Guidehouse
Outwit Complexity

Home Energy Report Program Evaluation

CY2024 Final Report
(1/1/2024 – 12/31/2024)

Prepared for:

Potomac Edison

PotomacEdison™
A FirstEnergy Company

Submitted by:

Guidehouse Inc.
2617 Broadway Street
Boulder, CO 80304

August 2025

Table of Contents

Section **Page**

Executive Summary

Program Description

Potomac Edison's (PE's) Home Energy Report (HER) program, implemented by Oracle, is designed to generate energy savings by providing residential customers information about their specific energy use and related energy conservation suggestions and tips. The information is provided to customers in home energy reports (HERs) that illustrate the following:

- How customers' recent energy use compares to their energy use in the past
- Tips on how the customers can reduce energy consumption, some of which are tailored to each customer's circumstances
- Information on how the customers' energy use compares to that of neighbors with similar homes

In other studies, this information has stimulated customers to reduce their energy use, creating average energy savings in the 1% to 2% range depending on local energy use patterns.

Key Findings

Table 1 presents the evaluated net energy savings for PE's HER program in calendar year (CY) 2024 (i.e., January 1, 2024 through December 31, 2024). Key findings include the following:

- Total evaluated net program savings were 28,288 MWh,[1] with 18,953 MWh coming from Wave 1; 1,244 MWh from Wave 2; 1,203 MWh from ,Wave 3; 2,736 MWh from Wave 4; 1,352 MWh from Wave 5; 2,019 MWh from Wave 6; and 722 MWh from Wave 7.[2,3,4] This amounted to a realization rate of 94%.[5]
- The program saw an increase in energy savings in comparison to CY2023 (from 25,929 MWh in 2023); the percentage savings rate also increased from 1.65% to 1.72%.
- On average, participating customers reduced their electricity usage by 1.72%; 2.35% for Wave 1; 1.16% for Wave 2; 0.72% for Wave 3; 1.65% for Wave 4, 0.96% for Wave 5, 1.57% for Wave 6, and 1.89% for Wave 7.[6] This was an increase for Waves 1, 2, and 6 compared to CY2023.
- The HER program increased participation in PE's other residential energy efficiency programs in CY2024. Guidehouse estimated uplift savings (both from the current year and

[1] The total savings may not sum due to rounding.

[2] Savings are at the customer level and do not account for line losses.

[3] See Table 1-1 for a summary of when each wave launched.

[4] Energy savings generated by Waves 1, 4, 5, 6 and 7 were statistically significant at the 90% confidence level while savings generated by Wave 2 and 3 were not statistically significant; however, savings from all waves are included in net savings irrespective of their statistical significance. This references the claimed model for each wave; see section 2.3 for more details.

[5] The implementer reported 27,605 MWh of savings for HER in their year-end report. This differed from the Potomac Edison semi-annual report number Guidehouse compared to for the realization rate due to the timing of when the two values are obtained, and revision based on additional data received in the interim. Compared to the year-end report value, Guidehouse found a realization rate of 102% for electric.

[6] The savings percentages do not reflect double counting adjustments from uplift.

previous years) at 1,350 MWh (or 4.46% of total savings) and excluded these uplift savings from evaluated net program savings.[7]

- Guidehouse applied an upstream lighting adjustment factor in the 2024 evaluation to account for cross participation in the HER program and the residential lighting program. The upstream lighting uplift savings amounted to a total of 700 MWh or 2.31% of HER program electric savings.[8]
- The system residential peak occurred on January 22nd, 2024 at 8 a.m. and the coincident demand savings corresponding to this peak was 7.58 MW.[9]
- Electricity savings generated by the HER program (i.e., 1.72% for all waves combined) are within the typical range of savings for residential HER programs (i.e., 1%-2%).

Table 1. Evaluation Summary, CY2024

Type of Statistic	2024
Number of Participants, All Waves*	115,837
Percent Savings	1.72%
Evaluated Net Savings before Uplift Removal (MWh)†	30,278
Current Year Uplift Savings in Other EE Programs (MWh)	345
Legacy Uplift Savings in Other EE Programs (MWh)	1,005
Percent of Savings from Uplift‡	4.46%
Upstream Lighting Adjustment (MWh)	700
Percent of Savings from Upstream Lighting	2.31%
Evaluated Net Savings after Uplift Removal (MWh)§,‖	28,228
Reported Electric Savings (MWh)**	**30,123**
Realization Rate	**94%**

* The number of participants is based on the customer ID from billing data, and only includes currently active customers. Any participant who has an inactive date that is before 2024-01-01 is not counted in this participant count.

† The evaluated net savings include savings from all waves irrespective of the statistical significance of the results. Savings generated by Waves 1, 4, 5, 6 and 7 were statistically significant at the 90% confidence level while savings generated by Waves 2 and 3 were not statistically significant. This references the claimed model for each wave; see section 2.3 for more details.

‡ This is the combined percentage for current year uplift and legacy uplift.

§ The evaluated net savings include savings from all waves irrespective of the statistical significance of the results.

‖ Numbers may not sum due to rounding.

** The implementer reported 27,605 MWh of savings for HER in their year-end report. This differed from the Potomac Edison semi-annual report number Guidehouse compared to for the realization rate due to the timing of when the two values are obtained, and revision based on additional data received in the interim. Compared to the year-end report value, Guidehouse found a realization rate of 102% for electric.

Source: Guidehouse analysis

[7] The current year and legacy uplift methodologies are described in Sections 2.4.1 and 2.4.2, respectively.

[8] The upstream uplift methodology is discussed in Section 2.4.3.

[9] Guidehouse does not directly evaluate demand savings using interval usage data for the PE HER program. The energy savings percentage is applied to the utility's load shape to calculate demand savings.

Recommendations for Program Improvement

Guidehouse found that evaluated net energy savings are within the typical range of savings for residential behavior programs. Guidehouse recommends PE and its program implementer consider the following actions:

- **Recommendation 1:** In the 2024 evaluation, Guidehouse removed customers with less than three months of pre-period data from the energy savings calculations for waves launched in 2021 and 2022 (although all PE customers added in 2021 and 2022 had at least three months of pre-period data so none were actually removed; note no customers were added in 2023 or 2024). For earlier waves, customers with less than three months of pre-period data were “grandfathered in.” Guidehouse will continue to conduct this removal in the future and recommends the program implementer comply with this eligibility requirement when launching new waves. When feasible, the implementer should collect more pre-period data, with an ideal of 12 months.
- **Recommendation 2:** The program implementer should continue to communicate program changes with the utility and Guidehouse to keep the data transfer process and response to data requests efficient. The implementer should communicate changes, such as refill of waves or deletion of pre-period data, to Guidehouse during data transfer to avoid confusion during the evaluation. Preferably, refills would be added to the program as a new wave rather than put into an existing wave to preserve the randomization. If new customers are added to an existing wave, the treatment to control customer ratio should match the existing wave.

1. Introduction

1.1 Program Description

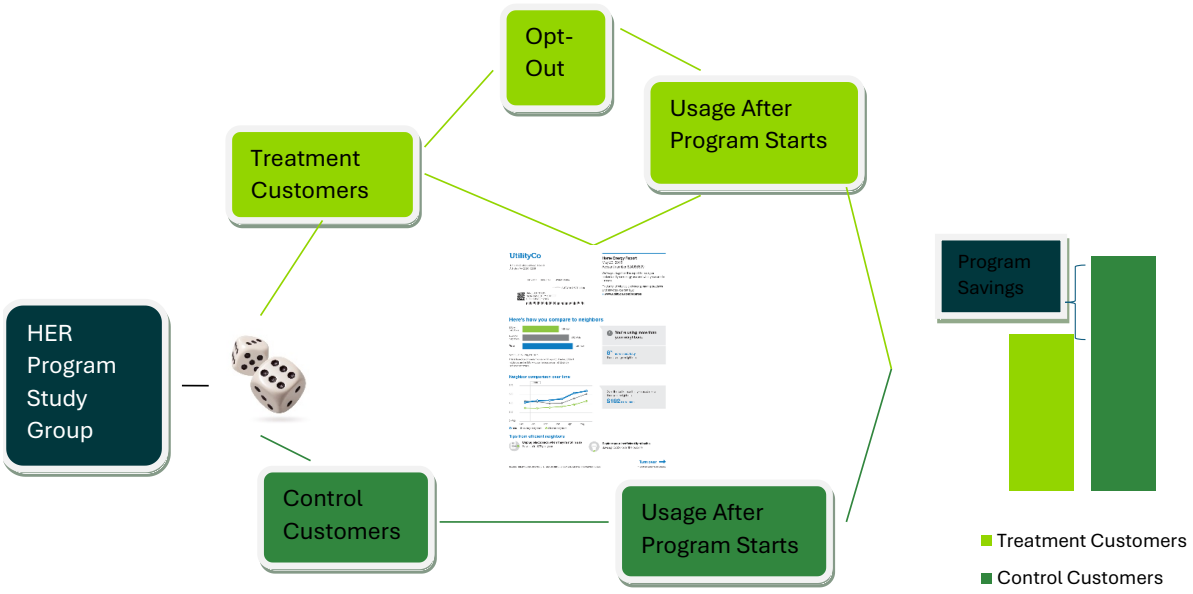
Potomac Edison's (PE) Home Energy Report (HER) program, implemented by Oracle, is designed to generate energy savings by providing residential customers information about their specific energy use and related energy conservation suggestions and tips. The information is provided to customers in home energy reports (HERs) that illustrate the following:

- How customers' recent energy use compares to their energy use in the past
- Tips on how the customers can reduce energy consumption, some of which are tailored to each customer's circumstances
- Information on how the customers' energy use compares to that of neighbors with similar homes

In other studies, this information has stimulated customers to reduce their energy use, creating average energy savings in the 1% to 2% range depending on local energy use patterns.

An important feature of the program is that it is a randomized controlled trial (RCT) design where the customers are randomly chosen by Oracle to enroll in the program but have the option of opting out of the program anytime.[10] Eligible customers are randomly assigned to a treatment (participant) group and a control (nonparticipant) group, for the purpose of estimating changes in energy use due to the program Figure 1-1 illustrates the program design and implementation of an HER program.

Figure 1-1. HER Study Design



Source: Guidehouse

[10] Randomly chosen here means the allocation to the treatment and control groups is random to ensure the saving impact is attributable solely to this HER program (and not other participant features). The experimental design might choose to target to a certain type of customers in the utility population, such as high energy usage customers.

The HER program rollout is summarized in Table 1-1. As participating customers move out of their home or opt out of the program, they drop from the program as participants. Similar customer attrition applies to the control group (though any concept of opt out does not apply).[11] Rates of customer attrition for the program are presented in Appendix A.

Table 1-1. Program Rollout Summary

Participation	Launch Date	Participants	Controls	Total
Wave 1	October 2012	75,600	26,250	101,850
Wave 2	February 2015	10,500	3,150	13,650
Wave 3	March 2016	31,500	15,750	47,250
Wave 4	September 2017	25,000	12,000	37,000
Wave 5	March 2020	20,000	15,000	35,000
Wave 6	January and June 2021	22,000	12,000	34,000
Wave 7	January 2022	6,500	3,500	10,000
	Total Participants	**191,100**	**87,650**	**278,750**

Source: PE tracking data

The actual number of email and print reports Oracle sent in 2023 is presented in Table 1-2.

Table 1-2. Report Delivery Schedule

Month	# of Emails Sent (HER)	# of Print Reports Sent*
January 2024	61,303	0
February 2024	60,749	92,350
March 2024	60,431	0
April 2024	60,878	91,733
May 2024	59,282	0
June 2024	60,204	89,836
July 2024	59,903	0
August 2024	59,153	88.938
September 2024	55,869	0
October 2024	52,043	88,273
November 2024	56,926	0
December 2024	48,347	105,932

**There were 6 batches of print reports sent, which did not neatly align with a calendar month. Each reporting batch, for example the 92,350 sent between February 4th and March 16th 2024 were assigned to the month of the start of that time period.*

Source: Oracle data

[11] Participants who opt out of receiving reports are retained for the purposes of evaluation to maintain the statistical equivalence of the treatment and control groups. Therefore, estimates of program savings reflect an intent-to-treat effect.

1.2 Evaluation Objectives

The primary objective of this analysis is to determine the extent to which participants in the HER program reduced their electric energy consumption due to the program.

2. Evaluation Approach

The evaluation approach Guidehouse employed in this analysis is consistent with the methodology described in the State and Local Energy Efficiency ACTION report (SEE Action Report)[12] and the Uniform Methods Project (UMP) Chapter 17 on Residential Behavior,[13] relying on statistical analysis appropriate for RCTs. This evaluation has three primary components: checking the allocation of customers to the treatment and control groups for consistency with an RCT, regression analysis to quantify program savings for the reporting period (calendar year [CY] 2024), and quantification of double counted savings from participation uplift in other energy efficiency programs. This section describes these components in more detail.

2.1 Statistical Consistency of the Program with an RCT

There were no new waves launched in 2024. In CY2022, Guidehouse compared the monthly energy usage of the treatment and control groups for Wave 7 (launched in 2022) during the 12-month period prior to the start of the program (January to December 2021). Guidehouse verified the RCT for Wave 1 during the 2014 evaluation, Wave 2 during the 2015 evaluation, Wave 3 during the 2016 evaluation, Wave 4 during the 2017 evaluation, Wave 5 during the 2020 evaluation, and Wave 6 during the 2021 evaluation. In light of these results and as detailed in the next section, Guidehouse used a statistical method appropriate for RCTs to quantify the energy savings for the program.[14]

2.2 Gross Impact Evaluation

Due to the RCT design of the HER program, free ridership and participant spillover are incorporated in the results of the regression analysis. Free ridership is accounted for because there are no participants who otherwise might have received the individualized reports in the absence of the program. While some customers receiving reports may have taken energy conserving actions or purchased high efficiency equipment anyway, the random selection of program participants (as opposed to voluntary participation) implies that the control group of customers who did not receive reports is expected to exhibit the same degree of energy conserving behavior and purchases. There is no participant spillover for this program because there is no specific measure, and all actions customers take within the home where they receive reports are captured by the analysis. The RCT design does not account for nonparticipant spillover; however, nonparticipant spillover is expected to be small for this type of program. As

[12] Todd, A., E. Stuart, S. Schiller, and C. Goldman. *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations.* Lawrence Berkeley National Laboratory. May 2012. Available at: http://behavioranalytics.lbl.gov/

[13] Stewart, J. and A. Todd. *Chapter 17: Residential Behavior Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures: September 2011 – August 2020.* Golden, CO: National Renewable Energy Laboratory. 2020. NREL/SR-7A40-77435. Available at: https://www.nrel.gov/docs/fy21osti/77435.pdf.

[14] In 2022, Guidehouse reviewed the RCT for Waves 1-5, looking at pre-period data only for those customers who are still active in CY2022. Guidehouse concluded all of the waves were still consistent with an RCT. Four of the five waves had no individual months that showed a statistical difference in the mean energy usage. Wave 1 showed statistical differences in two out of twelve months, which is within our expectations of random chance. None of the five waves showed a statistically significant treatment effect in the pre-period regression.

such, the regression analysis described in Section 2.3 inherently estimates net savings. Gross savings are not estimated and there is no net to gross ratio.

2.3 Net Impact Evaluation Methodology

Guidehouse estimated program impacts using three regression analyses applied to monthly billing data: a linear fixed effects regression (LFER) model, a lagged-dependent variable (LDV) model, and a post only model. Although the three models are structurally different, all of them generate unbiased estimates of program savings in an RCT, and Guidehouse runs multiple models as a robustness check. This analysis was performed separately for each wave.

Guidehouse reports savings from the LDV model unless a significant amount of pre-program data is missing.[15] In cases where large amounts of pre-data are not available, the LDV model drops a significant amount of data from the evaluation period which can result in biased savings estimates. Based on reviewing data, Guidehouse chose a threshold of 40% of pre-program data missing as a cut-off for when to report savings from the post only model rather than the LDV model. The 40% is based on observations missing pre-period data out of the total number of observations going into the model.

For PE in CY2024, Guidehouse reported savings from the LDV model for Waves 5, 6, and 7, which were launched after 2018, and the Post Only model for Waves 1, 2, 3, and 4, launched prior to 2018, due to lack of pre-period data.[16,17]

To get total program savings, Guidehouse multiplied the average daily savings estimate from the relevant regression by the total participating days of all participants in the post-period,[18] as shown in Equation 2-1.

