Residential Behavioral Program Persistence Effects in Pennsylvania

Jacob Thomas, GDS Associates, Inc.
Jeffrey Huber, GDS Associates, Inc.
Jesse Smith, Nexant

ABSTRACT

In 2013, two electric distribution companies ("EDCs") in Pennsylvania discontinued their well-populated Home Energy Report ("HER") programs. The programs were restarted in 2015, providing at least a short window of opportunity to research the persistence of energy savings from such residential behavioral programs in Pennsylvania. The Pennsylvania Public Utility Commission ("PPUC") ordered the Statewide Evaluation Team ("SWE") to perform a statistical billing analysis to analyze whether effects persisted and at what rate such effects decayed if at all for these EDCs. The study has implications for several aspects of Pennsylvania's legislated energy efficiency and conservation programs, including potential analysis, evaluation of the effective useful life of a behavioral program, and whether a deemed rate of decay for such a program should be adopted in the statewide Technical Reference Manual ("TRM"). This paper presents the SWE's evaluation, results, and conclusions concerning HER persistence in Pennsylvania and concludes with a discussion of additional opportunities for research that the SWE recommends the PPUC and EDCs consider for future analysis of the HER programs in Pennsylvania.

Background

Pennsylvania Act 129 and the SWE

Pennsylvania ACT 129 was passed in October of 2008 and signed into law. The Act requires that seven of the state's largest EDCs deliver energy efficiency programs that reduce their electric load. It also establishes savings targets in multiple year phases. The Act 129 SWE monitors and verifies data collection, quality assurance and the results of each EDC's Energy Efficiency and Conservation ("EE&C") Plan and the EE&C program as a whole. As part of its TRM update, the Commission directed the SWE to conduct an assessment of the savings decay associated with HER programs. The study was limited in scope and time, so the SWE research team did not have the capability to investigate many interesting questions related to the HER programs in Pennsylvania, but we did recommend areas for further research by the PPUC in the future. [1]

Pennsylvania HER Programs

Two EDCs subject to Act 129, PPL Electric Utilities Corporation ("PPL") and Duquesne Light Company ("Duquesne"), ran HER programs in Program Year 4 ("PY4") but then

[1] The study was limited due to its nature as a special requested analysis by the PPUC in addition to the contracted scope of work for the SWE. It was acknowledged that this analysis might be supplemented with additional studies in the future if PPUC so directed.

discontinued the programs in PY5.[2] Accounting methods in effect for Act 129 compliance led to the brief discontinuation of the programs, which were then restarted.[3]

PPL HER program. PPL serves the retail electricity needs of nearly 1.5 million customers residing in 29 counties of central and eastern Pennsylvania. During PY5, PPL had two separate groups of residences on its Energy Efficiency Behavior and Education Program, administered by Opower. The first group, called the Legacy group, consisted of homes that began the program in May 2010. Another group, called the Expansion group, began the program about a year after the Legacy group. The groups are independent, with no home participating in both programs. Both groups were designed as a randomized control trial, with randomly-selected treatment and control accounts. For both the Legacy and Expansion programs, the respective control groups consisted of a number of customers equal to the size of the treatment groups and with equivalent pre-program energy usage.

The Legacy treatment group consisted of approximately 48,700 residential accounts with average electricity consumption just over 18,000 kWh per year (or 1,500 kWh per month). In PY4, PPL reported estimated savings of 360 kWh per home for the year from the Legacy program, which equates to 2.0% savings. A 95% confidence interval on the savings estimate is between 1.7% and 2.3% of annual consumption, or between 308 and 413 kWh. The Legacy treatment group provided reported savings totaling over 15,000 MWh in PY4.

The Expansion treatment group had approximately 52,900 residential accounts with average electricity consumption of over 27,000 kWh per year, or 2,270 kWh per month. As stated earlier, this was an entirely different group of participating homes from the Legacy treatment group and the Legacy control group. In PY4, the Expansion savings were estimated to be 495 kWh per home for the year, with a 95% confidence interval ranging from 392 to 598 kWh. On a percentage basis, the point estimate is 1.7% annual kWh savings, with a confidence interval of 1.3% to 2.1%. In aggregate, the Expansion treatment group HER program accounted for over 21,000 MWh of energy savings in PY4.

