2021 Indiana Legacy Programs EM&V Report

Prepared for:
Indiana Michigan Power

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1. Introduction

Under contract with Indiana Michigan Power (I&M), ADM Associates, Inc., (ADM) performed evaluation, measurement and verification (EM&V) activities that confirmed the energy savings (kWh) and demand reduction (kW) realized through the energy efficiency programs that I&M implemented in Indiana during the January 2021 through February 2021 (PY2021).

This chapter provides a summary of evaluation findings for the residential program portfolio and presents information regarding the organization of the report.

1.1. Impact Evaluation Findings

The savings variables presented in this evaluation report are defined in Table 1-1.

Table 1-1 Savings-Related Terminology

Variable	*Definition*
kWh Savings Goal	*kWh Savings Goal* is the energy savings goal cited in the applicable portfolio plan.
Ex Ante Gross kWh Savings	*Ex Ante Gross kWh Savings* are the annual energy savings reported by I&M and are typically obtained from I&M's DSM/EE Program Scorecard documents.
Gross Audited kWh Savings	*Gross Audited kWh Savings* are determined by reviewing tracking data presenting for any errors, and adjusting *Ex Ante Gross kWh Savings* accordingly.
Gross Verified kWh Savings	*Gross Verified kWh Savings* are determined by applying an installation rate to the *Gross Audited kWh Savings*. The installation rate is defined as the ratio of units that were installed (verified) to the number of units reported (claimed).
Ex Post Gross kWh Savings	*Ex Post Gross kWh Savings* are the realized annual gross kWh savings reflecting all adjustments made by ADM, without accounting for free ridership or spillover.
Ex Post Net kWh Savings	*Ex Post Net kWh Savings* are equal to *Ex Post Gross kWh Savings*, adjusted to account for free ridership and spillover.
Ex Post Net Lifetime kWh Savings	*Ex Post Net Lifetime kWh Savings* is the *Ex Post Net kWh Savings* occurring over the course of the applicable measure effective useful life (EUL).
Gross Realization Rate	*Gross Realization Rate* is equal to *Ex Post Gross kWh Savings* divided by *Ex Ante Gross kWh Savings*.
Net-to-Gross Ratio	*Net-to-Gross Ratio* is equal to *Ex Post Net kWh Savings* divided by *Ex Post Gross kWh Savings*.

Variable	*Definition*
Free Rider[1]	A *free rider* is a program participant who would have implemented the program measure or practice in the absence of the program. Free riders can be: 1) total, in which the participant's activity would have completely replicated the program measure; 2) partial, in which the participant's activity would have partially replicated the program measure; or 3) deferred, in which the participant's activity would have completely replicated the program measure, but at a future time than the program's timeframe. The free ridership estimate are the savings attributable to free riders.
Spillover (Participant and Non-Participant)[2]	*Spillover effects* are reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program. There can be participant and/or non-participant spillover. *Participant spillover* is the additional energy savings that occur when a program participant independently installs energy efficiency measures or applies energy saving practices after having participated in the efficiency program as a result of the program's influence. *Non-participant* spillover refers to energy savings that occur when a program non-participant installs energy efficiency measures or applies energy savings practices as a result as a result of a program's influence.

Based on the definitions presented in Table 1-1, Table 1-2 presents a summary of the components of the impact evaluation that are accounted for in savings variables presented in this report.

Table 1-2 Components of Impact Evaluation Accounted for in Savings Variables

Category	*Tracking Data Review*	*In-Service Rates*	*Ex Post Gross Analysis*	*Net-to-Gross Analysis*
Gross Audited	✓			
Gross Verified	✓	✓		
Ex Post Gross	✓	✓	✓	
Ex Post Net	✓	✓	✓	✓

ADM performed EM&V activities for 6 legacy residential programs and one legacy C&I program offered by I&M through February 2021. Total portfolio ex post gross energy savings are 9,277,248 kWh, while ex post net energy savings are 6,939,033 kWh, as shown in Table 1-3.

[1] Northeast Energy Efficiency Partnerships (NEEP) EMV Glossary version 2.1. https://neep.org/media/4330

[2] Ibid.

Table 1-3 Summary of Energy Savings – PY2021

Program Name	*Ex Ante Annual kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Annual Net kWh Savings*	*Net-to-Gross Ratio*	*Lifetime Net Ex Post kWh Savings*
Home Appliance Recycling	507,558	507,558	498,649	454,055	89%	227,725	50%	1,821,799
Home Energy Products - Lighting	4,594,703	4,594,703	3,502,283	4,070,510	89%	2,062,138	51%	6,275,070
Home Energy Reports	3,439,220	3,439,220	3,439,220	3,374,624	98%	3,374,624	100%	3,374,624
Low Income Home Energy Reports	48,483	48,483	48,483	47,572	98%	47,572	100%	47,572
Residential Online Energy Check-up	796,518	796,518	530,055	796,549	100%	719,155	90%	6,123,969
Schools Energy Education	348,202	348,202	135,264	328,377	94%	312,770	95%	2,355,040
Work Direct Install	215,811	215,812	215,812	205,560	95%	195,048	95%	2,543,824
Total	9,950,497	9,950,497	8,369,767	9,277,248	93%	6,939,033	75%	22,541,898

Total portfolio ex post gross peak demand savings are 1,090.30 kW, while ex post net peak demand savings are 788.16 kW, as shown in Table 1-4.

Table 1-4 Summary of Peak Demand Impacts – PY2021

Program Name	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Home Appliance Recycling	64.82	64.82	63.68	53.56	0.83	26.86	50%
Home Energy Products - Lighting	629.28	629.28	479.67	534.79	0.85	269.85	50%
Home Energy Reports	392.61	392.61	392.61	385.23	0.98	385.23	100%
Low Income Home Energy Reports	5.53	5.53	5.53	5.43	0.98	5.43	100%
Residential Online Energy Check-up	54.78	54.78	39.71	54.83	1.00	46.64	85%
Schools Energy Education	23.65	23.65	10.97	43.06	1.82	41.33	96%
Work Direct Install	27.49	27.49	27.49	13.40	0.49	12.82	96%
Total	1,198.16	1,198.16	1,019.65	1,090.30	0.91	788.16	72%

1.2. Cost Effectiveness Evaluation Findings

The following cost effectiveness tests were performed for the programs: Total Resource Cost (TRC) test, Utility Cost Test (UCT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A test score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The test results for each program are presented in Table 1-5.

Table 1-5 Summary of PY2021 Benefit-Cost Ratios

Program	*Utility Cost Test*	*Total Resource Cost Test*	*Ratepayer Impact Measure*	*Participant Cost Test*
Home Appliance Recycling	1.29	1.86	0.48	N/A
Home Energy Products (Lighting)	0.74	1.03	0.37	4.62
Low Income Home Energy Reports	1.00	1.00	0.40	N/A
Home Energy Engagement	1.96	1.96	0.51	N/A
Home Weatherproofing	0.00	0.00	0.00	N/A
Schools Energy Education	2.00	2.00	0.59	N/A
Work Direct Install	2.82	2.09	0.60	3.64

1.3. Organization of Report

This report is divided into two volumes that provide information on the impact, process, and cost effectiveness evaluation of the Indiana Michigan Power portfolio of residential programs implemented in Indiana during the 2021 program year. Volume I is organized as follows:

- Chapter 2: Home Appliance Recycling
- Chapter 3: Home Energy Products - Lighting
- Chapter 4: Home Energy Reports
- Chapter 5: Low Income Home Energy Reports
- Chapter 6: Residential Online Energy Check-up
- Chapter 8: Work Direct Install
- Chapter 7: Schools Energy Education
- Chapter 8: Work Direct Install
- Chapter 9: Cost Effectiveness Evaluation

2. Home Appliance Recycling

This chapter presents the results of both the impact and process evaluations of the 2021 Home Appliance Recycling Program that Indiana Michigan Power (I&M) offered to its Indiana residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess gross and net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year;
- Document sources of program awareness among participants;
- Assess satisfaction among participating customers;
- Document and assess quality assurance and control procedures; and
- Provide recommendations for program improvement as appropriate.

2.1. Program Description

The Home Appliance Recycling Program was designed to help customers reduce their energy consumption by removing old, working refrigerators and freezers from their homes for recycling. There was a limit of two refrigerators and/or freezers per household per calendar year.

The goal of the program was to reduce the number of old, inefficient refrigerators. Removing old, inefficient refrigerators and freezers prevents them from being resold or transferred to another utility customer. This program generates energy savings because the old appliances, which are generally inefficient, are permanently removed from the system. The environment also benefits from the recycling process through safe disposal of environmentally harmful material.

I&M contracts with Appliance Recycling Centers of America (ARCA) to implement the program, which is configured as a turnkey, stand-alone energy efficiency initiative. The customer receives no-cost pick-up and removal services in addition to a $40 rebate per recycled refrigerator or freezer. To be eligible for the program, appliances to be recycled must be in working condition, plugged in and cooling at the time of pick-up. Additionally, the program limits residential customers to recycle a maximum of two units per household per calendar year.

2.2. Estimation of Ex Post Gross Savings

2.2.1. Methodology for Estimating Ex Post Gross Energy Savings

2.2.1.1. Review of Documentation

I&M's implementation contractor developed and maintained a participant tracking database that includes a full list of all customers, the make and model numbers of the refrigerators and freezers that were recycled, and a number of other important appliance and household characteristics. The

first step in the evaluation effort was to review this program tracking system and other relevant program materials.

ADM reviewed the tracking system data on reported recycled units to determine that all reported units were eligible for the program, and that no duplicate or erroneous entries are present. Additionally, the tracking system was reviewed to ensure that the proper data fields required to support this evaluation as well as future evaluations were included. Finally, the program tracking data and the associated summary data provided in the I&M DSM EE Program Scorecard were reviewed for consistency.

ADM confirmed that the tracking database included all necessary information to conduct the impact analysis, including appliance and household characteristics. The review did not identify any duplicate or obviously erroneous entries.

2.2.1.2. Procedures for Estimating Measure-Level Gross Energy Savings

ADM conducted the gross energy savings analysis in accordance with the Department of Energy (DOE) Uniform Methods Project (UMP) Refrigerator Recycling Protocol.[3] The UMP is a DOE initiative aimed at developing a consistent framework and set of protocols for determining the energy savings from specific energy efficiency measures and programs. The project represents a refinement of the body of knowledge supporting energy efficiency EM&V activities, and each protocol was written by technical experts within the field and peer-reviewed by industry experts.

The protocols presented in the UMP provide a straightforward method for evaluating gross and net energy savings for common residential and commercial measures offered in ratepayer-funded initiatives in the United States.[4] For appliance recycling, the UMP specifies a regression model developed by The Cadmus Group that uses data from a metering study of 472 refrigerators across five utilities to relate the unit energy consumption (UEC) of refrigerators – metered in situ operating conditions – to various characteristics of the appliance.

In accordance with the UMP Refrigerator Recycling Protocol, the statistical model for determining annual kWh considered the following independent variables:

- Unit age;
- Unit capacity (cubic feet);
- Dummy indicator for configurations (top freezer, side-by-side, etc.);
- Primary/Secondary usage designation;
- Location in conditioned/unconditioned space; and

[3] Keeling, J.; Bruchs, D. (2017). Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68563. http://www.nrel.gov/docs/fy17osti/68563.pdf.

[4] Office of Energy Efficiency & Renewable Energy, https://energy.gov/oe/downloads/uniform-methods-project-methods-determining-energy-efficiency-savings-specific-measures, accessed: 3 January 2017.

- Weather (cooling degree days, heating degree days).

ADM used the UMP regression model developed by Cadmus to estimate the UEC for refrigerators recycled through the Home Appliance Recycling Program. Specifically, the average characteristics of recycled refrigerators were multiplied by the associated regression coefficients from the Cadmus model and summed to produce an estimated average in situ UEC for refrigerators.

It is important to note that the Cadmus model only considers refrigerators. Accordingly, ADM used a refrigerator-to-freezer ratio factor to determine the average UEC for freezers recycled through the program. This refrigerator-to-freezer factor methodology is similar to that used by the NMR Group, Inc. in their evaluation of the Massachusetts Appliance Turn-in program.[5] Using relevant secondary sources, ADM concluded that freezers on average use 15% less energy annually than refrigerators. This implies a refrigerator-to-freezer factor of 0.85. The analysis supporting this refrigerator-to-freezer factor is detailed in the previously mentioned Massachusetts Appliance Turn-In program evaluation performed by NMR Group, Inc.[6]

Additionally, ADM relied upon participant survey data to develop average partial use factors for both refrigerators and freezers. The partial use factor is designed to account for the fact that not all refrigerators and freezers are plugged in year-round. Secondary appliances are more likely to be unplugged for a portion of the year than primary appliances and the partial use factor is an important consideration when developing gross savings estimates.

Finally, gross energy savings were measured in accordance with the algorithms presented in the UMP Refrigerator Recycling Program Evaluation Protocol. The estimated average UECs for refrigerators and freezers were extrapolated to the population of program participating units to obtain a program level estimate of gross kWh energy savings resulting from refrigerator and freezer recycling. Specifically, the following algorithm was used:

$$GROSS\_kWh = N \times EXISTING\_UEC \times PART\_USE$$

Where:

$GROSS\_kWh$	= Annual electricity savings of refrigerators/freezers measured in kilowatt-hours (kWh)
N	= The number of refrigerators/freezers recycled through the program
$EXISTING\_UEC$	= The average annual unit energy consumption of participating refrigerators/freezers
$PART\_USE$	= The portion of the year the average refrigerator/freezer would likely have operated if not recycled through the program

[5] NMR Group, Inc. Massachusetts Appliance Turn-in Program Impact Evaluation, Final. June 15th, 2011. Available at: http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-Final-Report.pdf

[6] Ibid.

