there is wide variation in how soon this decline begins and how rapidly it takes place. Unlike a new energy efficiency measure that generates an anticipated amount of savings for a known period of time and then requires replacement, the impact of HER exposure appears to typically deteriorate gradually once customers no longer receive reports (Khawaja and Stewart 2014).

Looking at other disciplines outside energy efficiency that also aim to change human behavior for an extended period of time, behavioral changes due to energy efficiency programs may be just as—if not more—durable than changes achieved in other behavioral areas. Compared to persistence from behavior changes related to exercise, smoking, water conservation, and charitable donations, some studies document lengthier and more persistent change in energy efficiency (Allcott and Rogers 2013). For instance, random discontinuation of treatment was used to measure persistence in several distinct locations for long-duration HER programs (Allcott and Rogers 2013), with promising overall findings. Some behavioral savings have been demonstrated to persist for at least three years (Khawaja and Stewart 2014), and the Illinois TRM asserts that evidence suggests that at least some level of savings last for at least five years for HER programs (IL Statewide TRM 2016).

Implications of Length of Initial Program

There is some preliminary evidence that programs with a longer initial rollout period before reports are suspended may experience more robust persistence. Indeed it seems reasonable and intuitive that a shorter exposure to Home Energy Reports “may not provide sufficient time for customers to habituate behaviors or install equipment” (Arnold 2014). HER persistence studies are typically preceded by initial program rollouts of about two years before any participants are dropped

from the intervention (Allcott and Rogers 2013), though there can be some variation, such as in the examples described below.

One clear example of greater variation in program implementation phases comes from Commonwealth Edison, whose customers generally received reports for a longer period relative to other peer HER programs. In ComEd's study, participants received reports for varying lengths of time before they were stopped: four years for Wave 1 customers, two years for Wave 3, and only one year for Wave 5. ComEd found the savings decay to be quite gradual for both Wave 1 and Wave 3 customers, but noticeably sharper for the Wave 5 customers who had received the reports relatively briefly before they were stopped (Olig and Sierzchula 2016).

On the other side of the spectrum, customers at what was then Connecticut Light and Power (now Eversource) stopped receiving reports after just six to eight months (NMR, Tetra Tech, and Allcott 2013). This study found that the persistence group continued to have similar savings to the ongoing monthly report group for the first two months, but there was a substantial drop-off in savings from the persistence group starting three months after report cessation (NMR, Tetra Tech, and Allcott 2013). By the fifth month after report cessation, the persistence group's small energy savings were no longer statistically significant (NMR, Tetra Tech, and Allcott 2013). However, it is unclear the extent to which this rapid drop-off in savings is due to the relatively brief initial rollout as compared to other potentially influential factors. Savings were sustained for much longer in a later iteration of this evaluation (NMR 2016), which is discussed in more detail later in this paper.

Despite these examples, there is also some evidence that a longer initial exposure to a behavioral program may not always lead to more gradual savings decay. For instance, with PPL's Home Energy Report Program, the PPL Legacy group had the longest initial exposure to the reports relative to other groups, yet those customers' savings decayed the fastest. It is unclear why this was the case.

Decay Rates, Persistence Rates, and Measure Life

Defining Decay Rates and Persistence Rates

Hard measures such as new insulation are typically assumed to reduce energy consumption for fixed measure lives, but it's less clear what happens with various behavioral energy efficiency efforts once a program ceases (Allcott and Rogers 2013). To better understand what happens post-program with behavioral efforts, many persistence studies calculate a "decay rate" for the energy savings after a program ends.

Several utilities have proposed similar but slightly distinct definitions of what is meant by the term "decay rate." Nicor Gas, for instance, noted that savings decay is defined as "the reduction in savings post-suspension of the HER program" (Olig and Layton 2016, 6). Furthermore, Nicor defines the term "lifetime persistence savings" as "the total savings attributable to the program after reports are stopped" (Olig and Layton 2016, 9). Similarly, Commonwealth Edison stated that "savings decay is defined as the reduction in savings post-stoppage of the HER reports plus the opportunity cost of missed incremental savings" (Olig and Sierzchula 2016, 8).