Energy reporting was discontinued for both the Legacy and Expansion groups after May 2013, coinciding with the end of PY4. PPL resumed the program in October 2014, providing a 16 month timespan over which customers who had been receiving reports were no longer getting them.

Duquesne HER program. Duquesne provides retail electric service to nearly 600,000 customers in Beaver and Allegheny Counties in southwestern Pennsylvania. Duquesne incorporated a HER program, also administered by Opower, as part of its overall Residential Energy Efficiency Program (“REEP”). There were a total of 52,200 treatment group accounts in the program in PY4 with average usage of 13,500 kWh per year, or 1,125 kWh per month. In

[2] The Program Years end in May of each year. PY4 was year ending May 2013 and PY5 was year ending May 2014.

[3] PY4 was the last year of Phase I of Act 129, and accounting for energy reductions required that a measure still be within its useful life at the end of the phase to count towards compliance. The programs were deemed to have one-year useful lives, therefore the EDCs could claim savings from the program in PY4 (the last year of Phase I of Act 129) but would not be able to claim any savings in Phase II if they ran the program in PY5, since Phase II was a three-year program beginning in PY5. Both EDCs restarted their HER programs later in Phase II.

PY4, Duquesne reported just under 4,800 MWh of energy savings from the program, or roughly a 1.0% reduction. Duquesne discontinued sending reports after the end of PY4 (May 2013) and resumed the program in March 2015.

Table 1. Summary of HER program characteristics

Group Name	EDC	Number of participants	Reporting started	Reporting discontinued	PY4 % savings
Legacy	PPL	48,700	April 2010	May 2013	2.0%
Expansion	PPL	52,900	April 2011	May 2013	1.7%
Duquesne	Duquesne	52,200	July 2012	May 2013	1.0%

Authorization of Study

In the *2016 TRM Update Final Order*, the PPUC ordered the SWE to conduct an analysis of HER persistence in the Pennsylvania programs. In particular, the PPUC was interested in using the SWE's findings to update the existing custom measure protocol for HER programs in the Pennsylvania TRM. The SWE team that took up the analysis consisted of consultants from both GDS Associates, Inc. and Nexant. The PPUC's Technical Utilities Services ("TUS") also provided valuable review and input into the study process.

Study Objectives

The objectives of the study are threefold and focus exclusively on energy savings from the PPL and Duquesne programs after regular reporting has been discontinued. This study does not evaluate or comment on savings achieved during PY4 when the programs were active. However, as part of the SWE analysis, we did estimate program impacts during PY4 using our internally-developed models and produced results consistent with the savings claimed by the EDCs. Due to budgetary constraints as this was a special requested analysis, the scope for the study was limited, and therefore, several areas of potential further research could not be conducted during this particular engagement. As a result, several recommendations for further research were presented to the PPUC by the SWE as a result of this study. The three objectives of the study can be summarized as follows:

- Determine whether energy savings from a HER program persists after reporting is discontinued.
- If there is decay of savings evident, measure the rate of savings decay.
- Determine if a one-year effective useful life ("EUL") assumption for HER programs for energy efficiency potential analysis is appropriate.

HER Persistence Analysis

This section of the paper will present data, statistical methods, and conclusions related to our analysis of the persistence of HER program effects after monthly reporting has ceased. The SWE's assessment of the one-year useful life assumption will be discussed in the next section of this paper.

Data Requirements and Preparation

The SWE required a significant amount of data from the EDCs in order to complete the study. The primary data it requested were monthly billing histories for every customer in the treatment and control groups for several years, including the twelve months of consumption history originally required by the EDC to establish program eligibility. For PPL, this represented multiple years of billing history for approximately 200,000 residential accounts. There were just over 100,000 accounts each for the Legacy and Expansion treatment groups and each of these treatment groups had separate unique control groups of approximately the same size. The SWE also collected billing histories from Duquesne for over 100,000 accounts in its control and treatment groups respectively. The second major piece of information provided by the EDCs was a table with account-specific information about when HER reports were sent and the start and stop dates of program participation. The SWE used this information to verify the months during which reports were not provided to the treatment groups.