Gross peak demand savings were calculated based on the critical peak demand definition provided by I&M. Measure specific normalized 8,760 hour load shapes were used to identify the average demand during this on-peak period. These load shapes assign a portion of estimated gross kWh energy savings to each hour of the year. After identifying the total kWh savings that fall into the defined on-peak hours, dividing by the total number of hours in the peak period results in the average gross peak demand reduction. The specific appliance load shapes that were used were originally developed as part of the End-Use Load and Consumer Assessment Program (ELCAP) – a major end-use data collection program undertaken by the Bonneville Power Administration.[7]

2.2.2. Results of Ex Post Gross Impact Evaluation

The estimated gross impacts resulting from the 2021 Appliance Recycling Program are summarized in Table 2-1 and Table 2-2. Gross realization rates are summarized in Table 2-3. The gross realization rate is 89% and 90% for kWh savings and kW savings, respectively.

Table 2-1 Ex Post Gross kWh Savings

Appliance Type	*Claimed Appliances Recycled*	*Ex Ante Gross kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*
Refrigerators	527	433,342	433,342	425,140	387,138	89%
Freezers	110	74,216	74,216	73,509	66,917	90%
Total	637	507,558	507,558	498,649	454,055	89%

Table 2-2 Ex Post Gross kW Savings

Appliance Type	*Claimed Appliances Recycled*	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
Refrigerators	527	55.55	55.55	54.49	45.54	82%
Freezers	110	9.27	9.27	9.19	8.02	86%
Total	637	64.82	64.82	63.68	53.56	83%

[7] Pratt RG, CC Conner, EE Richman, KG Ritland, WF Sandusky, and ME Taylor. 1989. Description of Electric Energy Use in Single-Family Residences in the Pacific Northwest. (End-Use Load and Consumer Assessment Program [ELCAP]). DOE/BP-13795-21, prepared for Bonneville Power Administration by Pacific Northwest Laboratory, Richland, Washington.

Table 2-3 Gross Realization Summary

Savings Variable	*Ex Ante Gross*	*Ex Post Gross*	*Gross Realization Rate*
Annual Energy Savings (kWh)	507,558	454,055	89%
Peak Demand Reduction (kW)	64.82	53.56	83%

The calculations leading to these results are detailed in the sub-sections to follow.

2.2.2.1. Database Review

As a first step toward estimating program level kWh and kW impacts, ADM reviewed program tracking data for accuracy. ADM confirmed that the tracking database included all necessary information to conduct the impact analysis, including appliance and household characteristics. The review did not identify any duplicate or erroneous entries.

The tracking database was compared to summary data presented in the I&M DSM EE Program Scorecard. The number of units recycled through the program in 2021 was consistent across the two documents.

2.2.2.2. Verification of Units Recycled

To verify that the number of units claimed in the program tracking database was accurate, ADM administered a survey with a sample of PY2020 program participants.

All of the respondents who completed the participant survey verified that they had in fact participated in the program during 2020. However, for participating appliances to accrue energy savings by being taken out of service, the units must be in working condition at the time of pick-up. Six respondents who recycled a refrigerator reported that their units were not in working condition at the time they were collected for recycle. Five respondents who recycled a freezer reported that their units were not in working condition at the time they were collected for recycle.

Based on these results, the verification rates shown in Table 2-4 were determined for each appliance type.

Table 2-4 Verification Rates by Appliance Type

Appliance Type	
Refrigerator (n=317)	*Freezer (n=110)*
98.11%	95.45%

Based on these verification rates, Table 2-5 reports the numbers of refrigerators and freezers recycled through the program during 2021 that were verified as being in working condition when recycled and therefore were program-eligible.

Table 2-5 Recycled Appliances Verified to be in Working Condition

Unit Type	*Quantity Reported as Recycled*	*Verification Rate*	*Quantity of Recycled Units Verified as program Eligible*
Refrigerator	527	98.11%	3,091
Freezer	110	95.45%	769

2.2.2.3. Per-Unit Gross Annual kWh Savings Estimates

Per-unit gross annual kWh savings were calculated as described in 2.2.1.2. The details and results of these calculations are presented in this section.

For refrigerators, Unit Energy Consumption (UEC) estimates were derived using the DOE monitoring procedure-based regression model developed by Cadmus in the development of the Uniform Methods Project Refrigerator Recycling Evaluation Protocol. The model specification and estimated coefficients of the Cadmus model are shown in Table 2-6.

Table 2-6 Uniform Methods Project UEC Regression Details[8]

(Dependent Variable – UMP Estimated In Situ UEC)

Independent Variables	*Coefficient*
Intercept	0.582
Appliance Age (years)	0.027
Dummy: Manufactured Pre-1990	1.055
Appliance Size (square feet)	0.067
Dummy: Single-Door Configuration	-1.977
Dummy: Side-by-Side Configuration	1.071
Dummy: Primary Usage Type	0.6054
Interaction: Uncooled Space x CDDs	0.02
Interaction: Uncooled Space x HDDs	-0.045

The program tracking database included information regarding configuration, size, and age for all refrigerators collected during 2021. Of these 527 refrigerators, 28.3% were side-by-side models and 4.7% were single-door models; the average size was 18.15 cubic feet and the average age was

[8] Source: Cadmus et al. (2013). The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. April 2013.

20.61 years old. Finally, 10.5% of refrigerators were manufactured before 1990. Table 2-7 shows the relevant refrigerator characteristics used to estimate UEC.

Table 2-7 2021 Average Refrigerator Characteristics

Appliance Characteristics	*Refrigerators*
Population Size	527
Appliance Age (years)	20.61
Manufacture Pre-1990	10.5%
Average Size (Cubic Feet)	18.15
Single-Door Configuration	4.7%
Side-by Side Configuration	28.3%
Primary Usage	0.0%
Interaction: Uncooled x CDD	1.22
Interaction: Uncooled x HDD	10.25

The refrigerator characteristics shown above were used in conjunction with the model coefficients in Table 2-6 to calculate annual energy consumption estimates for program participating refrigerators. The refrigerator-to-freezer factor of 0.85 was applied to develop annual energy consumption estimates for freezers. These calculations are shown below:

Refrigerator UEC (kWh)

365.25 * (0.582 + 0.027 * 21.5741 (Age) + 1.055 * 0.1051 (Percent Pre-1990) + 0.067 * 18.3320 (Size) - 1.977 * 0.0536 (Single Door) + 1.071 * 0.2444 (Side by Side) + 0.6054 * 0.4132 (Primary Usage) + 0.02 * 1.2165 (HDD Interaction) - 0.045 * 10.2584 (HDD Interaction)) = 903 kWh

Freezer UEC (kWh)

903 * 0.85 (refrigerator-to-freezer factor) = 767 kWh

A final adjustment was made to account for the fact that not all refrigerators and freezers are plugged in year-round. Secondary appliances are more likely to be unplugged for a portion of the year than primary appliances, and since there was a large presence of secondary appliances in the program, the partial use adjustment is an important consideration when developing gross savings estimates. The partial use adjustment is based on participant survey responses regarding participants' usage of the recycled units, and assigns different "use factors" based on three categories into which recycled appliances fall:

- Some units that were recycled were not being used at all before being sent for recycling. The use factor for such units therefore would be zero. That is, these units were not being used and therefore had no baseline energy usage.
- Other units were being used, but for only part of the year. For these units, the use factor is calculated by dividing the number of months in the past year that the unit had been in use by the number of months in the year. Based on data collected through the survey of

participants, the average number of months-in-use for a partly used refrigerator was 5.43 months, implying a use factor of 0.45 (i.e., 5.43/12). For partly used freezers in this category, the use factor was 0.45, reflecting an average of 5.38 months.

- Units which are constantly in use have a use factor of one (1).

The overall use factor and the corresponding overall Unit Energy Savings (UES) are calculated as a weighted average across the three categories, where the weights are determined by the percentages of units falling into the three categories. Table 2-8 shows the calculation of the overall UES for refrigerators and freezers when partial use is considered.

Table 2-8 Unit Energy Savings Adjusted for Partial Use

Operating Status of Unit	*Percentage of Recycled Units in Category*	*Use Factor*	*Calculation of UES to Adjust for Part Use*
Refrigerators			
Not running	3.17%	0	0
Running part time	5.71%	0.09	72
Running all time	91.11%	1.00	817
Weighted Average UES for Refrigerators			
Freezers			
Not running	9.09%	0	0
Running part time	2.73%	0.08	58
Running all time	88.18%	1	695
Weighted Average UES for Freezers			

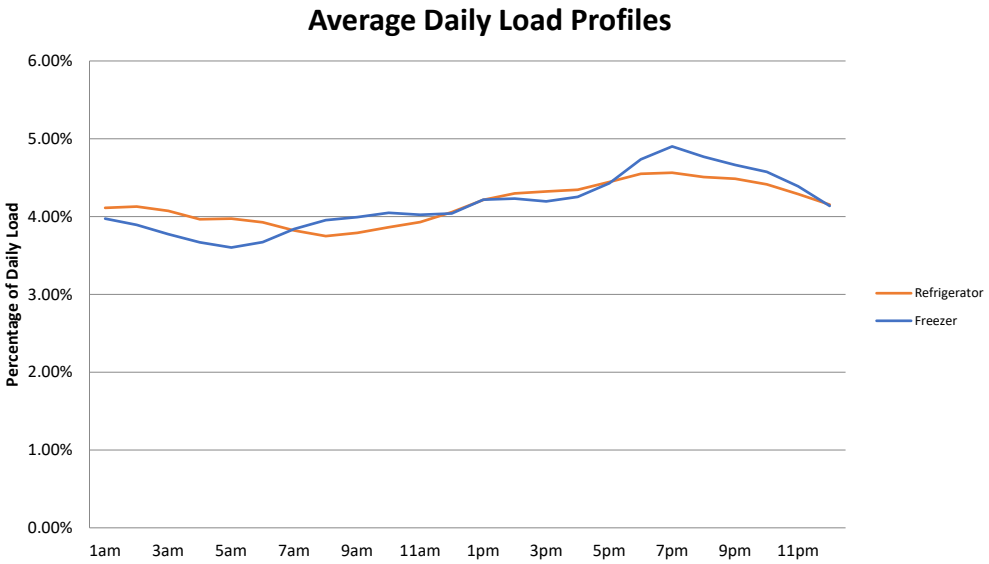
Based on the findings detailed in this section, the ex post gross per-unit annual kWh savings for refrigerators recycled through the program is estimated to be 735 kWh; the ex post gross per-unit annual kWh savings for freezers recycled through the program is estimated to be 608 kWh.

2.2.2.4. Per-Unit Peak kW Reduction Estimates

Appliance load shapes for refrigerators and freezers were used to estimate the average kW reduction occurring during I&M's defined on-peak period. These load shapes were normalized versions of load shapes originally developed as part of the End-Use Load and Consumer Assessment program (ELCAP).[9] The average daily load profile for each appliance type recycled through the program is shown in Table 2-9.

[9] Ibid.

Table 2-9 Average Daily Load Profile



Using these normalized ELCAP load shapes, ADM determined that approximately 2.3% of the annual gross kWh savings attributable to a recycled refrigerator occurs during the on-peak period. This is equivalent to 18.98 kWh; dividing by the number of on-peak hours (198) results in an average on-peak demand reduction of 0.10 kW per recycled refrigerator.

Similarly, it was determined that approximately 2.3% of a freezer's energy consumption occurs during on-peak hours (15.85 kWh). Average on-peak demand reduction is thus 0.08 kW per recycled freezer.

2.3. Estimation of Ex Post Net Savings

2.3.1. Methodology for Estimating Ex Post Net Energy Savings

This section explains ADM's net savings estimation methodology which is based on the UMP protocol. The two effects discussed in this section are free ridership and secondary market impacts. Responses from the participant survey where used to estimate each effect. The UMP protocol used to recommend estimating a third effect, induced replacement, but no longer includes this recommendation due to the difficulty of estimating the affect and the small impact on savings overall.

The UMP protocol does not recommend estimation of participant spillover for appliance recycling programs because there are limited opportunities for "like" spillover (i.e., spillover resulting from measures similar to those incentivized through the program) and the program does not provide energy assessments or education to encourage adoption of additional measures. As such, ADM did not estimate participant spillover for the Home Appliance Recycling Program.

Net savings for recycled appliances are calculated relative to UMP gross savings using the formula below.

$$Net\ Savings = Gross\ Savings - Freeridership - Secondary\ Market\ Impacts$$

Where:

Gross Savings	= The evaluated in situ UEC for the average recycled unit, adjusted for part use (UMP definition of gross savings);
Free ridership	= Program savings from units that would have been destroyed even in the absence of the program;
Secondary Market Impacts	= Program savings that would have occurred in the absence of the program based on the estimated/assumed counterfactual actions of appliance acquirers.

2.3.1.1. Methodology for Estimating Free Ridership

Free ridership occurs when an appliance recycled through the program would have been taken off the grid even in the absence of the program. The first step of the free ridership analysis was to ask participants if they had considered discarding the program appliance before learning about the program. If the participant indicated no previous consideration of unit disposal, they are categorized as non-free-riders and removed from the subsequent free ridership analysis.