In terms of the calculations necessary, both decay rates and persistence rates can be calculated relatively simply. The decay rate is the percentage annual reduction in savings following the end of the program, whereas the persistence rate is:

$$\text{Persistence rate: } 100 - \text{decay rate}$$

For instance, if a program experiences a 20 percent decay in savings during the first year following report cessation, then the persistence rate is 80 percent.

Results: Decay Rates, Persistence Rates, and Measure Life

Perhaps the most noteworthy finding from savings decay rates is that there is a very wide variety of decay rates found for HER programs, as described below.

On the lower side of the scale, a ComEd study found annual decay rates of a mere 4.39 percent for customers who had received the reports for two and a half years before stoppage, which translates to about a 96 percent persistence rate. For customers who had received the reports for four years before they were discontinued, the annual decay rate was just 2.12 percent, which equates to nearly a 98 percent persistence rate (Olig and Sierzchula 2016). For these longer initial roll out periods, the findings translate to measure lives of a robust 11 and 14 years respectively (Olig and Sierzchula 2016). That said, these measure lives are based largely on extrapolating out early decay rates observed soon after a program's conclusion, and may therefore be overly optimistic; there is no reason to expect savings decay rates to be linear. Additionally, there are a number of reasons that adopting such extended measure lives could be problematic—including, but not limited to, the fact that homes likely change hands more often than every 11 to 14 years. Perhaps based on such limitations, this study's overall recommendations for estimated duration of persistence from HER programs based on this report were a 22 percent decay rate and a five-year measure life (Olig and Sierzchula 2016).

Puget Sound Energy also encountered heartening persistence results. Their study found that households in their suspended group were still experiencing statistically significant savings even in the fifth year of not receiving reports (Emerick 2016).

There were also potentially promising results from a National Grid study, though the study's unique design—which included a short program exposure period, followed by a brief period of report cessation—precludes drawing overly broad conclusions. This study was in fact unable to calculate a decay rate for its Home Energy Reports once treatment was stopped because the reduced treatment group did not see any decay in savings relative to the continued treatment group. However, it is important to note that this experiment included a somewhat complex process of stopping and restarting reports over time, rather than one permanent report cessation, as is often the case in other studies. The customers stopped receiving the paper reports for only about a 10 month period; customers then received reports again for another two months, which was then followed by another gap in report receipt, this time three months long (Arnold 2014). It is also noteworthy that though the paper HERs were reduced during this time, the electronic HERs were not—meaning the program was only completely stopped for customers for whom the utility did not have an e-mail address (Arnold 2014). In other words, in practice, some participants continued exposure to the program throughout the persistence phase.

Another example from Massachusetts is the Building Operator Certification (BOC) training program, which is unique both in terms of the type of program as well as the variation in anticipated persistence. As the name suggests, a BOC training program aims to teach building engineers and maintenance personnel techniques and strategies they can use to make the buildings they work in both more comfortable for occupants and also more efficient. Two Massachusetts utilities have deployed a BOC training program, and both utilities assume a level of persistence somewhat briefer (Menges 2016) than the eight years of persistence found in national data (Bliss and Brannan 2015). Cape Light Compact only claims savings for five years, beginning the year the certification was complete; in other words, Cape Light Compact claims savings for “a five-year measure life for BOC-training-induced savings” (Bliss and Brannan 2015, 38). National Grid also assumes a five-year measure life (Menges 2016).