Equation 2-1. Calculation of Evaluated Net Savings

$$Evaluated\ Gross\ Savings\ (MWh) = \frac{Avg\ Daily\ Savings\ (kWh) * Number\ of\ Program\ Days}{1{,}000}$$

[15] Guidehouse prefers to report out the LDV model for several reasons. First, although both the LFER and LDV models generate unbiased estimates of program savings, as an empirical matter—based on our past analyses and those in the academic literature—estimated savings from the LDV model tend to have lower standard errors than those from the LFER model, though the differences are usually very small. Second, the LDV model embodies more flexibility than the LFER model, in that the former allows the individual customer control variable to vary seasonally while the latter does not; the LFER model treats all unobserved inter-household heterogeneity affecting households' energy usage as time-invariant, while the LDV model uses lagged individual controls that can vary over time. Third, compared to the post only model the LDV model incorporates pre-program data (through the lag) and can thus account for small differences between the treatment and control groups that can occur even with the RCT. Fourth and finally, the program implementer uses a structurally similar model for their estimates, making the two sets most comparable.

[16] In 2021, Guidehouse checked the number of pre-period months for Waves 1-6 and for five of the six waves the median number of pre-period months was 12 months (i.e., a full year of pre-period data). Note that for Wave 6, launched in 2021, many customers only had seven months of pre-period data in the model because they were added to the wave in June 2021. This is resolved in the 2022 evaluation since this wave has a full year of post data being analyzed.

[17] FirstEnergy asked Oracle to delete customer data prior to 8/01/2018 to resolve a technical issue. This resulted in customers in waves launched prior to 2018 having no pre-data and necessitating the use of the Post Only model.

[18] Savings accrue for participants with active accounts. Customers that opt-out of HERs continue to generate savings after they opt-out of the program.

2.3.1 LFER Model

The LFER model combines both cross-sectional and time series data in a panel dataset. The regression essentially compares pre- and post-program billing data for participants and controls to identify the effect of the program. The customer-specific constant term ("fixed effect") is a key feature of the LFER analysis and captures all customer-specific effects on energy usage that do not change over time, including those that are unobservable. The fixed effect represents an attempt to control for any small systematic differences between the treatment and control customers that might occur due to chance. Specifically, Guidehouse estimated the regression model shown in Equation 2-2.

Equation 2-2. LFER Model

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Participant_k * Post_t + \varepsilon_k$$

Where,

ADC_{kt}	= The average daily usage in kWh for customer *k* during billing cycle *t*. This is the dependent variable in the model.
$Post_t$	= A binary variable indicating whether bill cycle *t* is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).
$Participant_k$	= A binary variable indicating whether customer *k* is in the participant group (taking a value of 1) or in the control group (taking a value of 0).
α_{0k}	= The customer-specific fixed effect (constant term) for customer *k*. The fixed effect controls for all customer-specific effects on energy usage that do not change over time.
α_1, α_2	= Regression parameters corresponding to the independent variables.
ε_{kt}	= The error term clustered for customer *k.* Cluster-robust standard errors account for heteroscedasticity and autocorrelation[19] at the customer level.

Average daily savings are indicated by the parameter α_2.

2.3.2 LDV Model

As with the LFER model, the LDV model combines both cross-sectional and time series data in a panel dataset. The difference is that LDV model uses lagged energy use for the same calendar month of the pre-program period replacing the customer-specific fixed effect as a control for any small systematic differences between the treatment and control customers. In particular, energy use in calendar month *m* of the post-program period is framed as a function of both the treatment variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between control and treatment customers will be reflected in differences in their past energy use, which is highly correlated with their current energy use.

Formally, the model is shown in Equation 2-3.

[19] Ordinary Least Squares (OLS) regression models assume the data are homoscedastic and not autocorrelated. If either of these assumptions is violated, the resulting standard errors of the parameter estimates are likely underestimated. A random variable is heteroscedastic when the variance is not constant. A random variable is autocorrelated when the error term in one period is correlated with the error terms in at least some previous periods.

Equation 2-3. LDV Model

$$ADC_{kt} = \beta_1 Participant_k + \beta_{2t} ADClag_{kt} * Month_t + \beta_{3t} Month_t + \varepsilon_k$$

Where all parameters in common are as defined in the LFER model and,

$ADClag_{kt}$	= Customer *k*'s energy use in the same calendar month of the pre-program year as the calendar month of month *t*, and $Month_j$ is a binary variable taking a value of 1 if the observation is in Month *j* and 0 otherwise.[20]
$Month_t$	= A binary variable taking a value of 1 if the observation is in Month *j* and 0 otherwise.
$\beta_1, \beta_{2t}, \beta_{3t}$	= Regression parameters corresponding to the independent variables. Parameters β_{2t} and β_{3t} are specific to each month of the post-program period.

In this model, β_1 is the estimate of average daily energy savings due to the program.

2.3.3 Post Only Model

The post only model, as shown in Equation 2-4**,** is similar to the LDV model; however, it does not include the lagged interaction term containing pre-period usage in LDV model. All the parameters in the equation are defined the same way as in the LDV model and the program savings are calculated the same. The post only model accounts for only billing data in the post-period and is not influenced by pre-period data, hence it is an appropriate model in cases with significant missing pre-data.

Equation 2-4. Post Only Model

$$ADC_{kt} = \beta_1 Participant_k + \beta_{2t} Month_t + \varepsilon_k$$

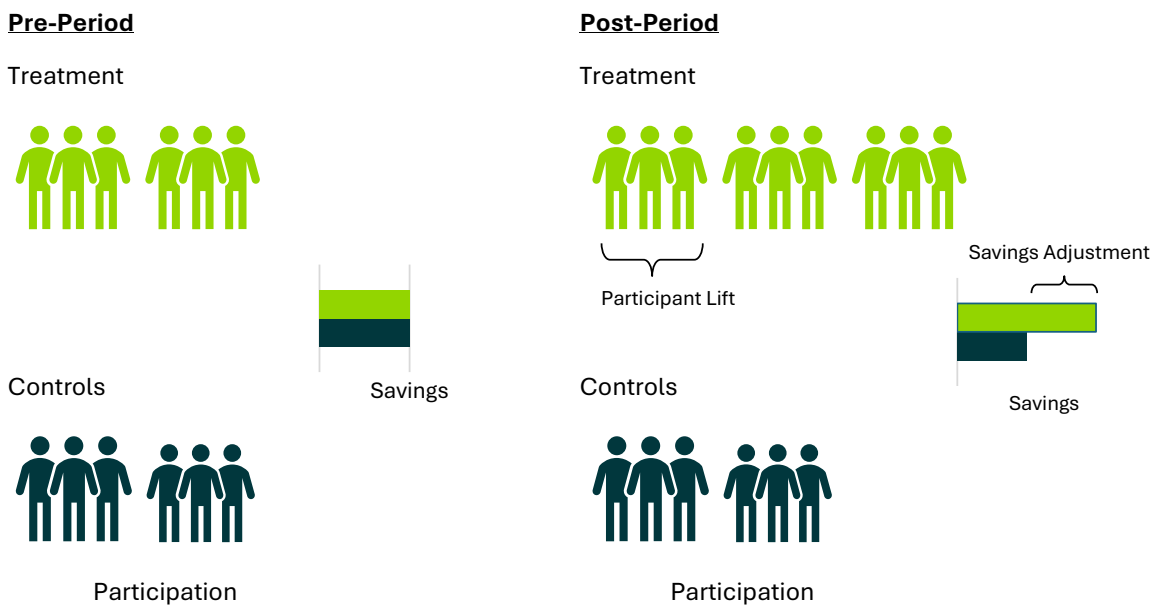
2.4 Uplift Analysis Methodology

The HERs include energy saving tips, some of which encourage participants to enroll in other energy efficiency programs offered by PE. If participation rates in other energy efficiency programs are the same for HER participants and controls, the savings estimates from the regression analysis are already "net" of savings from the other programs, as this indicates the HER program had no effect on participation in the other energy efficiency programs. However, if the HER program affects participation rates in other energy efficiency programs, then portfolio savings differ from the simple summation of savings in the HER and energy efficiency programs (illustrated in Figure 2-1). For instance, if the HER program increases participation in other energy efficiency programs, the increase in savings may be allocated to either the HER program or the energy efficiency program but cannot be allocated to both programs simultaneously without double counting the increase in savings.

[20] The use of interaction terms $ADClag_{kt} * Month_t$ allows the effect of lagged energy use on current energy use to vary by calendar month.

On the other hand, if the HER program generates negative participation in other energy efficiency programs—a negative spillover—then there is no double counting of savings.[21] These negative double counted savings are zeroed out, because they represent a downward bias in the statistical estimate of HER program savings. In other words, the negative spillover inappropriately lowers the counterfactual energy use—or baseline—against which program savings are measured, causing the estimate of HER program savings to be too low.