Next, the remaining participants (i.e., those who had previously considered discarding the program appliance) were asked a series of questions to determine the distribution of program appliances that would have been kept within participant households versus those that would have been discarded. If one considers the counterfactual scenario where there is no program intervention, there are essentially three outcomes for participating appliances:

- The appliance would have been kept in use by the participant household.[10]
- The appliance would have been discarded in such a way that it was transferred to another customer for continued use.
- The appliance would have been discarded in such a way that it would be taken out of service.

Of the three outcomes, participants who responded that their appliance would have been discarded and taken out of service is indicative of free ridership. This is because the recycled units would have been removed from the grid even without program intervention.

2.3.1.2. Methodology for Estimating Secondary Market Impacts

Secondary market impacts refer to the effect the program has on would-be acquirers of program participating units. In the event that a program unit would have been transferred to another

[10] Note that units kept by participant households but *not* used are accounted for in the estimation of part-use factors and therefore discounted from gross savings.

customer (sold, gifted, donated), the question then becomes what other appliance acquisition decisions are made by the would-be acquirer of the program unit now that it is decommissioned and unavailable. The would-be acquirer could:

- Not purchase/acquire another unit.
- Purchase/acquire a different non-program used appliance.
- Purchase a new appliance instead.

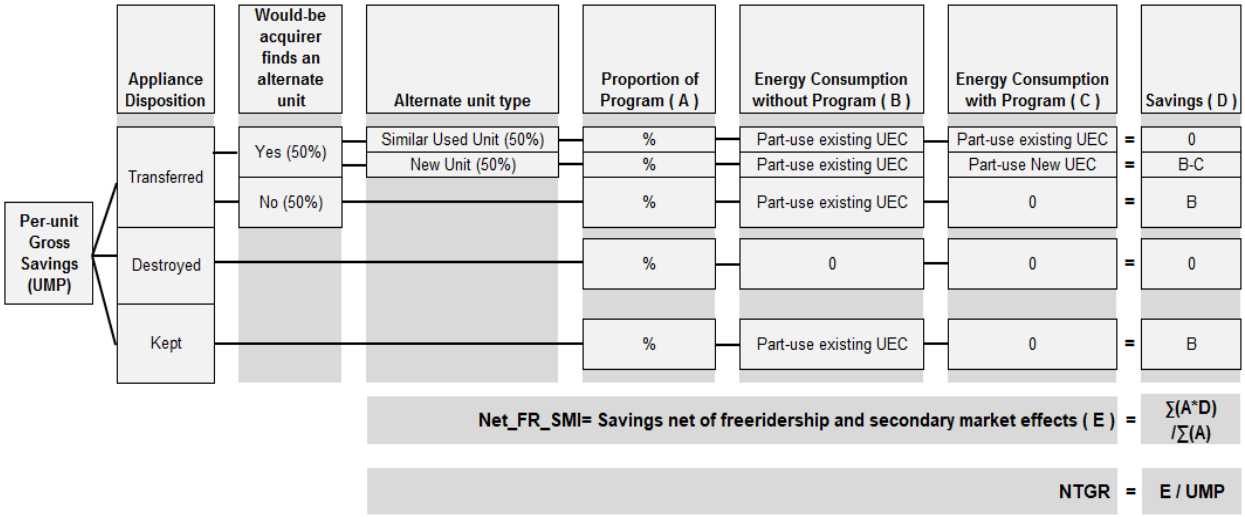
Ultimately, the true market level outcome in the absence of the program is difficult to assess. As a result, this evaluation will take a midpoint approach, as recommended by the UMP protocol. That is, 50% of would-be acquirers of program avoided transfers are assumed to find an alternate unit. The next question of interest is whether the alternative units acquired would be used (similar to those recycled by the program) or new. Again, this market distribution is difficult to estimate with any certainty. This evaluation will take the UMP recommendation and assumes that 50% of the alternative units would be used and 50% would be new, standard efficiency units. Energy consumption for a standard efficiency new refrigerator is assumed to be 490 kWh based on sales-weighted appliance data from the Association of Home Appliance Manufactures (AHAM).[11] Similarly, energy consumption for a standard new freezer is assumed to be 344 kWh.

2.3.1.3. Complete Net-to-Gross Calculation

Figure 2-1 summarizes the complete net-to-gross calculation that was used in this evaluation. Note that this diagram depicts net savings as calculated using the UMP protocol.

[11] AHAM Energy Efficiency and Consumption Trends 2015

Figure 2-1 Net Savings Calculation Summary Diagram



2.3.2. Results of Ex Post Net Impact Evaluation

ADM estimated net-to-gross ratios for both refrigerators and freezers by adjusting gross savings for free ridership. Free ridership equaled 50% of savings and was estimated using results from the participant survey and applying the methodology described in Section 2.3.1. Applying the estimated net-to-gross ratio of 50% for refrigerators and the estimated net-to-gross ratio of 52% for freezers to the gross savings presented in Section 2.2.2 results in the net savings detailed in Table 2-10 and Table 2-11 below.

Table 2-10 Ex Post Net kWh Savings

Appliance Type	*Ex Ante Gross kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*
Refrigerators	433,342	433,342	425,140	387,138	89%	192,819	50%
Freezers	74,216	74,216	73,509	66,917	90%	34,906	52%
Total	507,558	507,558	498,649	454,055	89%	227,725	50%

Table 2-11 Ex Post Net kW Savings

Appliance Type	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Refrigerators	55.55	55.55	54.49	45.54	82%	22.68	50%
Freezers	9.27	9.27	9.19	8.02	86%	4.18	52%

Appliance Type	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Total	64.82	64.82	63.68	53.56	83%	26.86	50%

The calculations leading to these estimated net-to-gross ratios are detailed in the sub-sections to follow.

2.3.2.1. Calculation of Net-to-Gross Ratios for Recycled Appliances

ADM used the formula shown below to estimate net savings for recycled refrigerators and freezers. Note that this definition considers gross savings under the UMP definition. Each component of the net savings calculation is described in 2.2.1 of this report. Spillover and induced replacement effects were not considered as part of the net savings analysis for this evaluation.

$$Net\ Savings = Gross\ Savings - Freeridership - Secondary\ Market\ Impacts$$

Where:

Gross Savings = The evaluated in situ UEC for the average recycled unit, adjusted for part use (UMP definition of gross savings);

Free-ridership = Program savings from units that would have been destroyed even in the absence of the program;

Secondary Market Impacts = Program Savings that would have occurred in the absence of the program based on the estimated/assumed counterfactual actions of appliance acquirers.

Net savings are essentially calculated using a decision tree. The decision tree is populated with estimated percentages of appliance disposition in the absence of the program based on responses to the PY2020 participant survey. In other words, participants' actions concerning discarded equipment are used to estimate savings values under all possible scenarios. The weighted average of savings under these scenarios is then used to calculate the net savings attributable to the program.

Participant survey respondents were first asked if they had considered discarding the program appliance before learning about the program. Respondent answers to this question are shown in Table 2-12.

Table 2-12 Prior Consideration of Disposal

	Measure	*Response*	*Percent of Respondents (n=113(ref), 320 (frz))*
Had you already considered disposing of the *[refrigerator, freezer]* before you heard about *[I&M]'s* appliance recycling program?	Refrigerator	Yes	71%
		No	25%
		Don't know	4%
	Freezer	Yes	73%
		No	25%
		Don't know	3%

Respondents who indicated they had not considered disposal before learning about the program were considered non-free-riders. That is, for these respondents it was assumed they would have kept the appliance in use absent the program, since they hadn't considered disposal before learning about the program. Respondents who indicated they had considered disposal or "didn't know" if they had considered disposal were asked additional questions to determine whether the appliances they recycled were indicative of free-ridership.

Table 2-13 shows appliance disposition based on participant survey responses. Table 2-14 shows the same calculation for freezers.

Table 2-13 Refrigerator Discard/Keep Distribution

Discard/Keep	*Proportion of Participant Sample (n = 294)*	*Discard Scenario*	*Proportion of Discards*	*Overall Proportion*
Discard	67%	Transfer	43%	29%
		Destroy	57%	38%
Keep	33%			33%

Table 2-14 Freezer Discard/Keep Distribution

Discard/Keep	*Proportion of Participant Sample (n = 104)*	*Discard Scenario*	*Proportion of Discards*	*Overall Proportion*
Discard	63%	Transfer	38%	24%
		Destroy	62%	38%
Keep	38%			38%

Secondary market impacts account for program effects on would-be acquirers of program units (since they are no longer available to acquire program units). Only units that would have been transferred absent the program are considered in the secondary market impact analysis. As detailed in Section 2.3.1.2, a midpoint approach is taken in this evaluation, based on the recommendation of the UMP protocols. That is, 50% of would-be acquirers of program avoided transfers are assumed to find an alternate unit. Of those who are assumed to find an alternative unit, 50% are assumed to find a similar used unit, while 50% are assumed to purchase a new unit.

ADM determined net savings as UMP gross savings less free-ridership and secondary market impacts. Figure 2-2 depicts the complete net-to-gross ratio calculation for refrigerators. Figure 2-3 shows the same calculation for freezers. As the figures show, ADM's estimated net-to-gross ratios are 0.50 for recycled refrigerators and 0.52 for recycled freezers.

Figure 2-2 Net-to-Gross Ratio Calculation – Refrigerators

	Appliance Disposition	Would-be acquirer finds an alternate unit	Alternate unit type	Proportion of Program (A)	Energy Consumption without Program (B)	Energy Consumption with Program (C)		Savings (D)
Per-unit Gross Savings (UMP)	Transferred (29%)	Yes (50%)	Similar Used Unit (50%)	7.3%	827 kWh Part-use existing	679 kWh Part-use existing	=	0 kWh
			New Unit (50%)	7.3%	827 kWh Part-use existing	490 kWh New existing	=	337 kWh
		No (50%)		14.6%	827 kWh Part-use existing	0	=	827 kWh
	Destroyed (38%)			38.0%	0	0	=	0 kWh
	Kept (33%)			32.7%	827 kWh Part-use existing	0	=	827 kWh
						Net_FR_SMI= Savings net of freeridership and secondary market effects	=	416 kWh
						NTG_INR	=	50%

Figure 2-3 Net-to-Gross Ratio Calculation – Freezers

	Appliance Disposition	Would-be acquirer finds an alternate unit	Alternate unit type	Proportion of Program (A)	Energy Consumption without Program (B)	Energy Consumption with Program (C)		Savings (D)
Per-unit Gross Savings (UMP)	Transferred (25%)	Yes (50%)	Similar Used Unit (50%)	6.1%	679 kWh Part-use existing	679 kWh Part-use existing	=	0 kWh
			New Unit (50%)	6.1%	679 kWh Part-use existing	344 kWh New existing	=	335 kWh
		No (50%)		12.3%	679 kWh Part-use existing	0	=	679 kWh
	Destroyed (39%)			38.7%	0	0	=	0 kWh
	Kept (37%)			36.8%	679 kWh Part-use existing	0	=	679 kWh
						Net_FR_SMI= Savings net of freeridership and secondary market effects	=	353 kWh
						NTG_INR	=	52%

3. Home Energy Products - Lighting

This chapter presents the results of both the impact and process evaluations of the 2021 Home Energy Products – Lighting Program that Indiana Michigan Power (I&M) offered to its residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess gross and net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year;
- Assess marketing and outreach approaches;
- Assess coverage of retailer and lamp types; and
- Provide recommendations for program improvement as appropriate.

3.1. Program Description

The Home Energy Products – Lighting program was designed to increase demand for energy-efficient lighting through upstream incentives and by providing discounts for online lighting purchases.

The objectives of the program included lowering electric consumption in the residential market sector through the purchase and installation of eligible energy efficient lighting measures. The program works with lighting manufactures and retailers to reduce the cost of efficiency lighting technologies and to encourage retailers to promote the purchase of efficient lighting.

3.2. Estimation of Ex Post Gross Savings

The following section presents the methodology that was used for estimating the gross energy and demand impacts resulting from the Home Energy Products – Lighting Program in 2021.

3.2.1. Methodology for Estimating Ex Post Gross Energy Savings

The M&V approach for the Home Energy Products – Lighting Program focused on determining the following:

- Number of bulbs discounted and sold through the program;
- Average annual kWh savings per purchased bulb type; and
- Average kW reduction per purchased bulb type.

3.2.1.1. Review of Documentation

As a first step, ADM reviewed data tracking systems associated with the program to ensure that the data provided sufficient information to identify bulb types/characteristics and to calculate energy and demand impacts in accordance with the 2015 Indiana Technical Reference Manual (TRM) Version 2.2. ADM further reviewed the program data to verify required fields were

populated (i.e., the data was not missing) and that the program measures were appropriately categorized by measure type. Finally, the program tracking data and the associated summary data provided in the I&M DSM EE Program Scorecard were reviewed for consistency and duplicate or erroneous entries.

ADM's review of the program data tracking data found there to be sufficient information to estimate energy and demand impacts in accordance with the Indiana TRM. The data included details of the LED bulbs discounted through the program, including bulb types and wattages, information on retail pricing and program discounts, manufacturer and retailer information, and ex ante savings and demand reductions. ADM did not discover erroneous or duplicative entries in the primary tracking data.

3.2.1.2. Procedures for Estimating Measure-Level Gross Energy Savings

ADM referenced the methodologies and deemed inputs from the Indiana TRM to calculate the gross annual energy savings and gross peak demand reduction from distributed program LEDs.