In the PPL Legacy Program in Pennsylvania, a linear decay rate of 29.9 percent was calculated for the HER program, based on the assumption that savings decay would continue over time at the rate it was directly observed during the first 16 months after the HER program activities had ended—a potentially optimistic assumption. This rate of decay would lead to a complete erosion of the program savings about three years after the reports were stopped (Residential Behavioral Program Persistence

Study 2015). In the PPL Expansion Program, the measured decay rate was 22 percent per year, which would lead to the program's savings having fully decayed by about 4 ½ years after report cessation, again assuming linear decay (Residential Behavioral Program Persistence Study 2015). In an analysis conducted for the Pennsylvania PUC, all three HER persistence studies in Pennsylvania found at least some level of savings for up to 16 months after report cessation (Residential Behavioral Program Persistence Study 2015).

Natural Gas Examples

Currently there are not sufficient studies of persistence for HER programs specifically in the natural gas sector to draw conclusions. However, findings from Illinois and Massachusetts shed some early light on the topic and suggest a few areas for future study to better understand what may happen to behavioral persistence after a natural gas program ends.

Nicor Gas in Illinois found the decay rate for its HER was 46 percent one year after reports were stopped, which translates into a 54 percent persistence rate (Olig and Layton 2016). This information was used to calculate an estimated measure life of three years for Nicor's HER program, including one year of receiving the program plus two additional persistence years (Olig and Layton 2016). Overall, Nicor's monthly savings analysis revealed relatively steady persistence for the first 12 months after the reports were no longer sent, followed by a sharper decline at about 18 months (Olig and Layton 2016).

On a related note, the Illinois Technical Reference Manual includes two different persistence rate assumptions depending on the program's fuel type. The persistence rate provided for electric Home Energy Reports is 82 percent for the first year after reports are stopped, 68 percent in the second year, 56 percent in the third year, and 46 percent in the fourth year (Illinois Statewide TRM 2016). The persistence rate provided for natural gas Home Energy Reports is 45 percent for the first year after reports are stopped, 20 percent in the second year, nine percent in the third year, and four percent in the fourth year (Illinois Statewide TRM 2016). These numbers are similar to Nicor's persistence findings, if a bit more conservative in their estimates.

A Puget Sound Energy persistence study found particularly promising findings for natural gas. In this one study, savings decay appeared nearly immediately for electricity, but was more delayed for natural gas customers. At 90 percent confidence and 10 percent precision levels, natural gas customers who stopped receiving Home Energy Reports experienced a drop in savings that was not statistically significantly different from those of customers who continued to receive reports—1.6 percent vs. 1.1 percent (Emerick 2015).

A study of a National Grid HER program found a more immediate drop-off in savings for the natural gas cohort than for the electric group, but this finding was most likely unrelated to the fuel type. It is important to note that the gas cohort had a shorter initial exposure to the HERs than the electric cohort (Arnold 2014); other research suggests that the duration of the initial program may have been the cause of this disparity. Nevertheless, future examination of decay rates for natural gas programs would be helpful in better understanding this finding in its broader context.

Decay Rate Outliers

The Duquesne Light Company HER program had the lowest rate of decay of any such program observed in the literature to date, at least to the knowledge of these authors. Program activities were halted after participants had received reports for three years, and the estimated decay rate was a mere 1.2 percent per year (Residential Behavioral Program Persistence Study 2015). This is far lower than other typical decay rates observed in HER persistence studies or related meta-analyses (Residential Behavioral Program Persistence Study 2015). See "Future Research," for further discussion.

In contrast, in an initial phase of a study of an HER program at Eversource, savings persisted well for just two months post-treatment and then decayed sharply, totaling an 83 percent decay within five months after report delivery ended (NMR Group, Tetra Tech, and Allcott 2013). It is possible this rapid savings decay was due to customers' relatively short initial exposure to the reports, though further investigation is necessary to better understand this finding. Yet it is worth noting that Eversource conducted a later evaluation in which decay was substantially more gradual (NMR Group 2016). This later study focused on high-use customers specifically and found annual savings decay levels between 21 and 34 percent (approximately 24 percent overall), which is closer to the rates of savings decay more commonly found when HER programs are stopped (NMR Group 2016). This same evaluation found that savings remained statistically significant for at least two years, and potentially up to three years, after the cessation of reports (NMR Group 2016).