Opower had processed these data in two important ways that made the analysis more time- and cost-efficient. First, Opower had "calendarized" these data. Calendarization involves spreading usage into the calendar month in which it took place and then computing average daily kWh consumption as opposed to aggregate monthly kWh consumption. This process is important to the analysis for three major reasons:

1. It ensures that particularly short or long billing periods are converted into appropriate calendar months of consumption.
2. It allows control and treatment billing data to be appropriately aligned with each other within each month, which eliminates billing cycle mismatches.
3. Proper control group selection and alignment of calendarized months, will allow for the control of variations in consumption due to changes in weather because control and treatment consumption is based on the same days with the same weather.

Second, Opower handled outliers to trim the raw database into clean, usable data. The SWE excluded such outliers from their analysis as well: The following outlier conditions resulted in flagging the data for removal from the analysis.

- Usage occurring after the customer move out date
- Billing data with duration less than one day
- Billing months with read dates that overlapped other billing month read dates
- Negative or very high (>300 kWh per day) daily usage that would indicate errant data

Determination of Program Impacts

To determine the energy savings impacts associated with the program, the SWE used a linear fixed effects regression ("LFER") modeling approach. The LFER is a panel regression approach in which time series data for each customer is stacked up into one database and a single regression model is structured such that model coefficients represent the difference in consumption between the control and treatment groups. Fixed effects are included to control for consumption differences in each home. The model developed by the SWE is depicted below. A separate model was constructed for each of the three groups we evaluated. SAS statistical software was used to develop the analytical databases and the GENMOD procedure was used to estimate the LFER coefficients.

$$DailyUse_{i,m} = \beta_0 + \beta_1 Post_m + \sum_i \gamma_i Acct_i + \sum_m \propto_m D_m + \sum_m \theta_m Treatment_i Post_m$$

Where:

i	=	index to represent each residential account
m	=	index to represent each month of each year of the analysis period
$DailyUse_{i,m}$	=	average daily usage in month m for customer i
Post	=	indicator variable to represent months after the start of the program
β_0, β_1	=	model coefficients
$Acct_i$	=	indicator variable for each account in the database
γ_I	=	fixed effects coefficient for account i
D_m	=	indicator variable for each month/year of the analysis period
α_m	=	coefficients for each month
Treatment	=	indicator representing a customer in a treatment group
θ_m	=	coefficient representing average daily energy savings in month m

The θ coefficient represents the savings, in kWh per day, of the program in each month. Taking this estimate and dividing it by the control group average usage in the month provides the percentage reduction achieved by the program in each month. The SWE models, using all treatment and control data, achieve PY4 savings estimates consistent with those reported by the EDCs in their PY4 Annual Reports to the PPUC. Figures 1 through 3 below show the estimated energy savings from HER programs as a percentage of control group consumption for each month for each of the three treatment groups. The solid lines represent savings when HER programs were active and reports were being sent to treatment homes. The dashed line represents months in which reports were not being sent to customers. As seen in the Figures, the HER effects did not decay within the 16 to 21 months after the reports ceased.

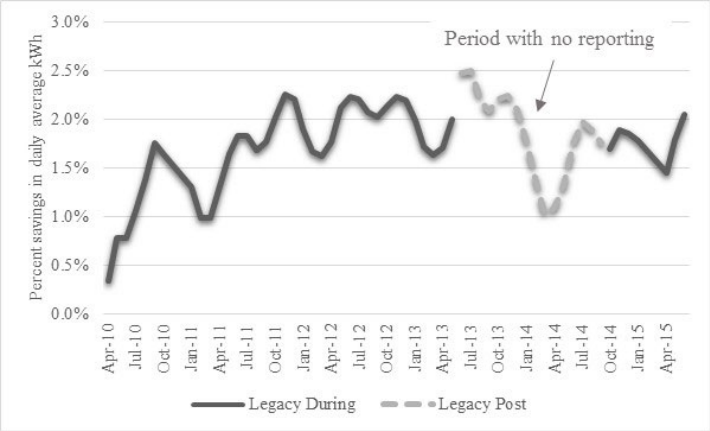

Figure 1. Estimated program impacts during and after program reporting – PPL Legacy