The following sections describe the specific algorithms and inputs that were used to calculate energy and demand impacts for all program-discounted LED lamps.

Standard and Specialty LED Lighting: The following algorithm was used to determine annual kWh energy savings, in accordance with the *Residential ENERGY STAR Lighting (CFL and LED)* section from the Indiana TRM:

$$\Delta kWh = \frac{(Watts_{BASE} - Watts_{EFF})}{1{,}000} \times ISR \times HOURS \times (1 + WHF_E)$$

Where:

$Watts_{BASE}$	= Baseline bulb wattage based on lookup of efficient bulb lumens, from Illinois Technical Reference Manual v. 8.0, measures 5.5.6 and 5.5.8
$Watts_{EFF}$	= Wattage of efficient lamp, actual
ISR	= In Service Rate or percentage of distributed units that are installed, as determined through analysis of customer survey response data; 76%
HOURS	= Average hours of use per year; 902 or 1,190[12]
WHF_E	= Waste Heat Factor for Energy to account for cooling savings from efficient lighting; dependent on purchase location

[12] In line with the 2015 Indiana Technical Reference Manual Version 2.2 (Indiana TRM), for decorative, candelabra specialty lamps, 1,190 annual hours of operation are applied; otherwise, 902 annual hours of operation are applied. Decorative, candelabra specialty lamps account for approximately 10% of program-level gross and net realized kWh savings.

ADM calculated ex post peak demand reduction using the following Indiana TRM defined equation:

$$\Delta kW = \frac{(Watts_{BASE} - Watts_{EFF})}{1{,}000} \times ISR \times (1 + WHF_D) \times CF$$

Where:

$Watts_{BASE}$	= Baseline bulb wattage based on lookup of efficient bulb lumens, from Illinois Technical Reference Manual v. 8.0, measures 5.5.6 and 5.5.8
$Watts_{EFF}$	= Wattage of efficient lamp, actual
ISR	= In Service Rate or percentage of distributed units that are installed, as determined through analysis of customer survey response data; 76%
WHF_D	= Waste Heat Factor for Energy to account for cooling savings from efficient lighting; dependent on purchase location
CF	= Summer peak coincidence factor, 0.11

3.2.1.3. Methodology for Calculating of In-Service Rates (ISR)

Ex post kWh savings and kW reductions were adjusted by applying first-year in-service rates to the savings estimates.

For lamps sold in retail stores, ADM developed in-service rates based on responses of 150 customers to survey questions on the number of bulbs purchased in the past six months and the number installed at the time of the survey. The in-service rate applied to lamps sold in stores is 88%.

The in-service rate (ISR) was equal to:

$$ISR = \frac{\sum Bulbs\ installed\ at\ time\ of\ survey}{\sum Bulbs\ purchased}$$

Table 3-1 below displays the first-year in-service rate of program LEDs developed from the sample of 150 respondents.

Table 3-1 In-Service Rates by Bulb Type

Measure	*Expected Quantity of Discounted Bulbs*	*First-Year ISR*	*Verified Quantity of Discounted Bulbs*
Standard LED (In-Store)	669,686	76%	510,464
Specialty LED (In-Store)	213,643	76%	162,848
Standard LED (Online)	43,092	19%	8,260
Specialty LED (Online)	17,160	19%	3,289
Total	943,581	73%	684,861

3.2.2. Results of Ex Post Gross Savings Estimation

This section presents the ex post annual gross energy savings and ex post gross demand reductions resulting from the 2021 Home Energy Products Program efficient lighting component.

3.2.2.1. Ex Post Gross kWh Savings

Table 3-2 below shows the estimated measure-level and program-level annual gross energy savings resulting from the program. The overall gross kWh realization rate for the program is 89%. The realization rate may have been a function of the ex ante estimate referencing the Indiana TRM for the baseline wattage.

Table 3-2 Measure-level Annual Gross kWh Savings – Lighting

Measure	*Verified Number of Bulbs*	*Ex Ante Gross kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*
Standard LED	136,774	3,878,939	3,878,939	2,956,696	2,696,253	70%
Specialty LED	41,622	715,764	715,764	545,587	1,374,257	192%
Total	178,395	4,594,703	4,594,703	3,502,283	4,070,510	89%

3.2.2.2. Ex Post Gross kW Reductions

Table 3-3 below shows the estimated measure-level and program-level ex post gross peak kW reduction resulting from the program. The overall gross kW realization rate for the program is 85%.

Table 3-3 Measure-level Gross kW Reduction – Lighting

Measure	*Verified Number of Bulbs*	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
Standard LED	136,774	531.25	531.25	404.94	367.00	69%
Specialty LED	41,622	98.03	98.03	74.72	167.79	171%
Total	178,395	629.28	629.28	479.67	534.79	85%

3.3. Estimation of Ex Post Net Savings

3.3.1. Methodology for Estimating Ex Post Net Impacts

ADM used two approaches to estimating lighting discount free ridership: self-reported responses from a random sample of customers who have purchased efficient light bulbs in the past six months and a consumer demand modeling approach based on PY2020 sales of discounted lighting through the program. The survey responses were collected in December 2018.

In addition to free ridership, ADM's net impact estimates include an adjustment for non-participant spillover.

3.3.1.1. Free Ridership: Self-report Survey Methodology

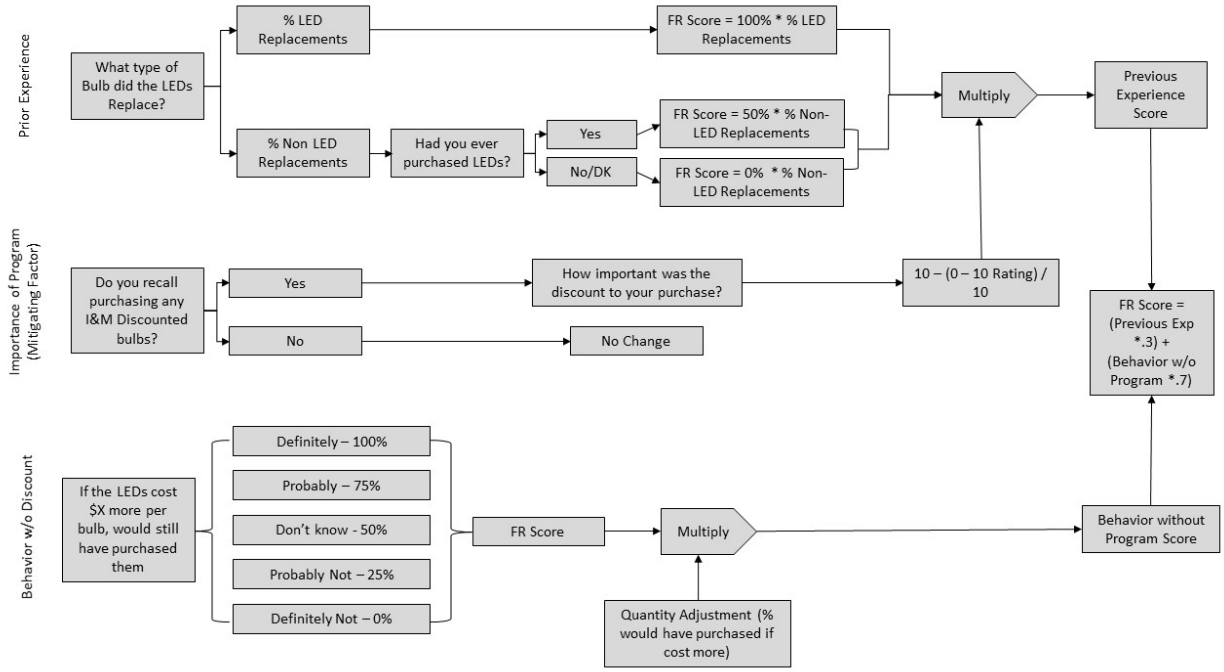
Survey respondents were asked a series of questions to elicit feedback regarding influences on their light bulb purchasing decisions. Respondents were asked questions about previous LED purchases, their likelihood of purchasing LEDs under a higher cost scenario, and if they recall receiving a program discount for the LEDs purchased. Each respondent was then assigned a free ridership score based on a free ridership scoring algorithm.

The final respondent FR score was calculated as follows:

*Final Respondent FR Score = 0.3 * [Prior Experience FR] + 0.7 * [Behavior w/o Discount FR] – Mitigating Factors*

The free ridership scoring algorithm for light bulb purchases is shown in Figure 3-1.

Figure 3-1 Free ridership Scoring for Targeted Random Dialing Survey Respondents



3.3.1.2. Free Ridership: Price-Response Model Methodology

ADM also estimated free ridership using a price-response modelling approach using PY2020 records of program discounted bulb sales. This approach estimated sales in response to changes in pricing of the bulbs. ADM developed a regression model to estimate the relationship between price and quantity sold. ADM used a negative binomial model to account for the right-skewed relationship between prices and quantities. The dependent variable was number of packages sold by the program. Independent variables used to predict sales included, month, promotion dummy (e.g. presence of a promotional event on the sales date), program price, and a dummy variable for each model type.

Model types were defined as a combination of bulb type (i.e. specialty LED vs. standard LED), bulb shape (i.e. A19 vs BR40), wattage range (i.e. 0-5, 5-10, etc.…), and the number of bulbs per package. Quantities of bulbs sold in the absence of the program were then predicted using pre-program prices and the price-response model, and program quantities were also predicted using program prices and the model coefficients. The final price response model is used to estimate a free ridership as described in the equation below:

$$Free\ ridership\ ratio = \frac{\sum_i^n (E[Bulbs_{NoProgram_i}])}{\sum_i^n (E[Bulbs_{Program_i}])}$$

Where:

$E[Bulbs_{NoProgram_i}]$ = the expected number of bulbs of type, *i*, purchased given original retail pricing (as predicted by the model).

$E[Bulbs_{Program_i}]$ = the expected number of bulbs of type, *i*, given program discounted pricing (as predicted by the model).

The price-response modeling approach is advantageous in that it is built upon actual sales data from participating retailers (as opposed to relying on consumer self-report surveys). There are, however, a number of limitations for the approach. Most importantly, non-program sales data is unavailable for inclusion in the model. As a result, the modeling of price impacts may fit program sales data well, but it is uncertain whether those price effects apply well to prices outside of program ranges. Additionally, there are likely variables that affect sales levels for LEDs that are not captured by the program tracking data; thus, there is a risk of omitted variable bias in addition to the inherent amount of error from statistical modeling.

3.3.1.3. Overall Estimation of Free Ridership Methodology

Due to the advantages and disadvantages associated with each of the above methods, ADM averaged the free ridership scores from each method to obtain a combined free ridership score.

3.3.1.4. Methodology for Estimating Non-Participant Spillover

To estimate PY2021 non-participant spillover, ADM:

- Calculated the PY2019 non-participant spillover ratio as equal to the total PY2019 portfolio non-participant spillover kWh savings divided by the total PY2019 portfolio ex post gross kWh savings.
- Multiplied the PY2019 non-participant spillover ratio by the total PY2020 portfolio ex post gross kWh savings.
- Calculated the PY2020 portfolio non-participant spillover kW by applying a flat load shape to the estimated PY2020 kWh non-participant spillover (NPSO kW = NPSO kWh / 8760).
- Allocated the PY2020 non-participant spillover kWh and kW to the individual programs in proportion to program expenditures.
- Calculated a non-participant rate equal to PY2020 non-participant spillover / PY2020 program gross savings.
- Applied the non-participant rate to PY2021 gross savings.

The total residential estimated PY2021 non-participant spillover was 41,119 kWh and 4.61 kW.[13]

[13] ADM changed the approach to estimating non-participant spillover in the final report from the approach used in the draft report in consultation with OUCC staff. The draft report applied the PY2019 non-participant spillover kWh and kW estimates to the PY2021 programs.

3.3.2. Results of Ex Post Net Energy Savings Estimation

The ex post annual net energy savings and ex post net demand reductions resulting from the 2021 Home Energy Products – Lighting Program are reported in the following sections.

3.3.2.1. Free Ridership: Self-report Survey Results

ADM calculated a free ridership value for each of the survey respondents, and these values were weighted by bulb type and quantity and then summed. The resulting free ridership estimate was 57% for standard LED bulbs and 33% for specialty LED bulbs, as shown in Table 3-4.

Table 3-4 Free Ridership: Self-report Survey Results

Estimation Methodology	*Bulb Type*	*Free Ridership %*
Self-Report Survey	Standard LED	57%
	Specialty LED	33%

3.3.2.2. Free Ridership: Price-Response Model Results

The estimated free ridership rate for specialty LEDs is 49%, while the estimated free ridership rate for standard LEDs is 51%. ADM ran separate models for each bulb type (i.e. LED Standard and LED Specialty). The coefficients on program price ("*ProPrice*") are negative (the expected direction) and statistically significant at the 99% level. The following tables present the final Standard and Specialty LED model specifications.