Remaining Challenges and Unknowns

Detecting Small Behavior Changes Over Time

Behavioral programs often generate small changes across a broad target audience. Since it's often difficult enough to detect these small changes initially (Allcott and Rogers 2013), trying to determine whether such small changes are persisting can be particularly challenging. It's also difficult to know specifically which behavior changes are persisting and therefore leading to savings. Data to date have been unclear on whether the primary drivers are habitual behaviors or equipment purchase behaviors (Khawaja and Stewart 2014). It is possible that behavior change interventions do not increase the number of different conservation actions that people take, but instead increase the intensity of the existing energy efficiency actions undertaken (Allcott and Rogers 2013), again making it all the more difficult to assess whether these changes last after the program ends.

Another challenge is the inherent seasonality of savings, which can make it nearly impossible to assess precisely when savings have completely eroded (Residential Behavioral Program Persistence Study 2015). For instance, if reports are stopped near the start of a heating or cooling season, any subsequent increased energy use could potentially be the result of an increased demand for energy for climate control purposes due to weather changes as opposed to any decay in the program's savings, although most HER programs are weather normalized.

Ongoing Persistence

Overall, Home Energy Report programs generally produce savings that increase rapidly during the first year, then continue to increase during the second year, though at a lower rate relative to the first year (Khawaja and Stewart 2014). After three to four years, program savings often begin to level off, either remaining steady or increasing at a slight rate. Although there is little evidence to demonstrate potential savings if customers were to continue to receive reports after four years (Khawaja and Stewart 2014), this timeline of continued savings is a strong example of ongoing persistence because the energy savings appear to continue for years while participants continue to receive reports.

Not all indications from ongoing HER programs have been quite as encouraging throughout the program implementation phase, however. For instance, in some HER programs for customers who only receive the reports on a quarterly basis, there were energy savings decays of nearly "0.2 kWh/day between 10 days and 80 days after the report arrival" (Allcott and Rogers, 2013, 14), suggesting that, at least initially, breaks in exposure to the reports may result in immediately diminished savings.

Taken together, these examples illustrate that the jury is still out on precisely what happens with ongoing persistence as related to HER programs. It remains to be seen whether customers experience fatigue from continuing to receive reports over several years and their behavior changes

drop off as a result, or whether they instead make additional behavioral changes as a result of some cumulative report impact.

Determining When Savings Decay is Complete

The precise moment at which post-program savings decay is complete is also murky from the existing data. The Pennsylvania Statewide Evaluators describe several different approaches for determining when persistence has ended in a program. One is to consider the savings decay to be complete the first month that savings reach zero percent. This approach will estimate the end of the persistence conservatively, and savings might reappear again the following month (Residential Behavioral Program Persistence Study 2015).

Another approach is to wait to declare the decay complete until every month in a year has reached zero savings, which will produce the slowest estimate of savings decay. This technique may also present challenges if the treatment and control groups differ in ways unrelated to the program that result in different levels of energy use well past the time when any residual effects from the program may linger (Residential Behavioral Program Persistence Study 2015).

A third approach is to wait until the *average* impact reaches zero percent. This approach is the middle ground between the other two strategies and is the approach favored by the Pennsylvania Statewide Evaluators (Residential Behavioral Program Persistence Study 2015). That said, additional data from other states would help determine which approach would be most accurate and responsible for determining when savings decay is complete.