Figure 2-1. Energy Efficiency Program Uplift



Source: Guidehouse

Guidehouse accounted for current year uplift, legacy uplift, and upstream program uplift as described in the following three sections. Equation 2-5 shows the overall adjustment to HER savings for uplift where CY refers to current year and MOR refers to move-out rate.

Equation 2-5. Uplift Adjustment

$$\text{HER Savings}_{\text{CY}}^{\text{Adjusted}} = HER\ Savings_{CY}^{Unadjusted} - Uplift\ Savings_{CY} - \sum_{i=1}^{CY-1} "Live"\ Legacy\ Uplift\ Savings_i \cdot (1 - MOR)^{CY-i} - Upstream\ Uplift_{CY}$$

[21] Negative uplift could occur for several reasons including: the HER program reduces the value of another Energy Efficiency program (for example, a customer no longer runs their AC except on days over 90 degrees so the value of an AC replacement is lower) or a temporal shift has occurred in participation in other programs (for example, assume that the control group participates in another program at a rate of 1% per year, but the treatment group joined that same program at a rate 5% in the first year after the HER program started and then 0% for the next four years; this will show positive uplift in the first year and negative uplift in the subsequent four years), in this case no change in total participation occurs but rather participation occurs sooner for the treatment group.

2.4.1 Accounting for Current Year Uplift

As data permitted, Guidehouse used a difference-in-difference (DID) statistic to estimate uplift in other energy efficiency programs in the current evaluation year. To calculate the DID statistic, Guidehouse calculated the difference between the HER treatment and control groups in average pro-rated[22] energy efficiency program savings per customer in the post period,[23] and subtracted the same difference from the pre-period.[24] For instance, if the energy efficiency program savings during the evaluation period is five kWh for the treatment group and three kWh for the control group, and the savings during the year before the start of the HER Program is two kWh for the treatment group and one kWh for the control group, then the DID statistic is one kWh, as reflected in Equation 2-6.

Equation 2-6. DID Statistic Calculation

(eval-period treatment group savings – eval-period control group savings) – (pre-year treatment *group savings - pre-year control group savings) = DID statistic*

$$(5 - 3) - (2 - 1) = 1$$

The DID statistic generates an unbiased estimate of uplift when the baseline average savings is the same for the treatment and control groups or when they are different due only to differences between the two groups in time-invariant factors, such as the residence's square footage.

An alternative statistic that generates an unbiased estimate of uplift when the baseline average savings in the energy efficiency program is the same for the treatment and control groups is a simple difference in savings during the evaluation period. Guidehouse uses this alternative statistic –the "post only difference" (POD) statistic – in cases where the energy efficiency program did not exist for the pre-program year.

Table 2-1, below, shows which programs were included in the current year uplift calculation.

2.4.2 Accounting for Legacy Uplift

The uplift adjustment methodology described above only accounts for uplift which occurs in the current calendar year because energy efficiency program tracking files in any given calendar year only capture the new measures installed in that year, regardless of the expected measure life. Uplift adjustments are needed to avoid reporting first-year savings in both the HER and other programs. However, for other energy efficiency programs that include measures with multi-year measure lives, HER program savings capture the portion of their savings due to uplift in each year of that program's measure life. For instance, a measure with a ten-year measure life that was installed in CY2023 could generate savings captured in the HER program savings not just for a portion of the year in CY2023, but in CY2024 through CY2033 as well.

[22] The regression analysis of HER savings only picks up the other energy efficiency program savings that actually occurred after the other measure was installed, not the annualized savings typically reported in program tracking data. Guidehouse, therefore, pro-rated the other program savings assuming a flat load shape.

[23] Where the averages are calculated over all treatment and control group customers, not just those who participated in other energy efficiency programs.

[24] This method aligns with the UMP Chapter 17, see footnote 13.

Consider the following example. For a household receiving HERs through the HER program who enrolls in the HVAC program in CY2021, the current year uplift adjustment subtracts HVAC CY2021 program savings to avoid double counting first-year savings for CY2021 in both the HER and HVAC programs. In CY2022, this household still receives savings from the HVAC program because it has a multi-year measure life. However, using the current year uplift analysis, the CY2022 HER uplift adjustment does not remove these savings because the CY2022 adjustment only accounts for measures installed in CY2022, the initial year that the household entered a program. Thus, when only relying on the current year uplift adjustment described earlier, HVAC's second year savings would be included in the CY2022 HER program's savings, which is inconsistent with the practice of only crediting utilities with first-year energy efficiency program savings.

Guidehouse accounts for legacy uplift by subtracting the double counted savings from previous years, adjusted for the average annual move out rate,[25] from CY2022 HER savings for 6 years.[26] The legacy uplift adjustment is shown in Equation 2-7.

Equation 2-7. Legacy Uplift Calculation

$$Legacy\ Uplift = \sum_{i=1}^{CY-1} "Live"\ Legacy\ Uplift\ Savings_i \cdot (1 - MOR)^{CY-i}$$

Where, "'Live' Legacy Uplift Savings" refers to uplift savings where the other energy efficiency programs' measure lives have not yet run out (i.e., within 6 years of the evaluation year) and MOR refers to the move out rate. Table 2-1 summarizes the programs that were considered in the legacy and current year uplift analyses.

[25] Since HER program participants are dropped from that program when they move, other energy efficiency programs' savings are no longer captured in the HER program savings from that point forward.

[26] Since multiple measures and programs are accounted for in legacy uplift, Guidehouse has chosen a representative measure life of 6 years across all programs to account for legacy uplift.

Table 2-1. Programs Included in Legacy and Current Year Uplift

Key Program Metrics	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Energy Efficient Products	✓									
HPwES	✓					✓	✓	✓	✓	✓
Energy Efficient HVAC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DHW Equipment	✓									
Appliance Turn-In programs	✓	✓	✓	✓	✓					
Appliance Rebate		✓	✓	✓	✓					
Appliance Recycling						✓	✓	✓	✓	✓
HW – Home Performance Comprehensive Visit (Whole House)		✓	✓	✓						
HW – Home Performance Rebate		✓	✓	✓						
HW Quick Home Energy Check-up (QHEC)		✓	✓	✓	✓	✓	✓	✓	✓	✓
WH Rebates							✓	✓	✓	✓
Energy Efficiency Kits					✓		✓	✓	✓	

Source: Guidehouse analysis

2.4.3 Accounting for Upstream Program Uplift

It is generally difficult to track participation in upstream programs such as lighting rebates. Guidehouse cannot use the DID approach to calculate uplift from upstream lighting programs as these are not tracked at the individual customer level. Guidehouse used adjustment factors from the Pennsylvania Technical Reference Manual (TRM) to account for savings from these programs.[27] Maryland utilities ended their residential upstream lighting programs in April 2023. Waves launched in 2024 have no upstream lighting factor applied. To account for upstream lighting measures only in place for ¼ of 2023 rather than the full year, we prorated each of the adjustment factors in **Error! Reference source not found.** by 25%. For example, a wave launched in 2022 (2 years since wave inception) has a new prorated upstream reduction factor of 0.94%, - 0.75% from CY2022 because there was a full year of upstream lighting measure and 0.19% from CY2023 due to the program ending in April 2023.

Table 2-2 provides adjustment factors based on the number of years since a wave's inception to calculate the adjustment factor. A "ceiling" is applied at year 4 to account for CFLs (which have historically comprised a large part of upstream sales) reaching the end of their useful life. Maryland utilities ended their residential upstream lighting programs in April 2023. Waves launched in 2024 have no upstream lighting factor applied. To account for upstream lighting measures only in place for ¼ of 2023 rather than the full year, we prorated each of the adjustment factors in **Error! Reference source not found.** by 25%. For example, a wave

[27] https://www.puc.pa.gov/media/1584/swe-phaseiv_evaluation_framework071621.pdf the adjustment factors are referenced from section 6.1.1.8.

launched in 2022 (2 years since wave inception) has a new prorated upstream reduction factor of 0.94%, - 0.75% from CY2022 because there was a full year of upstream lighting measure and 0.19% from CY2023 due to the program ending in April 2023.[28]

Table 2-2. Upstream Lighting Adjustment Factor

Years Since Wave Inception	Default Upstream Adjustment Factor
1	0.00%
2	0.94%
3	1.69%
4 and beyond	2.44%

Source: Pennsylvania TRM and Guidehouse Analysis

2.5 Data Used in Impact Analysis

In preparation for the impact analysis, Guidehouse cleaned the data provided by the HER program implementer, Oracle. Guidehouse performed the following data cleaning steps:

- Removed observations after a customer's account closure date.
- Filtered to observations in the twelve-month pre-program period or CY2024.
- Removed exact duplicate rows.
- For waves launched in or after 2021, removed customers with less than 3 months of pre-program data.[29]
- Aggregated observations of bills that ended in the same month.
- Removed observations with a bill duration of 0 days or more than 90 days.
- Excluded outliers, defined as observations with average daily usage at least 10 times larger or 10 times smaller than the median usage.