Table 3-5 Price-Response Model Final Specification – Standard LEDs

Coefficient	*Estimate*	*Std Err*	*t-statistic*	*p.value*	*CI-low*	*CI-high*
(Intercept)	0.69	0.19	3.74	0.00	0.33	1.06
model.numStandard LED_A-Line_0-5_0-500_2	0.38	0.19	2.01	0.04	0.01	0.76
monthsept2019	-1.45	1.44	-1.01	0.31	-4.26	1.36
monthoct2019	-1.45	0.28	-5.13	<0.01	-2.00	-0.90
monthnov2019	1.60	0.12	13.35	<0.01	1.36	1.83
monthdec2019	-0.43	0.32	-1.34	0.18	-1.05	0.20
monthjan2021	0.42	0.07	6.28	<0.01	0.29	0.55
monthfeb2021	0.20	0.04	5.23	<0.01	0.12	0.27
monthmarch2021	0.18	0.03	5.42	<0.01	0.11	0.24
monthmay2021	0.08	0.03	2.47	0.01	0.02	0.14
monthjune2021	0.43	0.03	13.47	<0.01	0.37	0.49
monthjuly2021	0.05	0.03	1.51	0.13	-0.02	0.12
monthaugust2021	0.04	0.03	1.39	0.16	-0.02	0.11
monthsept2021	0.12	0.03	3.72	<0.01	0.06	0.19
monthoct2021	0.06	0.03	1.93	<0.01	0.00	0.12
monthnov2021	0.10	0.03	2.99	<0.01	0.03	0.16
monthdec2021	-0.03	0.03	-0.85	0.39	-0.09	0.04

Coefficient	*Estimate*	*Std Err*	*t-statistic*	*p.value*	*CI-low*	*CI-high*
monthjan2021	0.05	0.08	0.63	0.53	-0.11	0.21
ProPrice	-0.15	0.00	-46.70	0.00	-0.15	-0.14

Table 3-6 Price-Response Model Final Specification – Specialty LEDs

Coefficient	*Estimate*	*Std Err*	*t-statistic*	*p.value*	*CI-low*	*CI-high*
(Intercept)	1.99	0.32	6.20	0.00	1.36	2.62
model.numSpecialty LED_Bulged Reflector_10-15_1000-1500_2	-0.75	0.33	-2.26	0.02	-1.41	-0.10
monthoct2019	-0.65	0.13	-4.82	<0.01	-0.91	-0.38
monthnov2019	-0.28	0.12	-2.42	0.02	-0.52	-0.05
monthdec2019	-0.46	0.11	-4.05	<0.01	-0.68	-0.24
monthjan2021	0.62	0.05	12.59	<0.01	0.53	0.72
monthfeb2021	0.08	0.03	2.38	0.02	0.01	0.14
monthmarch2021	-0.09	0.03	-3.39	<0.01	-0.15	-0.04
monthmay2021	0.05	0.03	1.84	0.07	0.00	0.10
monthjune2021	-0.01	0.03	-0.34	0.73	-0.07	0.05
monthjuly2021	-0.06	0.03	-2.05	0.04	-0.12	0.00
monthaugust2021	-0.05	0.03	-1.56	0.12	-0.10	0.01
monthsept2021	-0.02	0.03	-0.74	0.46	-0.08	0.04
monthoct2021	0.07	0.03	2.35	0.02	0.01	0.12
monthnov2021	0.08	0.03	2.71	0.01	0.02	0.13
monthdec2021	0.03	0.03	1.06	0.29	-0.03	0.09
monthjan2021	-0.26	0.08	-3.24	<0.01	-0.43	-0.10
ProPrice	-0.07	0.00	-32.86	<0.01	-0.08	-0.07

Table 3-7 below summarizes the resulting standard and specialty LED free ridership estimates from the price-response model. The overall free ridership estimate from the price-response model was 46%.

Table 3-7 Free Ridership: Price-response Model Results

Estimation Methodology	*Bulb Type*	*Free Ridership %*
Price-Response Model	Standard LED	51%
	Specialty LED	49%

3.3.2.3. Overall Estimation of Free Ridership Results

ADM applied a simple average of the two methodologies to determine the final free ridership score for standard LEDs and specialty LEDs in the program. The results, as shown in Table 3-8, is a free ridership score of 51% for standard LEDs and 49% for specialty LEDs.

Table 3-8 Final Free Ridership Estimation

Estimation Methodology	*Free Ridership %: Standard LED*	*Free Ridership %: Specialty LED*
Self-Report Survey	45%	33%
Price-Response Model	57%	65%
Final FR estimate (average)	51%	49%

3.3.2.4. Non-Participant Spillover Results

The non-participant spillover assigned to the Home Energy Products – Lighting Program was 41,119 kWh and 4.61 kW.

3.3.2.5. Ex Post Net kWh and kW Savings

Table 3-9 summarizes the net ex post kWh and kW savings of the Home Energy Products – Lighting Program. The annual net savings totaled 2,062,138 kWh, and the net-to-gross ratio is 51%.

Table 3-9 Program-Level Net kWh and kW Savings

Category	*kWh*	*kW*
Ex Ante Gross Savings	4,594,703	629.28
Gross Audited Savings	4,594,703	629.28
Gross Verified Savings	3,502,283	479.67
Ex Post Gross Savings	4,070,510	534.79
Gross Realization Rate	89%	85%
Ex Post Free Ridership	2,049,490	269.56
Ex Post Non-Participant Spillover	41,119	4.61
Ex Post Participant Spillover	0	0.00
Ex Post Net Savings	2,062,138	269.85
Net-to-Gross Ratio	51%	50%
Ex Post Net Lifetime Savings	6,275,070	n/a

4. Home Energy Reports

This chapter presents the results of both the impact and process evaluations of the 2021 Home Energy Reports Program that Indiana Michigan Power (I&M) offered to its residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year;
- Characterize levels of awareness of the home energy reports, online portal, and challenge emails among participants;
- Assess satisfaction with the report and information provided;
- Document and assess quality assurance and control procedures; and
- Provide recommendations for program improvement as appropriate.

4.1. Program Description

I&M contracted with implementation contractor Opower to deliver a behavioral-based program targeting residential customers. The program was designed to generate greater awareness of energy use and ways to manage energy use through energy efficiency education in the form of home energy reports (HER). The scope of the HERs program included informational messaging about energy use as well as recommendations for energy efficiency improvements that customers can implement in their homes.

The evaluation approach for the HER Program was aimed at determining:

- The number of participants that received reports during PY2021;
- Total kWh savings achieved under the program;
- Total kW demand reduction achieved under the program; and
- Assessment of program operations.

4.2. Estimation of Ex Post Savings

4.2.1. Methodology for Estimating Ex Post Energy Savings

To complete the evaluation of energy savings impacts, I&M and program implementation staff provided ADM with the following data:

- Billing data which covers at least one year prior to the first HER (for a given wave), as well as all of 2021.

- Customer lists for each customer associated with a HER Program treatment or control group, when the first HER was received, whether the customer opted out or stopped electrical service.
- ADM verified that the treatment and control customers had similar average daily consumption during the pre-program period.

4.2.1.1. Regression Model for Estimating Energy Savings

ADM conducted a regression analysis for the delivery waves using a census of program participant billing data and control group. The billing data for participants included two years of monthly observations for each customer. The pre-period data was the billing data for one year prior to treatment start period for the wave and the "post" period as 2021.

To serve as a baseline, ADM used data from a control group of randomly selected customers. This group was also screened for duplicate entries.

The mixed effects panel regression model[14] used during 2021 is specified as follows:

$$kWh_{i,t} = \beta_1 HDD65_{i,t} + \beta_2 CDD75_{i,t} + \beta_3 Post_{i,t} + \beta_4 (Post_{i,t} * HDD65_t) + \beta_5 (Post_{i,t} * CDD75_t)$$
$$+ \beta_6 (Post_{i,t} * Treatment_i) + \alpha_i Customer_i + \varepsilon_{i,t}$$

Where T(i) represents the number of bills available for i. The model is defined as "mixed effects" because the model decomposes its parameters into fixed-effects (i.e. HDD65, CDD75, Post, Treat, and its various interactions) and random effects (i.e. the individual customer's base usage). Put simply, a fixed effect is assumed to be constant and independent of the sample, while random effects are assumed to be sources of variation (other than natural measurement error) that are uncorrelated with the fixed effects. The approach is similar to others that treat the individual customer as a fixed-effect but is more computationally efficient as the number of individuals in the sample becomes very large.

While the results of this model are expected to be consistent with a pooled regression (which ignores the individual customer effect), controlling for the individual effect will achieve some improvement in the model's fit to the data. The variables included in the regression models are specified in Table 4-1 below.

Table 4-1 Description of Variables Used in the Regression Model

Variable	*Description*
Customer random intercept	Unique identifier for each customer to control for any customer specific differences.

[14] This was implemented in R using the lme4 package. The syntax used for model specification is lmer(avg.kw ~ 1 + hdd + cdd + post + post*hdd + post* cdd + treat*post + (1 | ACCOUNT_NUMBER), data=dataset)

Variable	*Description*
Heating Degree Days (HDD)	Average Heating Degree Days per day within each billing period. This will be calculated by summing up the number of heating degree hours per day, and then averaging over the number of days in the billing period.
Cooling Degree Days (CDD)	Average Cooling Degree Days per day within each billing period. This will be calculated by summing up the number of cooling degree hours per day, and then averaging over the number of days in the billing period.
Post	Indicator if an observation is post audit (=1 if post, =0 otherwise).
kWh	The average daily kWh usage for account i during billing period t.
Post * Treatment	Indicator that adjusts for the interactive effect between whether customer i's monthly billing data in period t in the pre or post period and whether customer i was in the treatment or control group during period t.

The HDD and CDD was calculated on a daily basis so they can be applied to each customer's billing period, however long that may be. It is rare that a customer's billing dates are on the first of each month, so this ensures that no estimation of usage must occur to match weather data with the billing data.

The coefficient estimate on β_6 from the regression model output was used to determine the annual Net kWh and kW savings for the program. The calculation steps are as follows:

1) To calculate account-level energy saving, multiply β6 by the number of days that the treatment group customer was treated during 2021
2) kW savings are calculated by applying a flat load shape (i.e. 1 / 8,784) to the kWh energy savings.
3) Sum the account-level kWh and kW savings of treated customers to arrive at a program level kWh energy savings and kW peak reduction numbers.

4.2.1.2. Estimating Net Savings

The experimental design of the Home Energy Reports program uses random assignment of customers to treatment and control groups to remove the effects of exogenous variables that would cause differences in energy consumption across the two groups. Consequently, the estimate of savings developed using the regression approach described above is a net savings estimate.

4.2.2. Results of Ex Post Savings Estimation

The estimated energy savings impacts are summarized in Table 4-2 and the estimated peak demand impacts are summarized in Table 4-3 resulting from the PY2021 Home Energy Reporting program.

Table 4-2 Summary of Energy Savings – PY2021

Ex Ante Gross kWh Savings	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*	*Ex Post Net Lifetime kWh Savings*
3,439,220	3,439,220	3,439,220	3,374,624	98%	3,374,624	100%	3,374,624

Table 4-3 Summary of Peak Demand Impacts – PY2021

Ex Ante Gross kW Savings	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
392.61	392.61	392.61	385.23	98%	385.23	100%

Differences in the availability of data when the estimates were made accounted for the discrepancy between ex ante estimates and ex post verified savings. Below is a summary of a data cleaning steps employed by ADM in preparing the model dataset utilized by ADM to determine ex post kWh savings:

- Filtering – ADM employed consumption and billing duration filters for outliers.
- CDD Base - ADM used a CDD base of 75°F
- HDD Base – ADM used a HDD base of 65°F

4.2.2.1. Ex Post kWh Savings

The impacts were calculated from the regression outputs for each wave. The regression results are reported in Table 4-4 below.

Table 4-4 HER Regression Model Output, by Wave

Statistic	*Wave 1*	*Wave 2*	*Wave 3*	*Wave 4*	*Wave 5*	*Wave 6*	*Wave 7*	*Wave 8*
Daily kWh Savings	0.61	0.47	0.37	0.00	0.15	0.00	0.22	0.22
Number of Treatment Customers	26,781	17,034	13,224	8,919	37,649	4,885	5,307	6,244
Number of Control Customers	4,409	7,731	7,187	4,647	14,870	1,997	2,138	2,487
R-Squared	0.44	0.43	0.43	0.53	0.63	0.70	0.65	0.63

The annualized kWh savings were calculated from the daily kWh savings estimate reported above, and includes an adjustment to account for program uplift. Daily kWh savings were equal to 0 for Wave 4 and Wave 6 because the treatment effect parameter for that wave was not statistically significant. The kWh savings by wave are reported in Table 4-5 below.

Table 4-5 kWh Savings, by Wave[15]

Wave	Full Treatment Period Treatment Groups Customer		Partial Treatment Period Treatment Groups Customer (Accounts Closed during 2021)			Savings Coefficient (Average Daily kWh Savings)	Total Ex Post Gross kWh Savings
	Number of Treatment Group Customers	Ex Post Gross kWh Savings	Number of Treatment Group Customers	Total Treatment Days for Partial Treatment Customers	Ex Post Gross kWh Savings		
1	26,781	1,473,197	137	9,141	5,587	0.61	1,478,784
2	17,034	718,716	131	8,786	4,119	0.47	722,835
3	13,224	434,446	125	7,926	2,893	0.37	437,339
4	8,919	0	114	7,667	0	0.00	0
5	37,649	497,804	366	24,031	3,530	0.15	501,334
6	4,885	0	58	3,825	0	0.00	0
7	5,307	106,679	64	4,159	929	0.22	107,608
8	6,244	125,260	96	6,563	1,463	0.22	126,723
Total	120,043	3,356,103	1,091	72,098	18,522	N/A	3,374,624

4.2.2.2. Ex Post kW Reductions

The annualized kW Peak Reductions were calculated by dividing the annualized kWh savings by 8,784. The results by wave are reported in Table 4-6 below.