Resumption of Program

To date, there has been relatively little research on what happens to energy savings if an HER program that has been terminated is later reinstated. PPL's approach of discontinuing its Home Energy Reports and then reinstating them after about 16 months sheds some initial light on what can happen when a ceased behavioral program is resumed. Within just a few months of reinstating the PPL program, both PPL Home Energy Report groups saw energy savings back up around two percent, which is the percent savings that would be expected of an HER program in general that had not been paused. The resumed subgroup even experienced post-reinstatement energy savings that were higher than the original savings during the original program rollout (Residential Behavioral Program Persistence Study 2015).

This is an interesting finding and may provide some comfort to program administrators considering implementing report cessation, given that this example indicates any potential savings decay can be quickly reversed if a program is restarted. Nevertheless, it would be premature to draw any conclusions based on this one example, though it is worth investigating whether other utilities experience a similarly quick recovery of savings upon resuming reports.

Areas for Future Research

Duration of Program Prior to Cessation

Additional research is needed to better understand the relationship between the duration of the program prior to cessation and the rate of savings decay. ComEd found that customers who received reports for either two or four years prior to report suspension experienced much greater persistence of savings relative to those who had only received the reports for one year (Olig and Sierzchula 2016). It is interesting that either two or four years of report receipt seemed effective at keeping savings decay at bay for a time, while one year was insufficient. It is worth exploring this relationship further. Is there a

tipping point in time at which customers have received sufficient exposure to the program that savings decay is forestalled? Is there a rollout duration at which cost-effectiveness can be maximized given the marginal costs of additional program rollout years relative to the potential marginal gains of postponing the discontinuation of reports? These questions require further investigation.

Fuel Type

There are also opportunities for further research related to the fuel type of a given program and the duration of the post-intervention persistence. While one study of the National Grid HER program in Massachusetts provided some initial evidence that savings from natural gas Home Energy Reports may taper off faster than those from electric Home Energy Reports (Arnold 2014), this finding was compounded by other factors and this example is anything but conclusive. This research found that savings decay appeared nearly immediately for natural gas, but was more delayed for the electric program. However, the electric customers had been receiving their reports for a full year longer than the gas customers when the report frequency was reduced (Arnold 2014) and other studies suggest that savings decay is affected by the duration of the initial program. Thus, this finding warrants further study.

In contrast, the Puget Sound Energy persistence study found that savings decay appeared nearly immediately for electricity, but was more delayed for natural gas customers. Electric customers whose reports were suspended experienced a statistically significant drop in savings (at 90 percent confidence and 10 percent relative precision levels) four years after suspension. Applying the same confidence and precision levels, suspended natural gas customers have not experienced a drop in savings different from those of customers who continued to receive reports (Emerick 2015). Whereas the average electric customer in the suspended group experienced savings at a rate of one-third of those continuing to receive reports—1.0 vs. 3.0 percent—the average savings of the gas customer in the suspended HER group was not statistically significantly different from that of the HER gas customers—1.1 percent vs. 1.6 percent (Emerick 2015).

Given the relatively few studies available, and their disparate results, further research is required to better understand what impact, if any, fuel type has on decay rate once a program intervention is reduced or ceased.

Initial Savings Rate and Subsequent Savings Decay

Another facet of persistence that warrants further investigation is whether there is a relationship between the initial level of savings from the program and how rapidly those savings decay once the program ends. For instance, the Duquesne Light Company HER Program in Pennsylvania experienced perhaps the most gradual percent annual savings decay (1.2 percent) after its customers stopped receiving reports compared to other similar programs (Residential Behavioral Program Persistence Study 2015). Interestingly enough, this program also achieved a baseline energy savings that was notably lower than the average expected savings from a Home Energy Report program. The Pennsylvania Statewide Evaluators posited that perhaps customers took more moderate, easier-to-maintain actions to reduce their energy use from the beginning of the program, which would have resulted in lower initial program savings but also more gradual savings decay post-program (Residential Behavioral Program Persistence Study 2015). However, additional research is needed to more closely examine whether the level of initial savings, and the degree to which participants are making drastic versus more moderate changes, may be correlated with persistence.