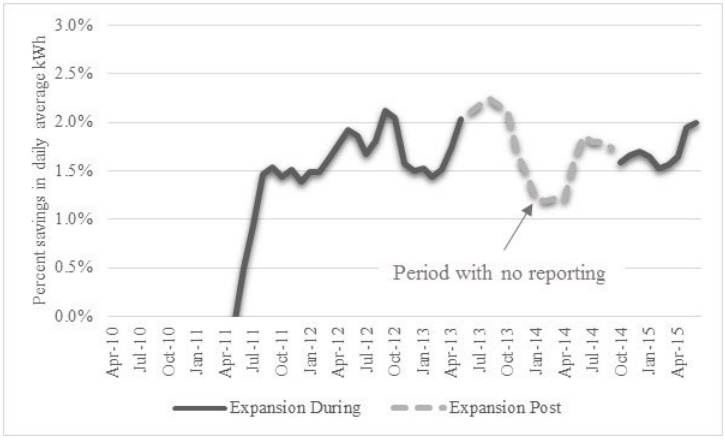

Figure 2. Estimated program impacts during and after program reporting – PPL Expansion

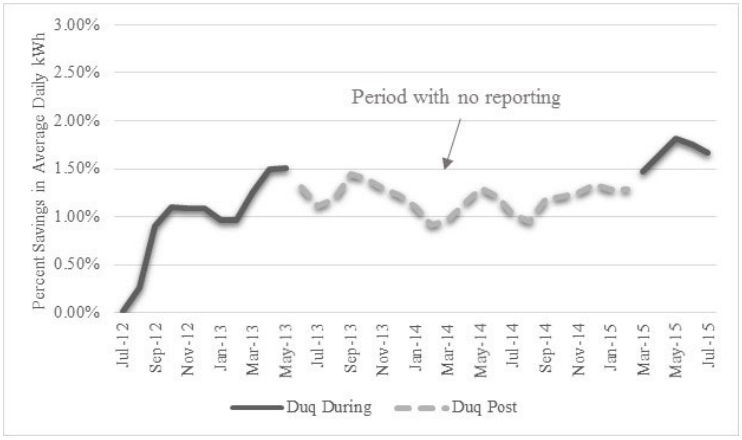

Figure 3. Estimated program impacts during and after program reporting – Duquesne

Measurement of Energy Savings Rate of Decay

Figures 1 through 3 show that HER energy benefits persisted for up to 16 months after the program was ended for all three Pennsylvania treatment groups. The second research objective was to measure the rate of decay of effects after program cessation. The following subsections describe the major challenges the SWE encountered when evaluating the rate of savings decay given the limited time available to fully assess decay.

Limited time series data available. Since both PPL and Duquesne restarted their HER programs in 2015, the number of months available to analyze decay of energy savings was limited. PPL had 16 months between stopping and restarting their programs and Duquesne had 21 months. With less than two years available for analysis, it was not possible to conduct a detailed study of the full decay patterns. Therefore, the SWE focused on calculating an average decay rate in the near term, across only the months for which data were available for analysis. Due to these missing data, the analysis in this paper cannot support any conclusions about how HER program impacts may decay in the longer term. Given the limited amount of time series information available, the SWE elected to estimate the rate of decay using a linear decay function. A linear trend was run through the period of non-reporting in order to determine at what rate of decay that trend would reach zero savings (or how long would it take at the observed rate of decay during the months of non-reporting for the treatment group consumption to equal the control group consumption).

Seasonal nature of the savings. The energy savings attributed to the program seem to be following seasonal patterns with greater savings in months with either hot or cold weather. This makes sense as a single large source of behavioral impacts can be achieved by adjusting thermostat settings to reduce electric heating and air conditioning requirements. The SWE team determined that full decay has occurred when the average impact had reached zero.

Time delay in reporting and effects. It is reasonable to assume that there will be a delay between the mailing and customer receipt of the HER and the observation of load impacts at the electric meter. Therefore, it would make sense to exclude one-to-two months of data after cessation of the program and include one-to-two months after the program resumed in the decay rate analysis. However, with no quantitative evidence of how long such lags may be, and given time and budgetary constraints on the analysis, the SWE elected to specifically use the months in which reports were not sent as the months under analysis for estimating savings decay.