Table 2-3 shows a summary of the data cleaning by wave. Across all waves, Guidehouse used at least 97% of the customers and at least 96% of observations (after accounting for data outside the analysis period) in our analysis. Detailed tables showing customers and observations removed for each data cleaning step by wave are available upon request.

[28] In evaluations of CY2024 through CY2026 (the end of the current cycle), the upstream lighting adjustment will be calculated based on the age of the wave in 2023, with waves not yet launched in 2023 having an upstream lighting factor of 0 and all other waves following the pro-rated reduction factors in **Error! Reference source not found.**. The new cycle (starting CY2027) will not include adjustments for uplift from upstream lighting.

[29] As part of the 2020 evaluation, Guidehouse, the program implementer, the regulator, and the utility agreed to impose a sufficiency threshold of at least 3 months of pre-program period data for customers entering the program. Therefore, for waves launched in or after 2021, customers with less than 3 months of pre-program data were considered ineligible and were removed from our savings calculations. Earlier waves were grandfathered in and retained customers with less than 3 months of pre-program data.

Table 2-3. Data Cleaning Summary

Wave	% Treatment Customers	% Control Customers	% Treatment Observations	% Control Observations
Wave 1	97.50%	97.49%	96.60%	96.56%
Wave 2	100.00%	100.00%	97.40%	97.54%
Wave 3	100.00%	100.00%	96.09%	96.04%
Wave 4	100.00%	100.00%	96.42%	96.45%
Wave 5	100.00%	100.00%	96.04%	96.06%
Wave 6	100.00%	99.99%	96.37%	96.34%
Wave 7	100.00%	100.00%	95.89%	95.90%

Source: Guidehouse analysis

3. Gross Impact Evaluation

As discussed in Section 2.2, the RCT design inherently estimates net savings, and no gross savings estimates are produced.

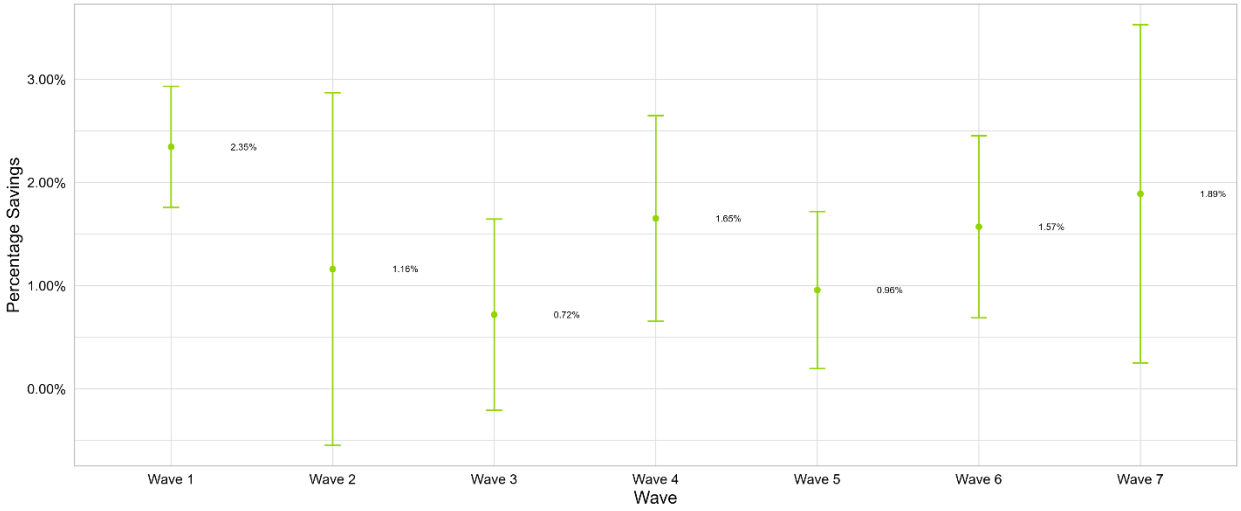
4. Net Impact Evaluation

As discussed in Section 2.3, for PE, there was enough pre-period data to produce reliable results with the LDV model for waves launched after 2018, so the LDV model was the primary model for reporting savings for Waves 5-7. The Post Only model was used for Waves 1-4 to accommodate the lack of pre-data for those waves.

There is growing use of solar panels in Maryland. This is driven in part by incentive funds made available by the Maryland Energy Administration, net metering, and Solar Renewable Energy Certificates (SRECs) (currently around $50/MWh). There is a possibility that behavior programs are driving general awareness of solar opportunities, it is unclear what implications this may have on the energy savings generated by behavior programs. Potomac Edison does not collect solar net metering data, as a result Guidehouse is unable to do any further research into the relationship between Potomac Edison's behavior program and solar installations.

Total evaluated net energy savings for program activity were 28,228 MWh in 2024. Figure 4-1 shows the percentage savings with 90% confidence bounds across all waves.

Figure 4-1. Percentage Savings Across All Waves



Source: Guidehouse analysis

4.1 Statistical Significance of Parameter Estimates

Key findings regarding the regression model parameter estimates for the model for which savings are being claimed include the following[30]:

- The LDV *Participant* parameter estimates are statistically significant at the 90% confidence level for Waves 1, 4, 5, 6, and 7.
- The LFER *Post*Participant* parameter estimates are statistically significant at the 90% confidence level for Waves 1,4, 5, 6, and 7.

[30]Savings are being claimed from Post Only model estimates for Waves 1-4 and LDV model for Waves 5-7.

- The post only *Participant* parameter estimates are statistically significant at the 90% confidence level for Waves 1, 4, 5, 6, and 7 .

Section 2.3 explains the calculation of program savings from the model parameter estimates. Figures showing the savings parameter estimates and confidence bounds for all models and waves are presented in Appendix B. Tables showing the complete model output for each model and wave are available upon request.

4.2 Uplift Savings in Other Energy Efficiency Programs

The estimates of program savings from the regression model include energy savings resulting from the uplift in participation in other energy efficiency programs caused by the HER program. To avoid double counting when aggregating savings across the portfolio, Guidehouse removes uplift in other energy efficiency programs from HER impacts as discussed in Section 2.4.

Uplift savings include three parts: 1) double counted first-year savings due to other energy efficiency programs run in CY2024 (current year uplift), 2) double counted cumulative savings due to other energy efficiency programs run in previous years (legacy uplift), and 3) double counted savings from upstream lighting programs (upstream lighting uplift). Table 4-1 presents a summary of each type of uplift and its effect on HER program savings.

Table 4-1. Summary of Uplift, All Waves, CY2024

Wave	Evaluated Net Saving (MWh)	Current Year Uplift (MWh)	% Double Counted (Current Year)	Legacy Uplift (MWh)	% Double Counted (Legacy)	Upstream Lighting Adjustment Factor	Upstream Lighting Uplift (MWh)	Final Net Savings (MWh)
Wave 1	19,842	126	0.64%	289	1.46%	2.44%	474	18,953
Wave 2	1,343	0	0.00%	68	5.07%	2.44%	31	1,244
Wave 3	1,401	19	1.36%	149	10.63%	2.44%	30	1,203
Wave 4	2,947	21	0.72%	121	4.11%	2.44%	68	2,737
Wave 5	1,782	133	7.47%	263	14.76%	2.44%	34	1,352
Wave 6	2,209	46	2.07%	94	4.25%	2.44%	50	2,019
Wave 7	755	0	0.00%	21	2.80%	1.69%	12	722
Total for all waves	30,279	345	1.14%	1,005	3.32%	16.33%	700	28,228

* The upstream lighting factor is different by wave depending on when the wave launched as shown in Maryland utilities ended their residential upstream lighting programs in April 2023. Waves launched in 2024 have no upstream lighting factor applied. To account for upstream lighting measures only in place for ¼ of 2023 rather than the full year, we prorated each of the adjustment factors in **Error! Reference source not found.** by 25%. For example, a wave launched in 2022 (2 years since wave inception) has a new prorated upstream reduction factor of 0.94%, - 0.75% from CY2022 because there was a full year of upstream lighting measure and 0.19% from CY2023 due to the program ending in April 2023.