Other Potential Areas to Explore in Future Research

There are also undoubtedly myriad other areas worth exploring further that haven't yet been investigated at all, at least to the knowledge of these authors. For instance, it would be interesting to examine whether there are any differences in persistence between customer segments. For instance, do high use customers' or low use customers' savings tend to persist longer, or are they comparable? Another question worth investigating further would be whether there's a relationship between how quickly a new program is ramped up and any persistence after the program is completed. One practical question to try to answer in the future is whether the persistence observed in behavioral programs is due to behavioral persistence, efficient measure installation, or some combination thereof—although determining which behaviors are actually taking place as a result of a program has proved historically to be very challenging. Finally, it could be incredibly valuable if we can determine through future research whether there are specific delivery channels (email vs. paper reports) and certain messages provided throughout a program's deployment that might increase the persistence after the program ends.

Concluding Thoughts (Longer-Term Persistence)

Moving forward, additional research to better understand what happens to decay rates several years post-program would be very useful. Some evaluators have tried to project savings decay out for several years after report cessation, but it may well be the case that savings decay is nonlinear, or becomes nonlinear after a few years (Residential Behavioral Program Persistence Study 2015). The Nicor Gas study specifically recommended examining what happens in the second year post-program (Olig and Layton 2016). What happens to persistence in year two and beyond is still largely unstudied, with only a few exceptions, yet this time period may yield additional savings. It is also likely worth assessing what happens to savings three to five years after report cessation; although it is intuitive that savings may decay more rapidly longer after the program's conclusion, data is needed to better understand if this is in fact the case and, if so, how rapidly the savings evaporate.

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Table 1. Overview of Home Energy Report Behavioral Persistence Studies

Utility	State	Duration of program prior to persistence measurement	Noteworthy Program Characteristics or Findings	Persistence Rates and Decay Rates
Commonwealth Edison	IL	Wave 1: 4 years, Wave 3: 2 years, and Wave 5: 1 year	Savings decay was gradual for Waves 1 and 3, but much sharper for Wave 5	Persistence rate of 96% for customers who'd received reports for 2.5 years before cessation (11-year measure life) and 98% persistence rate for customers who'd received reports for 4 years (14-year measure life)
Duquesne Light Company	PA	3 years	Very low decay rate	1.2 percent decay per year
Eversource	CT	6 to 8 months	Savings were sustained for longer in a later iteration of this program (for high-use customers in a later evaluation, the decay rate was only 21 to 34 percent)	There was substantial drop-off in savings in the third month following report cessation and 83% decay rate within the first 5 months following report cessation
National Grid	MA	10 months	Only paper reports were stopped during the cessation period (electronic reports continued to be sent, but the utility did not have email addresses for all participants)	Decay rate was higher for natural gas than for electric, but the specific calendar period in which participants didn't receive reports varied between the two groups
Nicor Gas	IL	1 year	Savings held relatively steady for the first year after report cessation, then there was a sharp decline in savings around the 18 month mark	In the first year following report cessation, 46% decay rate (54% persistence rate); 3-year measure life includes the first program implementation year, followed by two persistence years
PPL Electric Utilities	PA	3 years	When reports were temporarily halted for 16 months and then resumed, savings returned to previous rate of 2% after just a couple of months	PPL Legacy customers' decay rate was 29.9% and PPL Expansion customers' decay rate was 22%. Counterintuitively, customers who received reports for the longest period before report cessation experienced the fastest savings decay;
Puget Sound Energy	WA	2+ years	Natural gas customers no longer receiving reports continued to save at a statistically indistinguishable level from those continuing to receive reports, while the drop-off for electric customers was much sharper	The average electric customer in the suspended group experienced savings at a rate of one-third of those continuing to receive reports—1.0 vs. 3.0 percent. Natural gas customers who stopped receiving reports didn't experience a savings decay significantly different from those who continued to receive reports. (1.6 vs. 1.1 percent).

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