Table 4-6 kW Peak Reduction, by Wave

Wave	Total Ex Post Gross kWh Savings	Ex Post Gross kW Peak Reduction
1	1,478,784	168.81
2	722,835	82.52
3	437,339	49.92
4	-	-
5	501,334	57.23
6	-	-
7	107,608	12.28
8	126,723	14.47
Total	3,374,624	385.23

[15] Ex post gross kWh savings presented in this table account for the incremental impact of program uplift.

5. Low Income Home Energy Reports

This chapter presents the results of both the impact and process evaluations of the 2021 Low Income Home Energy Reports Program that Indiana Michigan Power (I&M) offered to its residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year;
- Document and assess quality assurance and control procedures; and
- Provide recommendations for program improvement as appropriate.

5.1. Program Description

I&M contracted with implementation contractor Opower to deliver a behavioral-based program targeting low-income residential customers. The program used data on customers' receipt of energy assistance and third-party data to identify likely low-income customers to target. The program was designed to generate greater awareness of energy use and ways to manage energy use through energy efficiency education in the form of home energy reports (HER). The scope of the HERs program included informational messaging about energy use as well as recommendations for energy efficiency improvements that customers can implement in their homes.

The evaluation approach for the HER Program was aimed at determining:

- The number of participants that received reports during PY2021;
- Total kWh savings achieved under the program;
- Total kW demand reduction achieved under the program; and
- Assessment of program operations.

5.2. Estimation of Ex Post Savings

5.2.1. Methodology for Estimating Ex Post Energy Savings

The methodology used to estimate ex post energy savings for the Low Income Home Energy Reports Program was the same as the approach used for the Home Energy Reports Program outlined in section 4.2 on page 30.

5.2.2. Results of Ex Post Savings Estimation

The estimated energy savings impacts are summarized in Table 5-1 and the estimated peak demand impacts are summarized in Table 5-2 resulting from the PY2021 Low Income Home Energy Reporting program.

Table 5-1 Summary of Energy Savings – PY2021

Ex Ante Gross kWh Savings	Gross Audited kWh Savings	Gross Verified kWh Savings	Ex Post Gross kWh Savings	Gross Realization Rate	Ex Post Net kWh Savings	Net-to-Gross Ratio	Ex Post Net Lifetime kWh Savings
48,483	48,483	48,483	47,572	98%	47,572	100%	47,572

Table 5-2 Summary of Peak Demand Impacts – PY2021

Ex Ante Gross kW Savings	Gross Audited kW Savings	Gross Verified kW Savings	Ex Post Gross kW Savings	Gross Realization Rate	Ex Post Net kW Savings	Net-to-Gross Ratio
5.53	5.53	5.53	5.43	98%	5.43	100%

Differences in the availability of data when the estimates were made accounted for the discrepancy between ex ante estimates and ex post verified savings. Below is a summary of a data cleaning steps employed by ADM in preparing the model dataset utilized by ADM to determine ex post kWh savings:

- Filtering – ADM employed consumption and billing duration filters for outliers.
- CDD Base - ADM used a CDD base of 75°F
- HDD Base – ADM used a HDD base of 65°F

5.2.2.1. Ex Post kWh Savings

The impacts were calculated from the regression outputs for each wave. The regression results are reported in Table 5-3 below.

Table 5-3 HER Regression Model Output

Statistic	Low Income
Daily kWh Savings	0.22
Number of Treatment Customers	2,339
Number of Control Customers	892
R-Squared	0.63

The annualized kWh savings was calculated from the daily kWh savings estimate reported above, and includes an adjustment to account for program uplift. The kWh savings are reported in Table 5-4 below.[16]

[16] Ex post gross kWh savings presented in this table account for the incremental impact of program uplift.

Table 5-4 kWh Savings

Full Treatment Period Treatment Groups Customer		*Partial Treatment Period Treatment Groups Customer (Accounts Closed during 2021)*			*Savings Coefficient (Average Daily kWh Savings)*	*Total Ex Post Gross kWh Savings*	*Ex Post Gross kW Peak Reduction*
Number of Treatment Group Customers	*Ex Post Gross kWh Savings*	*Number of Treatment Group Customers*	*Total Treatment Days for Partial Treatment Customers*	*Ex Post Gross kWh Savings*			
2,339	46,923	45	2,916	650	0.22	47,572	5.43

5.2.2.2. Ex Post kW Reductions

The annualized kW Peak Reductions were calculated by dividing the annualized kWh savings by 8,760. The results are reported in Table 5-5 below.

Table 5-5 kW Peak Reduction

Total Ex Post Gross kWh Savings	*Ex Post Gross kW Peak Reduction*
47,572	5.43

6. Residential Online Energy Check-up

This chapter presents the results of both the impact and process evaluations of the 2021 Residential Online Energy Check-up Program that Indiana Michigan Power (I&M) offered to its residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess gross and net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year;
- Document sources of program awareness and marketing activities;
- Assess satisfaction among participants; and
- Provide recommendations for program improvement as appropriate.

6.1. Program Description

The Residential Online Energy Check-up Program (OEC) identified energy saving opportunities through a web-based self-service assessment tool where customers answer basic questions about their homes and how they use energy. Upon completion of the questions online, the program generated a printable report that included:

- Useful details about energy consumption of the customer's home;
- Customized energy-saving recommendations;
- Potential savings from making the suggested improvements; and
- Environmental impact of implementing suggested improvements.

In addition, the customer was mailed a kit of low-cost energy efficiency measures dependent on their water heater type. Kits are limited to one per account every three years.

Energy efficient kits for participants with gas water heaters included:

- Three (3) 9W LEDs;
- Two (2) .5W LED night lights; and
- One (1) Digital thermometer.

Energy efficient kits for participants with electric water heaters included:

- Three (3) 9W LEDs;
- One (1) 1.5 GPM Kitchen faucet aerator;
- Two (2) 1.0 GPM Bathroom faucet aerators;
- Two (2) 1.5 GPM High-efficiency showerheads; and
- One (1) Digital thermometer.

6.2. Estimation of Ex Post Gross Savings

The following section presents the methodology that was used for estimating the gross energy and demand impacts resulting from the Residential Online Energy Check-up Program in 2021.

6.2.1. Methodology for Estimating Ex Post Gross Energy Savings

The M&V approach for the impact evaluation of the Online Energy Check-up Program focused on determining the following:

- Numbers of kits distributed;
- Percent of kit components installed; and
- Average annual energy (kWh) savings and demand (kW) reduction per kit measure.

6.2.1.1. Review of Documentation

As a first step, ADM reviewed data tracking systems associated with the program to ensure that the data provided sufficient information to identify unique customers for surveying and to calculate energy and demand impacts in accordance with the 2015 Indiana Technical Reference Manual (TRM) Version 2.2. ADM further reviewed the program data to verify that the fields required for performing the evaluation were tracked and populated (i.e., the data are not missing) and that the values were reasonable. ADM took several steps in its verification efforts, which consisted of the following:

- Validating program tracking data by checking for duplicate or erroneous entries;
- Verifying that gas and electric kits were sent to the appropriate participants and according to the agreed-upon process by I&M; and
- Conducting verification surveys with a sample of program participants to verify that customers listed in the program tracking database did indeed participate and that the correct total number of measures in the kit was received.

ADM also performed a review of the deemed savings estimates used to calculate ex ante energy impacts for installed kit measures. This evaluation activity served to verify that the ex ante calculations were consistent with algorithms and values specified in the Indiana TRM.

6.2.1.1.1. Number of Kits Mailed

The total number and type of OEC kits mailed and installed at participant homes in PY2021 was determined by (1) reviewing the program tracking system and related documentation from I&M and (2) administering an online survey to program participants. Specifically, the tracking system was checked to assure that: (1) duplicate shipments to the same account number did not exist (2) the ex-ante kWh savings are reasonable and (3) that appropriate kits types were sent to customers. Under program rules, kits were limited to one customer account every three years. ADM found no instances in which customers received more than one kit during the program year.

Additionally, ADM administered an online survey to 248 PY2020 program participants who received one of the two types of energy savings kits distributed through the program. All 248 survey respondents verified that they had participated in the program during 2020.

Based on the results of the verification survey effort and the review of the main program tracking system, ADM determined the total number of kits distributed to participants during PY2021 was 2,337 kits (1,320gas kits and 1,017 electric kits).

6.2.1.2. Procedures for Estimating Measure-Level Gross Energy Savings

Gross energy savings and peak demand reductions for the Online Energy Check-up Program were calculated by kit measure using deemed values and algorithms from the Indiana TRM. The following sections describe the specific algorithms and inputs used to calculate energy impacts for each measure in the kits.

LED Lighting: From the Indiana TRM, the *Residential ENERGY STAR Lighting (CFL and LED)* section was used to calculate energy impacts for the installation of LED lamps. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{(Watt_{BASE} - Watt_{EFF})}{1{,}000} \times ISR \times Hours \times (1 + WHF_E)$$

Where:

$Watt_{BASE}$ = Wattage of baseline lamp, 43

$Watt_{EFF}$ = Wattage of efficient lamp, 9

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

Hours = Average hours of use per year, 902

WHF_E = Waste Heat Factor for Energy to account for HVAC interactions with efficient lighting, dependent on location of participant residence

Following this, ADM calculated the peak demand reduction using the following TRM defined equation:

$$\Delta kW = \frac{(Watt_{BASE} - Watt_{EFF})}{1{,}000} \times ISR \times CF \times (1 + WHF_D)$$

Where:

$Watt_{BASE}$ = Wattage of baseline lamp, 43

$Watt_{EFF}$ = Wattage of efficient lamp, 9

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

CF = Summer Peak Coincidence Factor, 0.11

WHF_D = Waste Heat Factor for Demand to account for HVAC interactions with efficient lighting, dependent on location of participant residence

LED Night Light: From the Indiana TRM, the *LED Night Lights* section was used to calculate energy impacts for the installation of LED night lights. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{(Watts_{BASE} - Watts_{LED})}{1{,}000} \times ISR \times HOURS$$

Where:

$Watts_{BASE}$ = Wattage of incandescent night light, 5

$Watts_{LED}$ = Wattage of LED night light, 0.33

ISR = In Service Rate or percentage of distributed units that are installed, as determined through analysis of customer survey response data

HOURS = Average hours of use per year, 2,920

The Indiana TRM attributes no peak kW reduction to the installation of LED night lights.

Low Flow Faucet Aerator: From the Indiana TRM, the *Low Flow Faucet Aerator (Time of Sale or Early Replacement)* section was used to calculate energy impacts for the installation of energy saving kitchen and bathroom faucet aerators. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{ISR \times (GPM_{base} - GPM_{low}) \times MPD \times PH/FH \times DR \times 8.3 \times (T_{mix} - T_{in}) \times 365}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline faucet, 2.44 (kitchen), 1.9 (bathroom)

GPM_{low} = Gallons per Minute of low flow faucet, 1.5 (kitchen) and 1.0 (bathroom)

MPD = Average minutes per day used by each faucet in home, 4.5 (kitchen) and 1.6 (bathroom)

PH = Average number of people per household, as determined through analysis of customer survey response data; 2.64

FH = Average number of faucets per household, 1.0 (kitchen, single family) and 2.04 (bathroom, single family)

DR = Percentage of water flowing down drain, 50% (kitchen), 70% (bathroom)

T_{mix} = Average mixed temperature of water used by faucet, 93°F (kitchen), 86°F (bathroom)

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

Following this, ADM calculated the peak demand reduction using the following Indiana TRM defined equation:

$$\Delta kW = \frac{ISR \times (GPM_{base} - GPM_{low}) \times 60 \times DR \times 8.3 \times (T_{mix} - T_{in}) \times CF}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline faucet, 2.44 (kitchen), 1.9 (bathroom)

GPM_{low} = Gallons per Minute of low flow faucet, 1.5 (kitchen) and 1.0 (bathroom)

DR = Percentage of water flowing down drain, 50% (kitchen), 70% (bathroom)

T_{mix} = Average mixed temperature of water used by faucet, 93°F (kitchen), 86°F (bathroom)

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

CF = Summer Peak Coincidence Factor for measure, 0.0033 (kitchen), 0.0012 (bathroom)

High-efficiency Showerheads: From the Indiana TRM, the *Low-Flow Showerhead (Time of Sale or Early Replacement)* section was used to calculate energy impacts for the installation of high efficiency showerheads. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{ISR \times (GPM_{base} - GPM_{low}) \times MS \times SPD \times PH/SH \times 8.3 \times (T_{smix} - T_{in}) \times 365}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline showerhead, 2.63

GPM_{low} = Gallons per Minute of energy saving showerhead, 1.5

MS = Average number of minutes per shower event, 7.8

SPD = Average number of showers per person per day, 0.6

PH = Average number of people per household, as determined through analysis of customer survey response data; 2.73

SH = Average number of showerheads per household, as determined through analysis of customer survey response data; 1.65

T_{mix} = Average mixed temperature of water used for shower, 101°F

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

Following this, ADM calculated the peak demand reduction using the following Indiana TRM defined equation:

$$\Delta kW = \frac{ISR \times (GPM_{base} - GPM_{low}) \times 60 \times 8.3 \times (T_{mix} - T_{in}) \times CF}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline showerhead, 2.63

GPM_{low} = Gallons per Minute of energy saving showerhead, actual; 1.5

T_{mix} = Assumed temperature of water used for shower, 101°F

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

CF = Summer Peak Coincidence Factor for measure, 0.0023

Digital Thermometer: ADM assigned zero energy impacts to this measure.