Table 2-2.

Source: Guidehouse analysis

Table 4-2 shows a summary of current year uplift by HER program wave and other energy efficiency programs. Detailed tables of uplift by wave and other program are available upon request.

Table 4-2. Summary of Current Year Uplift

Wave	Appliance Recycling	HPwES	HVAC	QHEC	WH Rebates
Wave 1	20,861	35,267	69,960	-7,109	
Wave 2	-290	-31,539	-1,569	-97	
Wave 3	9,067	-13,904	4,284	5,679	
Wave 4	10,322	-6,236	10,889	-6,375	
Wave 5	129,838	3,361	-8,153	-183,486	
Wave 6	11,609	-7,637	11,407	22,720	-5,027
Wave 7	-5,087	-7,318	-1,393	-691	-4,993

Note: Negative uplift values were not included in the roll-up to total uplift as discussed in Section 2.4.1.
Source: Guidehouse analysis

4.3 Evaluated Net Program Impact Results

Table 4 3 presents evaluated net energy savings results of the HER program. The table also includes savings from CY2023 to serve as a comparison. Savings for CY2024 are within the typical range for behavior programs.

Table 4-3. Program Savings by Wave[31]

Type of Statistic	Wave 1 2024	Wave 2 2024	Wave 3 2024	Wave 4 2024	Wave 5 2024	Wave 6 2024	Wave 7 2024	All Waves CY2024	All Waves CY2023
Number of Participants*	49,533	5,284	15,749	13,177	12,760	14,699	4,635	115,837	123,975
Sample Size, Control*	17,556	1,585	7,925	6,264	9,563	7,932	2,482	53,307	57,195
Treatment Daily Usage in Post-period (kWh)	44	56	31	34	41	27	24	-	-
Participant Days†	18,610,259	2,026,908	6,144,408	5,192,442	4,519,265	5,150,230	1,610,422	43,253,934	43,790,603
Percent Savings	2.35%	1.16%	0.72%	1.65%	0.96%	1.57%	1.89%	1.72%	1.65%
(Percent Standard Error)	*0.36%*	*1.04%*	*0.56%*	*0.61%*	*0.46%*	*0.54%*	*1.00%*	-	-
Average Annual Savings (kWh)‡	389	242	83	207	144	157	171	256	231
(Annual Standard Error)	*59*	*216*	*65*	*76*	*70*	*54*	*90*	-	-
Evaluated Net Savings, Prior to Uplift Adjustment (MWh)	19,842	1,343	1,401	2,947	1,782	2,209	755	30,279	27,721
(Net Standard Error)	*3,014*	*1,201*	*1,098*	*1,082*	*862*	*755*	*398*	-	-
Current Year Uplift Savings in Other EE Programs (MWh)	126	0	19	21	133	46	0	345	266

[31] Savings are at the customer level and do not account for line losses.

Type of Statistic	Wave 1 2024	Wave 2 2024	Wave 3 2024	Wave 4 2024	Wave 5 2024	Wave 6 2024	Wave 7 2024	All Waves CY2024	All Waves CY2023
Legacy Uplift Savings in Other EE Programs (MWh)§	289	68	149	121	263	94	21	1,005	908
Upstream Lighting Adjustment (MWh)	474	31	30	68	34	51	12	700	766
Evaluated Net Savings (MWh)	18,953	1,244	1,203	2,736	1,352	2,019	722	28,229	**25,781**

Notes: Numbers may not add up due to rounding. Standard errors are provided in italics.

* The number of participant and control customers is based on the customer ID from billing data, and only includes currently active customers. Any customer who has an inactive date that is before 2024-01-01 is not counted in this count. The CY2023 counts are retained from that report.

† Refers to the total accumulated participating days of all active participants in CY2024 to capture all accumulated savings.

‡ Average annual savings are calculated by multiplying average daily savings (before accounting for uplift) by 365 days.

§ The legacy uplift savings only include uplift from previous years (i.e., not 2024).

Source: Guidehouse analysis

5. Findings and Recommendations

This section summarizes the key impact findings and recommendations.

- **Finding 1.** Total evaluated net program savings were 28,288 MWh,[32] with 18,953 MWh coming from Wave 1; 1,244 MWh from Wave 2; 1,203 MWh from ,Wave 3; 2,736 MWh from Wave 4; 1,352 MWh from Wave 5; 2,019 MWh from Wave 6; and 722 MWh from Wave 7.[33,34,35] This amounted to a realization rate of 94%[36].
- The program saw an increase in energy savings in comparison to CY2023 (from 25,929 MWh in 2023); the percentage savings rate also increased from 1.65% to 1.72%.
- **Finding 3.** The realization rate for CY2024 was 94%. The difference in reported and evaluated savings is likely driven by small differences in the modeling.
- **Finding 4:** Guidehouse found few negative usage bills in CY2024 (<0.5%). The bills were largely equally distributed between treatment and control customers and Guidehouse kept them in the analysis. Guidehouse believes the negative usage bills belong to solar net metering customers. Given the small percentage of negative usage bills with equal distribution between treatment and control, these customers are unlikely to impact the analysis. Additionally, solar net metering is not tracked by PE, so Guidehouse was not able to conduct a more in-depth analysis of the impact of solar net metering customers on program accomplishments.
- **Finding 5:** The statewide evaluator recommended including low-income programs in the uplift analysis. Low-income programs in Maryland are administered by the Maryland Department of Housing and Community Development (DHCD) not the utilities, and the utilities do not claim savings for the low-income programs. Hence, Guidehouse does not have the data to conduct uplift analysis for the low-income programs. Guidehouse worked with the DHCD evaluator to obtain this data and found the following: (1) DHCD's Multifamily (MEEHA) Program does not track data by account number and cannot be cross-walked to the HER program data, and (2) the Maryland Energy Assistance Program (MEAP) and Weatherization Assistance Program (WAP) are not funded by EmPOWER and do not allow customer data to be shared. Due to data issues, Guidehouse was unable to include double counting with DHCD's single-family program in the evaluation of CY2024, but will aim to include it in CY2025.
- **Finding 6:** The current evaluation assumes that HERs have a one-year measure life and do not have persistence. While this assumption has been under discussion for several years, a decision to move to a multiyear measure life has not been made in Maryland. The evaluation team will monitor ongoing discussions regarding HER measure life and

[32] The total savings may not sum due to rounding.

[33] Savings are at the customer level and do not account for line losses.

[34] See Table 1-1 for a summary of when each wave launched.

[35] Energy savings generated by Waves 1, 2, 4, 5, 6 and 7 were statistically significant at the 90% confidence level while savings generated by Wave 3 were not statistically significant; however, savings from all waves are included in net savings irrespective of their statistical significance. This references the claimed model for each wave; see section 2.3 for more details.

[36] The implementer reported 27,605 MWh of savings for HER in their year-end report. This differed from the Potomac Edison semi-annual report number Guidehouse compared to for the realization rate due to the timing of when the two values are obtained, and revision based on additional data received in the interim. Compared to the year-end report value, Guidehouse found a realization rate of 102% for electric.

persistence and adjust the evaluation framework as needed to remain consistent with regulatory guidance on these issues.

PE and the program implementer should consider the following items based on these findings:

- **Recommendation 1:** In the 2024 evaluation, Guidehouse removed customers with less than three months of pre-period data from the energy savings calculations for waves launched in 2021 and 2022 (although all PE customers added in 2021 and 2022 had at least three months of pre-period data so none were actually removed). For earlier waves, customers with less than three months of pre-period data were “grandfathered in.” Guidehouse will continue to conduct this removal in the future and recommends the program implementer comply with this eligibility requirement when launching new waves. When feasible, the implementer should collect more pre-period data, with an ideal of 12 months.
- **Recommendation 2:** The program implementer should continue to communicate program changes with the utility and Guidehouse to keep the data transfer process and response to data requests efficient. The implementer should communicate changes, such as refill of waves, to Guidehouse during data transfer to avoid confusion during the evaluation. Preferably, refills would be added to the program as a new wave rather than put into an existing wave to preserve the randomization. If new customers are added to an existing wave, the treatment to control customer ratio should match the existing wave.

Appendix A. Attrition Rates

Table A-1 shows the move out rate of PE customers and the percent change by year.

Table A-1. Customer Attrition Rate by Year

Year	Customer Attrition	Percent
2018	4,375	2.70%
2019	10,098	6.41%
2020	17,077	9.36%
2021†	25,389	12.70%
2022†	3,303	1.79%
2023	9,008	5.56%
2024	13,014	6.61%
Total	**82.273**	**6.45%***

* Total move out rate reflects the average annual move out rate per year. No move out information is available before 2018 because all data pre-2018 were deleted at the request of First Energy.