HER Persistence Analysis Results

Initial decay of impacts. Over a 16 month period, the PPL Legacy group had an estimated linear decay rate of 29.9% per year. The PPL Expansion group had an estimated decay rate of 22.0% per year over the 16 month period between the stopping and restart of the HER program. The Duquesne analysis indicates very little if any decay over a 21 month period. The estimated rate of decay for the Duquesne treatment group is 1.2% per year.

The SWE team is unsure why the savings impacts from the Duquesne reports persisted as long as they did. However we did note that the overall savings from the Duquesne program were roughly half that of the PPL programs to begin with, but that the Duquesne program was only ten months old, so customers may still be in the ramp-up period associated with initiation of the behavioral program. The fact that the program with the shorter life had slower decay seems to be a

contradictory result from several other recent studies. A study of a six-month program at Connecticut Light and Power found full decay of the program within five months of cessation (NMR Group, Tetra Tech and Hunt Alcott 2013). As another example, the rate of decay was highest for the wave of customers with the shortest time on the reporting program in ComEd's behavioral program (Olig and Sierzchula 2016). The ComEd wave had a year of treatment before cessation of reporting, and Navigant measured a 22.4% rate of decay relative to decay rates of 4.4% and 2.1% for more mature programs (*Ibid*).

Interestingly, and somewhat counterintuitively, the PPL Legacy group had the longest exposure to HERs but also the fastest rate of decay of the three groups. In 2014, the Cadmus Group released a white paper in which they performed a meta-analysis of the persistence issue. They estimated an average annual energy savings decay rate of 20.0% after two years of treatment in their analysis (Khawaja and Stewart 2014). The meta-analysis reviewed five different studies in which the participants received treatment for between 24 and 28 months. The measured decay rates from those studies ranged from 11% to 32% (*Ibid*). The PPL Legacy and Expansion results are consistent with the results from those studies analyzed by Khawaja and Stewart. ComEd found much lower rates of decay for the wave of customers that were on their program for two and a half years, nearly the equivalent time of the PPL Legacy and Expansion groups. ComEd measured a decay rate of 2.1% for the similar wave (Olig and Sierzchula 2016).

Table 2. Summary of HER energy savings decay estimates

Group Name	No. months w/ HER	No. months w/o HER	Est. annual rate of decay
PPL Legacy	38	16	29.9%
PPL Expansion	24	16	20.0%
Duquesne	10	21	1.2%

Long-term decay of effects. The SWE was unable to draw conclusions about the longer-term decay of effects due to lack of a sufficiently long time series. Since both PPL and Duquesne restarted their programs in 2015, the data available to analyze decay covers less than a two- year period. It is worth noting that the SWE analysis for the shorter time periods assumed linear rates of decay. However, we think that the rates of decay for periods beyond a year or two are likely to be non-linear. A non-linear rate of decay could produce vastly different results with regards to the amount of time required for impacts to fully erode.

Restarting of programs. Interestingly, the Pennsylvania HER program experience seems to indicate that resumption of these types of programs leads to rapid recovery of the savings which had eroded during the time when the programs were not active (just under two years, in the case of the Pennsylvania programs). Both PPL programs, even after a relatively significant level of erosion of impacts over 16 months, saw savings recover back to 2.0% within just a few months of restarting their program. Duquesne actually saw increased savings after restarting the program, with energy savings reaching nearly 2.0% within a few months. That was better savings than in any month in the initial run of the HER program. Admittedly, this observation is

made after only several months of program resumption and this study did not have the opportunity to observe whether these recovery effects persisted over a longer period. This effect has important ramification for HER program design and cost effectiveness.

Cost Effectiveness Considerations

The third objective of the study was to analyze the appropriateness of a one-year EUL for residential behavioral programs in Pennsylvania. Based on the findings of persistence of HER effects after cessation of the program, the SWE conducted a scenario analysis to provide estimates of the benefit/cost implications of changing the assumed measure life of the HER measure from one to five years. Even though the Duquesne HER program showed that decay rates could be much lower, the evidence from the PPL HER programs, and additional evidence from the Cadmus meta-analysis, prompted the SWE to select a 20% decay rate as the default assumption and examined the effect on savings potential and portfolio cost-effectiveness by modifying the HER program delivery approaches.