6.2.1.3. In-service Rates (ISR)

Ex post annual gross kWh savings and peak kW reductions resulting from the Online Energy Check-up Program were adjusted by applying the estimated measure-level installation rates of kit measures to the calculated measure-level gross energy impacts.

The program relies on participants' installation of the measures, and some of the items may have been uninstalled or perhaps were never installed upon receiving the kit. In the development of measure-level ISRs for the program, ADM surveyed a sample of 248 PY2020 program participants

(173 gas water heater participants and 75 electric water heater participants) who received energy conservation kits through the program.

Table 6-1 below displays the in-service rates developed from the participant survey responses.

Table 6-1 In-Service Rates per OEC Measure by Kit Type

Measure	*ISR*	*ISR with Planned Install in Next 6 Months*
9W LED	73%	91%
1.5 GPM Showerhead	36%	56%
1.5 GPM Kitchen aerator	52%	69%
1.0 GPM Bathroom aerator	42%	64%
0.5W LED night light	36%	42%

6.2.2. Results of Ex Post Gross Savings Estimation

The ex post gross energy and demand impacts resulting from the 2021 Online Energy Check-up Program are reported in the following sections.

6.2.2.1. Ex Post Gross kWh Savings

The estimated annual gross energy savings resulting from the Online Energy Check-up Program are summarized in Table 6-2 below.

Table 6-2 below shows the measure-level and program-level annual gross energy savings of the program. The gross kWh realization rate for the program is 100%.

Table 6-2 Measure-level Annual Gross kWh Savings

Measure Type	*Ex Ante Annual kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*
9w LED	175,430	175,430	154,992	175,939	100%
1.5 GPM Kitchen aerator	129,155	129,155	86,693	129,156	100%
1.0 GPM Bathroom aerator	39,397	39,397	21,727	38,929	99%
1.5 GPM Showerhead	432,110	432,110	255,065	432,118	100%
0.5w LED night light	20,425	20,425	11,578	20,407	100%
Total	796,518	796,518	530,055	796,549	100%

Table 6-3 below displays a breakdown of ex ante and ex post gross kWh savings by kit type. The program-level ex post annual gross kWh savings for electric water heater kits is 676,744 kWh, whereas the program-level ex post annual gross kWh savings for gas water heater kits is 119,805 kWh.

Table 6-3 Annual Gross kWh Savings by Kit Type

Kit Type	*Kit Quantity*	*Ex Ante Annual kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*
Electric	1,017	676,966	676,966	430,886	676,744	100%
Gas	1,320	119,552	119,552	99,169	119,805	100%
Total	2,337	796,518	796,518	530,055	796,549	100%

6.2.2.2. Ex Post Gross kW Reductions

Table 6-4 below shows the measure-level and program-level estimated gross peak demand reduction of the program. The gross kW realization rate for the program is 100%.

Table 6-4 Measure-level Gross kW Reduction

Measure Type	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
9W LED	24.00	24.00	21.20	24.12	101%
1.5 GPM Kitchen aerator	5.91	5.91	3.97	5.90	100%
1.0 GPM Bathroom aerator	3.67	3.67	2.02	3.71	101%
1.5 GPM Showerhead	21.21	21.21	12.52	21.10	99%
0.5W LED night light	-	-	-	-	
Total	54.78	54.78	39.71	54.83	100%

Table 6-5 below displays a breakdown of ex ante and ex post gross demand reduction by kit type. The program-level ex post gross demand reduction for electric water heater kits is 41.21 kW, whereas the program-level ex post gross demand reduction for gas water heater kits is 13.61 kW.

Table 6-5 Gross kW Reduction by Kit Type

Kit Type	*Kit Quantity*	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
Electric	1,017	41.19	41.19	27.70	41.21	100%
Gas	1,320	13.60	13.60	12.01	13.61	100%
Total	2,337	54.78	54.78	39.71	54.83	100%

6.3. Estimation of Ex Post Net Savings

6.3.1. Survey Data Collection

A survey of PY2020 program participants was administered to collect data for use in estimating participant free ridership and spillover savings. The PY2020 results were applied to the PY2021 activity to estimate the net impacts of the PY2021 program.

6.3.2. Methodology for Estimating Ex Post Net Energy Savings

The net savings analysis is used to determine what part of the gross energy savings achieved by program participants can be attributed to the effects of the program. The net savings attributable to program participants are the gross savings less free ridership, plus spillover. ADM estimated free ridership and participant spillover through a survey of program participants. Non-participant spillover was estimated through a survey of non-participants.

6.3.2.1. Methodology for Estimating Free Ridership

The calculation of a free ridership is based on the responses to questions on the following topics:

- Prior experience with similar energy saving equipment;
- Prior planning to purchase energy efficiency measures that were provided through the program; and
- Likelihood of installing similar equipment without the program.

6.3.2.1.1. Prior Experience

The program is designed to encourage customers to try efficiency measures that they previously did not have experience with by providing them at no cost to the customer. As such, a primary indicator of the likelihood that a participant is a free rider, is whether he or she has previously purchased a similar measure. Previous experience is used as an indicator of whether the customer would have coincidently purchased a similar measure on their own.

Prior experience is assessed through the following question:

- FR1: Thinking back to before you completed the Online Energy Check-up, had you purchased and installed any of the following items in your home in the last three years?

Respondents indicating that they had not purchased a given measure in the past three years are considered to have minimal to no prior experience with that measure, meaning that the intervention of the program is likely significantly influential in the energy savings resulting from the measure. These respondents receive an overall free ridership score of 0 for this measure. Otherwise, free ridership is assessed using the following three factors.

6.3.2.1.2. Prior Plans and Intentions

Customers were asked as to any plans they had to purchase any of the measures. This is addressed in the following question:

- FR2: Before you heard of the program, did you have specific plans to purchase any of these kit items that were sent to you? If so, which items did you plan to purchase?

For LEDs, night lights, shower heads, and bathroom faucet aerators, customers that respond that they planned to install the measures are asked the following question:

- FR3: Of the [MEASURE COUNT] [MEAUSRE] provided in the kit, how many did you plan to purchase on your own?

Respondents who indicate that they had plans to purchase the measure on FR2, are given a plans score of 1. The response to FR3 is used to adjust the plans score to reflect the number of items the respondent planned to purchase. For example, if the respondent planned to purchase one of the two items received, the plans score is adjusted to .5.

6.3.2.1.3. Likelihood of Purchasing Measure

Once customers learn of the program, it is possible that this knowledge will sway their decision-making process to install these energy efficient measures in their homes. Additionally, the information and measures provided through the program may help to overcome existing barriers to energy efficiency improvements. To address this, participants were asked the following questions:

- FR4: Using a scale where 0 means "not at all likely" and 10 means "very likely", if you had not completed the Online Energy Check-up or received the energy conservation kit, how likely would you have been to purchase any of the following items on your own within 12 months of when you received them?
- FR5: [IF FR4 > 0] Based on your response, there is some likelihood that you would have purchased some of the kit items in the next 12 months. Given that, we would like to know why you had not already purchased the items on your own. Had you not already purchased [MEASURE] because 1) you didn't want to spend the money, 2) you had not gotten around to it, 3) you didn't know where to purchase [MEASURE], 4) you didn't know enough about [MEASURE], or 6) another reason?

Respondents who indicated in FR4 that they had not already purchased a given measure because they did not want to spend the money, did not know where to purchase the measure, or did not know enough about the measure are considered to have had significant barriers to implementing these energy efficiency improvements and receive a score of 0% free ridership for the measure under this component. Otherwise, the likelihood of purchasing is scored as:

Likelihood of Purchasing = FR4/10

6.3.2.1.4. Free Ridership Scoring

For respondents who demonstrated prior experience with a measure, the scores for the prior plans and likelihood of purchasing the measures were averaged to assign a measure-level free ridership score to each respondent.

6.3.2.2. Methodology for Estimating Spillovers

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents were asked whether they implemented any additional energy saving measures for which they did not receive a program incentive.

Respondents were also asked to provide information on the attributes of the measures implemented for use in estimating the associated energy savings.

Participants who reported implementing on one or more efficiency measures were then asked two questions for use in developing a spillover score:

- SO1: On a scale of 0 to 10, where 0 represents "not at all important" and 10 represents "extremely important", how important was your experience with the Online Energy Check-up in your decision to purchase the items you just mentioned?
- SO2: On a scale of 0 to 10, where 0 represents "not at all likely" and 10 represents "extremely likely" how likely would you have been to make the additional purchases you just mentioned even if you had not completed the Online Energy Check-up?

The response to these questions were used to develop a spillover score as follows:

$$\text{Spillover} = \text{Average}(SO1, 10 - SO2)$$

All of the associated measure savings were considered attributable to the program if the resulting score was greater than 7.

6.3.2.3. Methodology for Estimating Non-Participant Spillover

To estimate PY2021 non-participant spillover, ADM:

- Calculated the PY2019 non-participant spillover ratio as equal to the total PY2019 portfolio non-participant spillover kWh savings divided by the total PY2019 portfolio ex post gross kWh savings.
- Multiplied the PY2019 non-participant spillover ratio by the total PY2020 portfolio ex post gross kWh savings.
- Calculated the PY2020 portfolio non-participant spillover kW by applying a flat load shape to the estimated PY2020 kWh non-participant spillover (NPSO kW = NPSO kWh / 8760).
- Allocated the PY2020 non-participant spillover kWh and kW to the individual programs in proportion to program expenditures.
- Calculated a non-participant rate equal to PY2020 non-participant spillover / PY2020 program gross savings.
- Applied the non-participant rate to PY2021 gross savings.

The total residential estimated PY2021 non-participant spillover was 9,546 kWh and 1.08 kW.[17]

[17] ADM changed the approach to estimating non-participant spillover in the final report from the approach used in the draft report in consultation with OUCC staff. The draft report applied the PY2019 non-participant spillover kWh and kW estimates to the PY2021 programs.

6.3.3. Results of Ex Post Net Energy Savings Estimation

The ex post annual net energy savings and ex post net demand reductions resulting from the 2021 Online Energy Check-up Program are reported in the following sections.

6.3.3.1. Free Ridership Results

Table 6-6 summarizes the number of survey responses and average free-ridership scores by measure for the Residential Online Energy Check-up Program.

Table 6-6 Survey Response Count and Average Free Ridership Score by Measure

Measure	*Survey Response Count*	*Average Free Ridership Score*
9W LED	479	37%
1.5 GPM Kitchen aerator	153	2%
1.0 GPM Bathroom aerator	153	4%
1.5 GPM Showerhead	153	7%
0.5w LED night light	326	6%

*Note due to a survey programming error, not all of the survey respondents were asked the free ridership questions. The counts shown in the table reflect the number of respondents that complete the free ridership questions.

6.3.3.2. Participant Spillover Results

Eight customers reported installing spillover measures. The spillover measures installed were energy efficient light bulbs and an ENERGY STAR washing machine. Based on deemed savings analysis of these spillover measures, ADM determined participant spillover energy savings and peak demand reduction for the Online Energy Check-up Program to be 12,387 kWh and 1.28 kW, respectively.

6.3.3.3. Non-Participant Spillover Results

The non-participant spillover assigned to the Online Energy Checkup Program was 9.546 kWh and 1.08 kW.

6.3.3.4. Ex Post Net kWh and kW Savings

Table 6-7 summarizes the net ex post kWh and kW savings of the Residential Online Energy Check-up Program. The annual net savings totaled 719,155 kWh and the net-to-gross ratio is 90%.

Table 6-7 Program-Level Net kWh and kW Savings

Category	*kWh*	*kW*
Ex Ante Gross Savings	796,518	54.78
Gross Audited Savings	796,518	54.78
Gross Verified Savings	530,055	39.71
Ex Post Gross Savings	796,549	54.83
Gross Realization Rate	100%	100%
Ex Post Free Ridership	99,327	10.55
Ex Post Non-Participant Spillover	9,546	1.08
Ex Post Participant Spillover	12,387	1.28
Ex Post Net Savings	719,155	46.64
Net-to-Gross Ratio	90%	85%
Ex Post Net Lifetime Savings	6,123,969	n/a

Table 6-8 below displays a breakdown of the ex post annual net and ex post net lifetime kWh savings by kit type. The program-level ex post net kWh savings for electric water heater kits is 633,898 kWh, and the program-level ex post net kWh savings for gas water heater kits is 85,257 kWh.

Table 6-8 Annual Net kWh Savings by Kit Type

Measure	*Ex Ante Gross kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*	*Ex Post Net Lifetime kWh Savings*
Electric	676,966	676,966	430,886	676,744	100%	633,898	94%	5,933,714
Gas	119,552	119,552	99,169	119,805	100%	85,257	71%	190,255
Total	796,518	796,518	530,055	796,549	100%	719,155	90%	6,123,969

Table 6-9 below displays a breakdown of the ex post net kW demand reduction by kit type. The program-level ex post net kW demand reduction for electric water heater kits is 37.45 kW, and the program-level ex post net kW demand reduction for gas water heater kits is 9.18 kW.