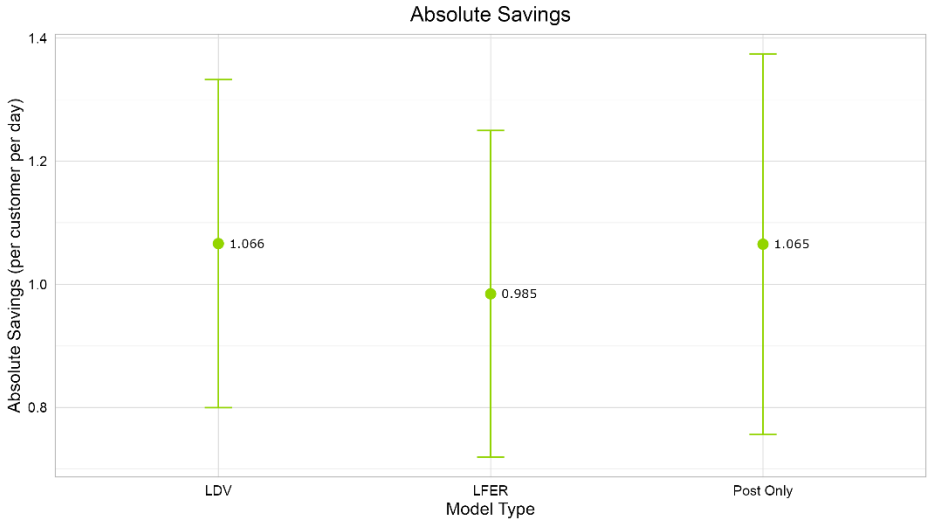
† The account inactive date data Guidehouse received from the implementer included many more inactivations than usual in late 2021 and had showed no inactivations for the first ¾ of 2022. Guidehouse asked the implementer about this but received no further information. As the 2021 and 2022 attrition rates average to a value similar to previous years (6.4%), Guidehouse is not too concerned.

Source: Guidehouse analysis

Appendix B. Parameter Estimates

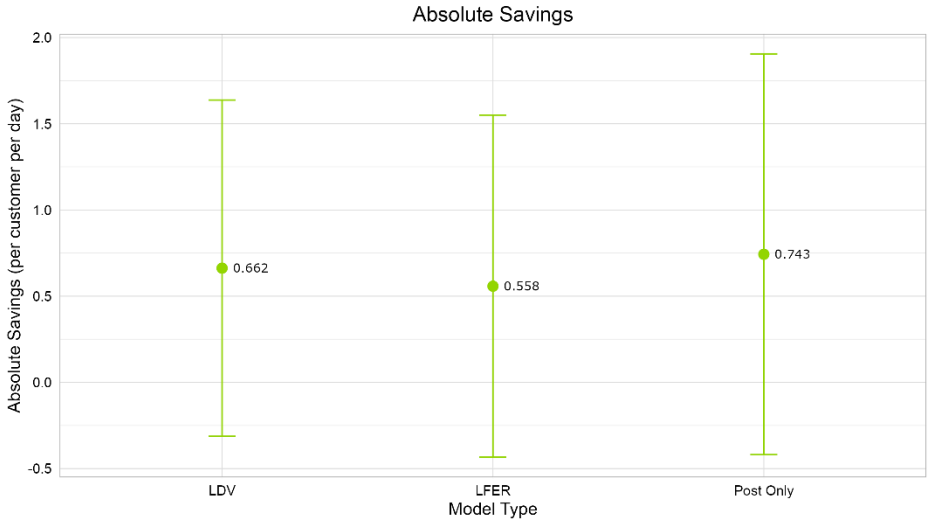
Figure B-1 through Figure B-7 show the comparison of the various models for each wave.