The SWE scenario analysis considered two different program delivery options. The first was a "multiple cohort" or "customer rotation" option in which customers would receive the HER for one year only and then HER reports would be distributed to a new cohort the next year. The second delivery option was a single cohort program in which a single group of customers would receive HER reports year after year over the life of the program. This single cohort approach describes how the programs have been implemented in Pennsylvania in recent years. In practice, a mixture of these two programs is probably in effect as customers are added and dropped to the program over time. However, the SWE focused on the two exclusive categories to simplify the analysis. The Total Resource Cost ("TRC") test was used to evaluate comparative cost effectiveness of the scenarios.

The SWE team's cost effectiveness analysis developed and analyzed five total scenarios under the two program delivery options:[4]

- Scenario CR1 – This scenario assumes that a single group of customers will receive the report each year, and then followed by a different group of customers who will receive the report in each subsequent year. We refer to this characteristic as "customer rotation" or "CR." This scenario assumes a 1-year useful life. The scenario is referred to as Scenario CR1 to note the customer rotation characteristic and the 1-yr useful life.
- Scenario CR5A – This scenario assumes customer rotation with 5-year useful life. The defining characteristic in this scenario is that first year savings (as well as the savings that accrue in years after the HER is distributed) will be accounted for as savings and benefits attributable to the respective cohort group. The letter "A" denotes the first of two scenarios which are characterized by customer rotation and 5-yr useful life.
- Scenario CR5B – This scenario also assumes customer rotation with 5-year useful life. In contrast to Scenario CR5A, savings that accrue in years after the HER is distributed will

[4] Each scenario is identified by its category (either "CR" for customer rotation or "SC" for single cohort) and its assumption for measure life. For example, CR1 corresponds to customer rotation with a one-year measure life.

be accounted for as benefits in the program years in which those savings occur. Therefore the TRC is calculated based only on savings that occur in a given years.

- Scenario SC1 – single cohort, "SC" with no customer rotation and a 1-year useful life. This has been the traditional program delivery approach for HERs.
- Scenario SC5 – single cohort with no customer rotation and a 5-year useful life.

Benefits and Costs

SWE developed all assumptions related to benefits and costs in the TRC from program information for PY4 for a specific EDC in Pennsylvania. It assumed benefits to be 400 kWh savings per home in the first year of the program. It also assumed avoided to be $0.05 per kWh in the first year with an escalation rate just under 2% per year. The nominal costs of the program were assumed to be constant at $27 per home per year. The analysis used an 8% discount rate. The scenario TRC benefit examples did not factor in additional capacity benefits of the consumption savings.

Cost Effectiveness Results

The SWE calculated example benefit/cost ratios for each of the five scenarios for each program year and a total across the five-year timeframe of the analysis. It is important to note that SWE presents the TRC ratios below to allow for comparison between scenarios and readers are cautioned not to use the TRC results as indicators of actual HER program cost-effectiveness. Rather, these figures provide context regarding the directionality of cost-effectiveness when considering single versus multiple cohort program delivery options and single year versus multiple year EUL analysis. Table 3 provides a summary of the TRC ratios for each of the five scenarios. For comparison purposes across program years, all benefits and costs have been computed on a present value Year 1 basis.[5]

Table 3. Summary of HER program Annual Cost Benefit Ratios

Scenario	Brief description	Y1	Y2	Y3	Y4	Y5	Total
CR1	Customer rotation/1-yr EUL	0.7	0.8	0.8	0.8	0.8	0.8
CR5A*	Customer rotation/5-yr EUL; TRC based on 5-yr EUL	2.1	2.1	2.1	2.2	2.2	2.1
CR5B*	Customer rotation/5-yr EUL; TRC based on 1-yr EUL	0.7	1.4	1.8	2.2	2.4	1.6
SC1	Single cohort/1-yr EUL	0.7	1.0	1.0	1.1	1.1	1.0
SC5	Single cohort/5-yr EUL	2.1	1.0	0.7	0.8	1.0	1.2

*The HER measure life is 5 years in both CR5A and CR5B in terms of assuming that savings persist, but the difference between the scenarios is that CR5A accounts for all lifetime savings of the program year in which the reports are distributed while CR5B accounts for future year savings in the year in which they occur.