Figure B-1. Wave 1 Model Estimate Comparison



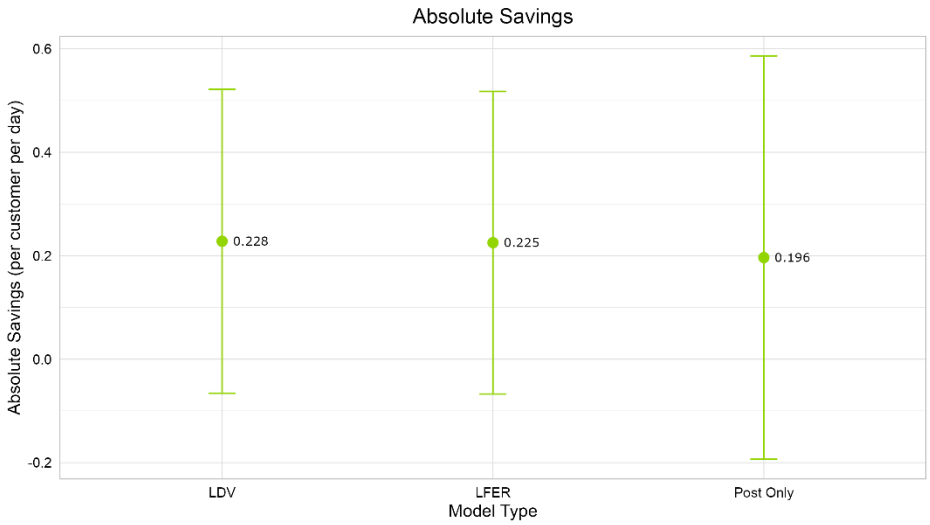
Source: Guidehouse analysis

Figure B-2. Wave 2 Model Estimate Comparison



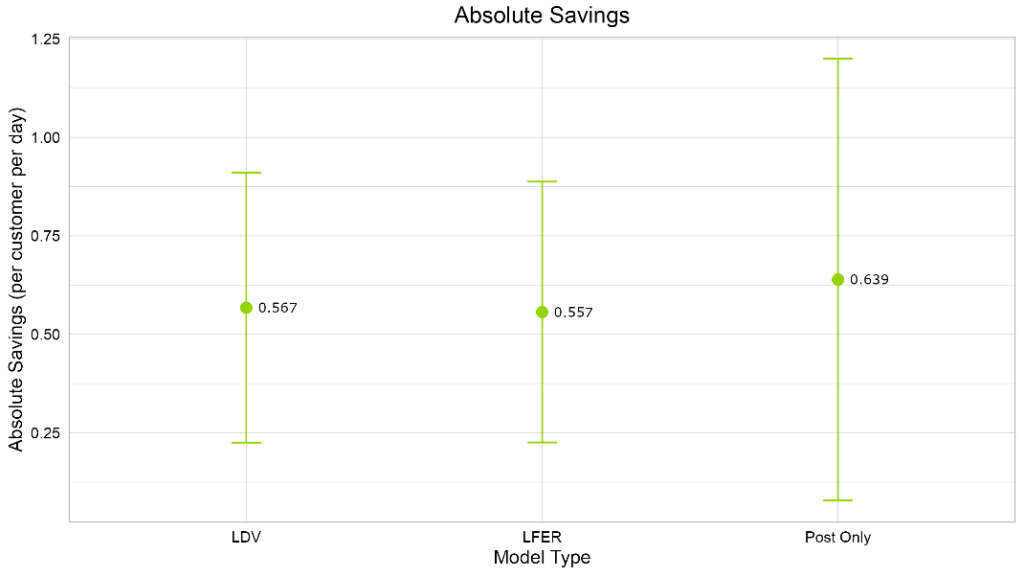
Source: Guidehouse analysis

Figure B-3. Wave 3 Model Estimate Comparison



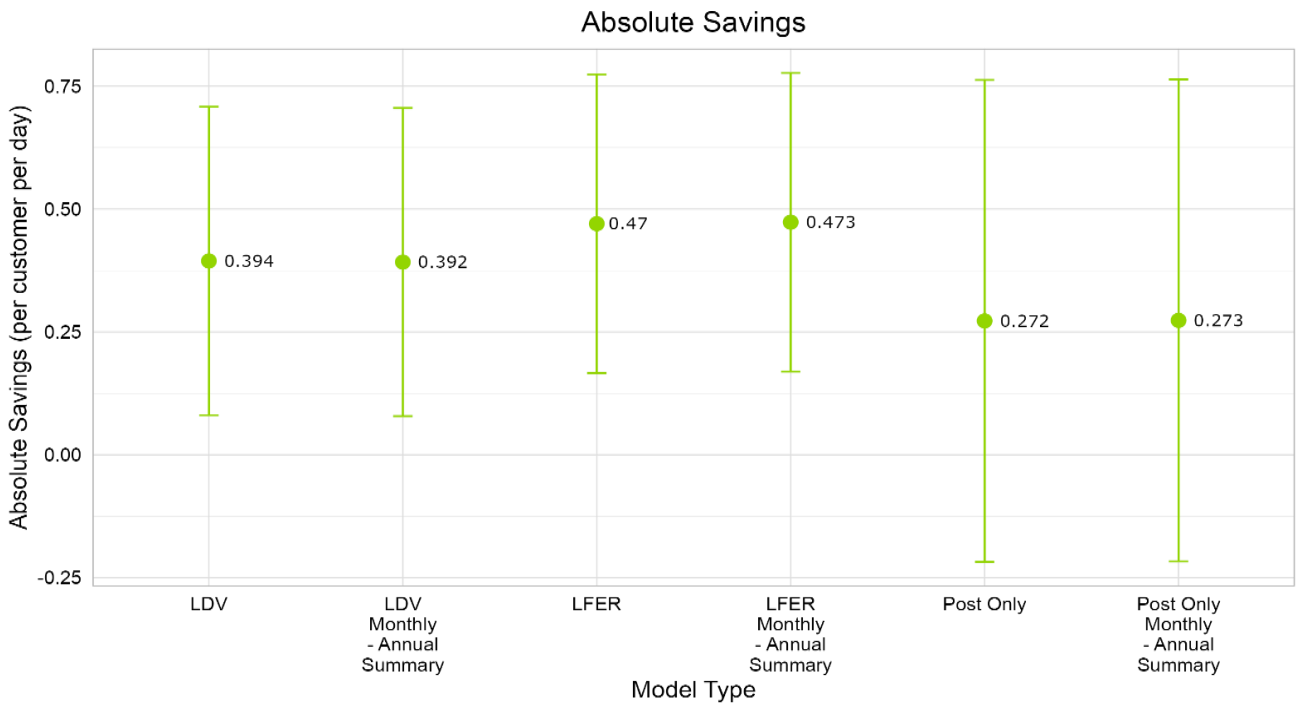
Source: Guidehouse analysis

Figure B-4. Wave 4 Model Estimate Comparison



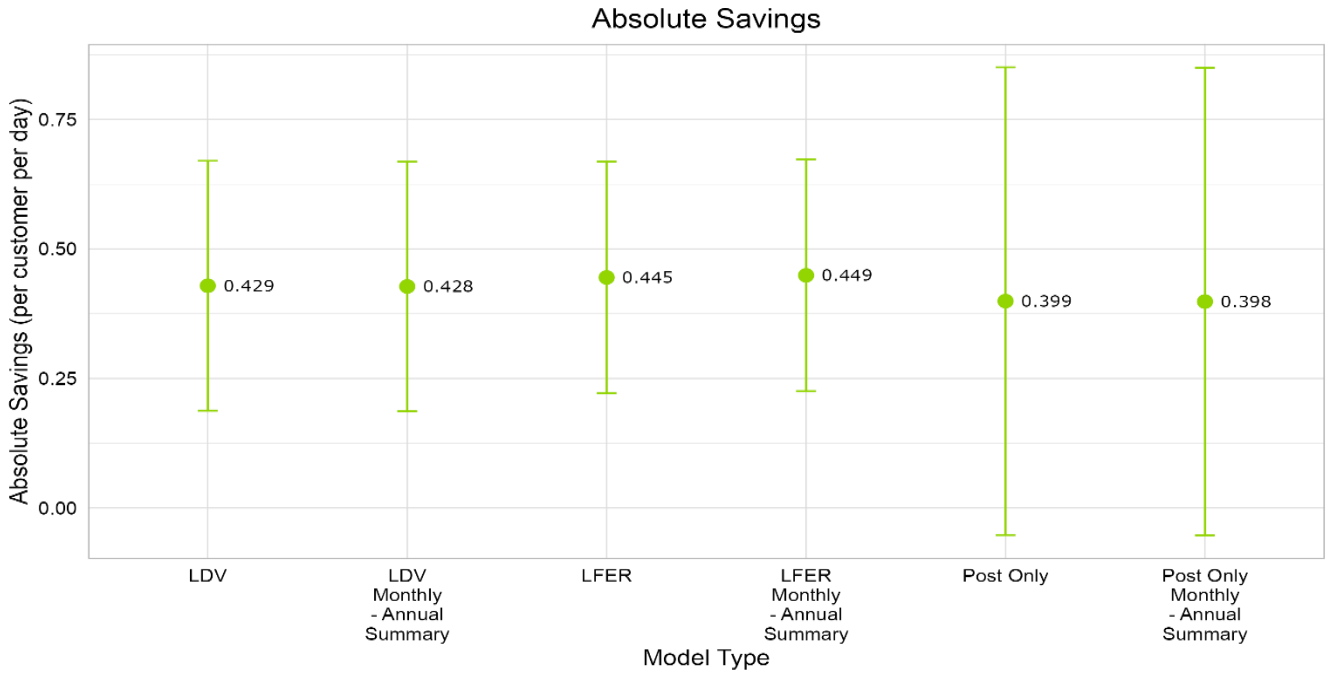
Source: Guidehouse analysis

Figure B-5. Wave 5 Model Estimate Comparison



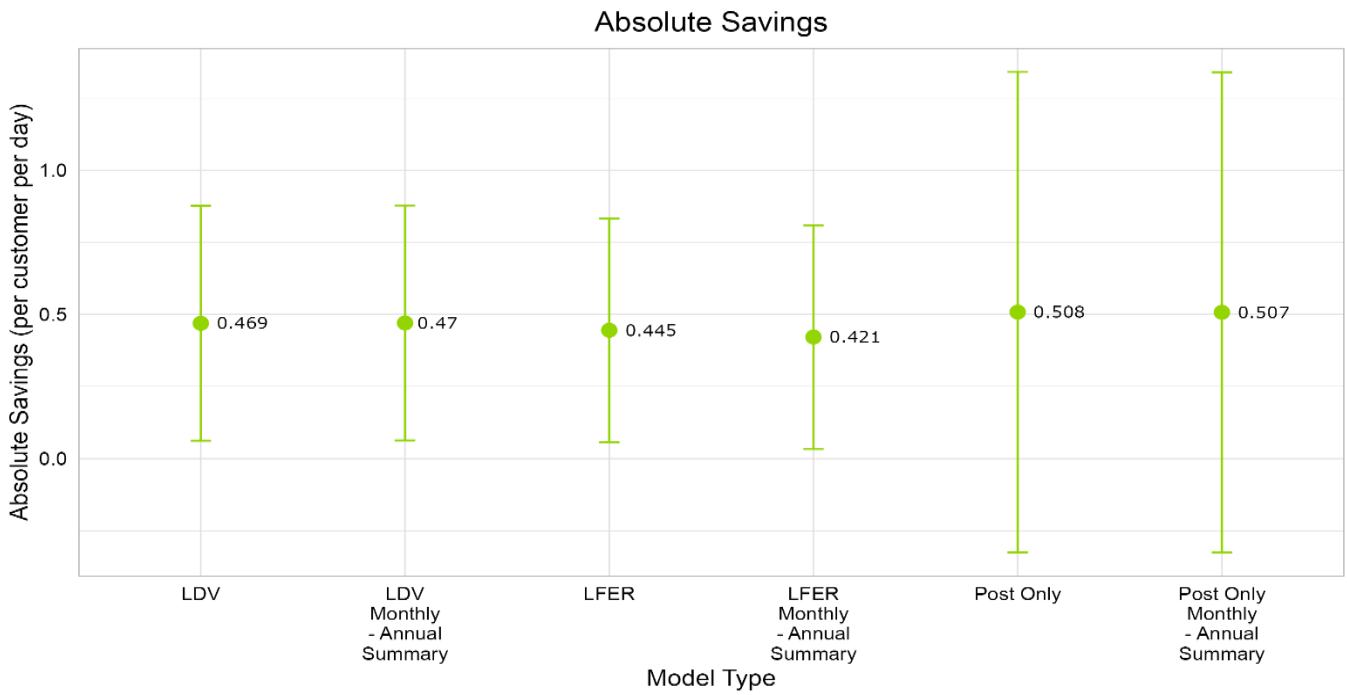
Source: Guidehouse analysis

Figure B-6. Wave 6 Model Estimate Comparison



Source: Guidehouse analysis

Figure B-7. Wave 7 Model Estimate Comparison



Source: Guidehouse analysis