In scenario CR1, the savings are held at 400 kWh with constant costs, so the only variables causing fluctuations in the TRC ratio are the discount rate and the assumed level of the

[5] Please note that natural degradation of the population through move-outs, etc. is not taken into consideration here

avoided costs over time. The TRC ratios are stable in this scenario at 0.8 per year. The CR5A and CR5B scenarios yield the greatest TRC ratios among the five scenarios because of the assumed persistence of savings for five years and the use of customer rotation to maintain "in-program" savings each year. Scenario SC1 provides stronger TRC results than CR1, because of the modest growth in savings associated with the single cohort approach as they continue to receive reports in subsequent program years and behavioral changes and reminders are reinforced. However, scenario SC1 effectively ignores the persistence issues identified in this and other studies. The TRC ratios in scenario SC1 increase slightly from 0.7 to 1.1 across the five years. Last, the TRC ratios in scenario SC5 show a decline in the first three years. This is a function of the decay rate, which means that the lifetime savings in years two and three are much less than the first year after accounting for the savings that are expected to persist had the reports been terminated. However, the TRC ratios in the fourth and fifth years begin to rebound as the continued delivery of HERs would offset additional decay each year. While this is counterintuitive because the incremental savings are decreasing and leveling off over time, the continued delivery of HERs yields an accumulation of avoided decay, which effectively stems the tide in decreasing cost-effectiveness observed in years 2 and 3.

SWE Recommendations

Based on the analyses summarized in this paper, the SWE made several recommendations to the PPUC regarding Residential Behavioral Programs in Pennsylvania's Act 129 programs. The SWE also made recommendations on considerations for further research on the HER persistence issue.

Recommendation for Pennsylvania Technical Reference Manual

The study showed that PPL and Duquesne had very different estimates of the annual decay rate following withdrawal of HER exposure. To a lesser extent, a different decay rate was observed between the PPL Legacy and Expansion groups. Based on these findings, the SWE believes it would be premature to stipulate a statewide decay rate for all residential HER programs offered as part of Act 129. The TRM does not currently deem savings for these programs either. In fact, with such disparate savings rates already determined from programs that can have so many different variations in design and delivery, it likely will not make sense to ever deem savings or decay rates. Further analysis of why program savings were so different would be instructive for further consideration of the issue.

Recommendation for Cost-Effectiveness

The study results indicate that a simple one-year EUL assumption for HER programs does not fully capture the lifetime savings produced by such programs for purposes of a TRC test. The analysis of all three Pennsylvania HER programs indicates that program savings impacts linger for many months after the cessation of the HERs. Although it is premature to stipulate a statewide decay rate, and while more analysis may be required to determine an appropriate measure life for HER, this report discusses several scenarios for reporting the cost-effectiveness of HER programs assuming a multiple year useful life. The SWE concludes that scenario CR5A for multiple cohort program delivery and scenario SC5 for single cohort program delivery represent the accounting methods for TRC testing most consistent with the prescribed

methods used for other Act 129 energy efficiency programs with long-term useful lives. These scenarios also best accounts for what the empirical data show regarding the persistence of energy savings.

Recommendations for Further Research and Evaluation

The SWE believes additional research is needed in the following areas as related to HER programs in Pennsylvania:

- *Examination of reasons for HER decay for all Pennsylvania EDCs subject to Act 129.* The differences observed in the PPL and Duquesne results indicate that there may be significant differences in the decay rate across EDCs and HER programs.
- *Further analysis of the relationship between duration of report exposure and the decay rate.* The homes in the PPL and Duquesne implementations examined in this study received HERs for a relatively brief period before the program was suspended. It may not be appropriate to extrapolate these decay rates to programs where participants have received HERs continuously for four or five years and have perhaps had more opportunity to enact more permanent changes in consumption to respond to the reports.
- *Long-term effects of HER cessation*. Both the PPL and Duquesne programs were restarted in 2015 so the SWE analysis was based on relatively short time horizons (less than 24 months in all three cases). The SWE used a linear model to extrapolate the observed decay rate and to estimate what would happen beyond two years. However, such predictions carry significant uncertainty. The SWE recommends studying these long-term effects in more detail before implementing any policy changes about how HER compliance savings or TRC ratios are determined.

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