Table 6-9 Net kW Reduction by Kit Type

Measure	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Electric	41.19	41.19	27.70	41.21	100%	37.45	91%
Gas	13.60	13.60	12.01	13.61	100%	9.18	67%
Total	54.78	54.78	39.71	54.83	100%	46.64	85%

7. Schools Energy Education

This chapter presents the results of both the impact and process evaluations of the 2021 Schools Energy Education Program that Indiana Michigan Power (I&M) offered to its residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation were to:

- Assess gross and net energy (kWh) savings and peak demand (kW) reductions resulting from participation in the program during the program year; and
- Provide recommendations for program improvement as appropriate.

7.1. Program Description

The Schools Energy Education Program (SEE) is an educational offering targeting 5th grade elementary school students, their parents/guardians, and their teachers, in the I&M service territory. The program provides schoolteachers with an energy education curriculum as well as energy conservation kits to distribute to their students. The energy conservation kits contain a variety of low-cost energy efficiency measures, as follows:

- Four (4) 9W LEDs;
- One (1) .5W LED night light;
- One (1) 1.5 GPM Kitchen faucet aerator;
- Two (2) 1.0 GPM Bathroom faucet aerator;
- Two (2) 1.5 GPM High-efficiency showerhead; and
- One (1) Filter Tone Alarm.

Additionally, the energy conservation kits include informational literature detailing energy-saving tips, measure installation instructions, and information on I&M efficiency programs. The kits also include supplies that students can use to test their home energy use and make minor improvements to the home's energy management, including a flow rate test bag, and a digital thermometer for testing hot water and fridge/freezer temperature.

The program is designed to not only result in the installation of the low-cost energy conservation kit measures, but also to improve student and parent/guardian awareness of energy-saving behaviors and equipment, as well as to incorporate energy education into the elementary school curriculum.

7.2. Estimation of Ex Post Gross Savings

7.2.1. Methodology for Estimating Ex Post Gross Energy Savings

7.2.1.1. Review of Documentation

The first aspect of conducting measurements of program activity was to verify that the tracking data report of participants and measures is accurate. To this end, ADM reviewed the program data to verify that the fields required for performing the evaluation were tracked and populated (i.e., the data was not missing) and that the values were reasonable. ADM took several steps in verifying the number of kits distributed and kit measures installed, which consisted of the following:

- Validating program tracking data provided by the implementation contractor, the program implementation contractor, by checking for duplicate or erroneous entries;
- Examining the parent/guardian survey data collected by the implementation contractor during 2021 to verify that customers listed in the program tracking database did indeed participate and that the number of measures reported in the kit were received.

ADM also performed a review of the deemed savings estimates used to calculate ex ante energy impacts for installed kit measures. This evaluation activity served to verify that the ex ante calculations were consistent with algorithms and values specified in the Indiana TRM.

7.2.1.1.1. Number of Kits Mailed

The total number of kits distributed to instructors and students during PY2021 was determined by (1) reviewing the program tracking system and related documentation from I&M and (2) examining the parent/guardian survey data collected by the program implementation contractor.

Based on the review of the main program tracking system and all related documentation from I&M and the implementation contractor, ADM determined the total number of kits distributed to students during PY2021 was 998.

7.2.1.2. Procedures for Estimating Measure-Level Gross Energy Savings

Gross energy savings and demand reductions for the Schools Energy Education Program were calculated (by kit measure) using the appropriate methodologies and deemed savings algorithms specified in the Indiana TRM. ADM reviewed the TRM and assessed the appropriateness of the engineering algorithms.

The following sections describe the specific algorithms and inputs used to calculate energy impacts for each measure in the kit.

LED Lighting: From the Indiana TRM, the *Residential ENERGY STAR Lighting (CFL and LED)* section was used to calculate energy impacts for the installation of LED lamps. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{(Watt_{BASE} - Watt_{EFF})}{1{,}000} \times ISR \times Hours \times (1 + WHF_E)$$

Where:

$Watt_{BASE}$ = Wattage of baseline lamp, 43

$Watt_{EFF}$ = Wattage of efficient lamp, 9

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

Hours = Average hours of use per year, 1,135

WHF_E = Waste Heat Factor for Energy to account for HVAC interactions with efficient lighting, dependent on location of the schools whose teachers received program kits

Following this, ADM calculated the peak demand reduction using the following TRM defined equation:

$$\Delta kW = \frac{(Watt_{BASE} - Watt_{LED})}{1{,}000} \times ISR \times CF \times (1 + WHF_D)$$

Where:

$Watt_{BASE}$ = Wattage of baseline lamp, 43

$Watt_{EFF}$ = Wattage of efficient lamp, 9

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

CF = Summer Peak Coincidence Factor for measure, 0.11

WHF_D = Waste Heat Factor for Demand to account for HVAC interactions with efficient lighting, dependent on location of the schools whose teachers received program kits

LED Night Light: From the Indiana TRM, the *LED Night Lights* section was used to calculate energy impacts for the installation of LED night lights. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{(Watts_{BASE} - Watts_{LED})}{1{,}000} \times ISR \times HOURS$$

Where:

$Watts_{BASE}$ = Wattage of incandescent night light, 5

$Watts_{EFF}$ = Wattage of LED night light, 0.33

ISR = In Service Rate or percentage of distributed units that are installed, as determined through analysis of customer survey response data

HOURS = Average hours of use per year, 2,920

The Indiana TRM attributes no peak kW reduction to the installation of LED night lights.

Low Flow Faucet Aerator: From the Indiana TRM, the *Low Flow Faucet Aerator (Time of Sale or Early Replacement)* section was used to calculate energy impacts for the installation of energy saving kitchen and bathroom faucet aerators. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{ISR \times (GPM_{base} - GPM_{low}) \times MPD \times PH/FH \times DR \times 8.3 \times (T_{mix} - T_{in}) \times 365}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline faucet, 2.44 (kitchen), 1.9 (bathroom)

GPM_{low} = Gallons per Minute of low flow faucet, 1.5 (kitchen) and 1.0 (bathroom)

MPD = Average minutes per day used by each faucet in home, 4.5 (kitchen) and 1.6 (bathroom)

PH = Average number of people per household, as determined through analysis of customer survey response data; 2.64

FH = Average number of faucets per household, 1.0 (kitchen, single family) and 2.04 (bathroom, single family)

DR = Percentage of water flowing down drain, 50% (kitchen), 70% (bathroom)

T_{mix} = Average mixed temperature of water used by faucet, 93°F (kitchen), 86°F (bathroom)

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

Following this, ADM calculated the peak demand reduction using the following Indiana TRM defined equation:

$$\Delta kW = \frac{ISR \times (GPM_{base} - GPM_{low}) \times 60 \times DR \times 8.3 \times (T_{mix} - T_{in}) \times CF}{RE \times 3{,}412}$$

Where:

ISR = In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline faucet, 2.44 (kitchen), 1.9 (bathroom)

GPM_{low} = Gallons per Minute of low flow faucet, 1.5 (kitchen) and 1.0 (bathroom)

DR = Percentage of water flowing down drain, 50% (kitchen), 70% (bathroom)

T_{mix} = Average mixed temperature of water used by faucet, 93°F (kitchen), 86°F (bathroom)

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of participant residence

RE = Recovery efficiency of electric hot water heater, 0.98

CF = Summer Peak Coincidence Factor for measure, 0.0033 (kitchen), 0.0012 (bathroom)

High-efficiency Showerhead: From the Indiana TRM, the *Low-Flow Showerhead (Time of Sale or Early Replacement)* section was used to calculate energy impacts for the installation of high-efficiency showerheads. The following equation was used to calculate the annual kWh energy savings:

$$\Delta kWh = \frac{ISR \times (GPM_{base} - GPM_{low}) \times MS \times SPD \times PH/SH \times 8.3 \times (T_{smix} - T_{in}) \times 365}{RE \times 3{,}412}$$

Where:

ISR = In-Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data

GPM_{base} = Gallons per Minute of baseline showerhead, 2.63

GPM_{low} = Gallons per Minute of energy saving showerhead, 1.5

MS = Average minutes per shower, 7.8

SPD = Average showers per day, 0.6

PH = Average number of people per household, as determined through analysis of customer survey response data; 2.73

SH = Average number of showerheads per household, as determined through analysis of customer survey response data; 1.65

T_{mix} = Average mixed temperature of water used for shower, 101°F

T_{in} = Assumed temperature of water entering house, dependent on climate, dependent on location of the schools whose teachers received program kits

RE = Recovery efficiency of electric hot water heater, 0.98

Following this, ADM calculated the peak demand reduction using the following Indiana TRM defined equation:

$$\Delta kW = \frac{ISR \times (GPM_{base} - GPM_{low}) \times 60 \times 8.3 \times (T_{mix} - T_{in}) \times CF}{RE \times 3{,}412}$$

Where:

ISR	= In Service Rate or percentage of units that are installed, as determined through analysis of customer survey response data
GPM_{base}	= Gallons per Minute of baseline showerhead, 2.63
GPM_{low}	= Gallons per Minute of energy saving showerhead, 1.5
T_{mix}	= Assumed temperature of water used for shower, 101°F
T_{in}	= Assumed temperature of water entering house, dependent on climate, dependent on location of the schools whose teachers received program kits
RE	= Recovery efficiency of electric hot water heater, 0.98
CF	= Summer Peak Coincidence Factor for measure, 0.0023

Filter Tone Alarm: The Indiana TRM does not dedicate a savings section to filter tone alarms. ADM referenced the methodology used in the 2015 DSM Portfolio Report of the programs offered by Vectren Energy Delivery.[18]

The algorithms provided to ADM that were used to estimate the annual energy impacts for the installation of filter tone alarms are as follows:

$$\Delta kWh_{CentralAirConditioner} = FLH_{cool} \times BtuH_{CAC} \times (1/SEER)/1000 \times EF_{elec}$$

$$\Delta kWh_{HeatPump} = FLH_{cool} \times BtuH_{CAC} \times (1/SEER)/1000 + FLH_{heat} \times BtuH_{HP} \times (1/HSPF)/1000 \times EF_{elec}$$

$$\Delta kW_{CentralAirConditioner} = BtuH_{CAC} \times (1/EER)/1000 \times EF_{elec} \times CF$$

$$\Delta kW_{HeatPump} = BtuH_{HP} \times (1/EER)/1000 \times EF_{elec} \times CF$$

Where:

EF_{gas}	= Efficiency savings for natural gas furnace
SEER	= Seasonal energy efficiency ratio
EER	= Energy efficiency ratio
$BtuH_{CAC}$	= Size of central AC units
HSPF	= Heating season performance factor

[18]https://iurc.portal.in.gov/_entity/sharepointdocumentlocation/7e8a84a2-8384-e611-8107-1458d04eabe0/bb9c6bba-fd52-45ad-8e64-a444aef13c39?file=skatterjohn_vectren%20cause%20no_5_23_201610-14-05am.pdf

$BtuH_{HP}$ = Size of heat pump

CF = Summer peak coincidence factor for heat pump/central AC

FLH_{cool} = Full load cooling hours

FLH_{heat} = Full load heating hours

ADM previously reviewed the input assumptions used by the Statewide Core evaluation for this measure and found most of the assumptions to be reasonable. However, ADM found that the EF_{elec} value of 0.035 was only applicable to units with poorly maintained filters, and the original study that developed this value applied a 1:1 ratio of properly maintained to poorly maintained appliances. This results in an average EF_{elec} of 0.0185 for a whole population, rather than the 0.035 value assumed for the Statewide Core evaluation. ADM applied this adjusted EF_{elec} to the savings algorithm for this measure, resulting in 19.11 kWh, and 0.053 kW per filter tone alarm.

7.2.1.3. In-service Rates (ISR)

Ex post annual kWh savings and kW demand reductions resulting from the Schools Energy Education Program were calculated by applying the estimated measure-level installation rates of kit measures to the calculated measure-level gross energy impacts.

The program relies on direct installation by the participant, and some of the items may have been uninstalled or perhaps were never installed by students and their parents/guardians upon receiving the kit. In the development of measure-level ISRs for the program, ADM referenced the collected survey data provided by the implementation contractor. These surveys were distributed by students' teachers for students and their parents/guardians to fill out after the kit measures had been installed. The ISR estimates were based on a sample of 448 participating parents and guardians whose children received the energy conservation kits through the program.

Table 7-1 below displays the installation rates developed from the collected survey data.

Table 7-1 Installation Rates per SEE Measure

Measure	*Installation Rate*	*%ElecWH Adjustment*	*ISR × %ElecWH Adjustment*
1.5 GPM Showerhead	48%	45%	22%
1.5 GPM Kitchen aerator	45%	45%	20%
1.5 GPM Bathroomaerator	41%	45%	18%
Filter Alarm	40%	100%	40%
0.5W LED night light	84%	100%	84%
9W LED	72%	100%	72%

7.2.2. Results of Ex Post Gross Savings Estimation

The ex post gross energy and demand impacts resulting from the 2021 Schools Energy Education Program are reported in the following sections.

7.2.2.1. Ex Post Gross kWh Savings

The estimated annual gross energy savings resulting from the Schools Energy Education Program are summarized in Table 7-2 below. The gross kWh realization rate for the program is 94%.

Table 7-2 Program-Level Annual Gross kWh Savings

Ex Ante Gross kWh Savings	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*
348,202	348,202	135,264	328,377	94%

Table 7-3 below shows the measure-level estimated annual gross energy savings resulting from the program. ADM calculated ex post energy impacts for each kit measure using deemed values and algorithms from the Indiana TRM and then factored the resulting gross energy impacts by the estimated measure-level installation rates. For faucet aerators and high-efficiency showerheads, gross energy impacts were also adjusted by the estimated percentage of participants with an electric hot water heater in their homes.[19]

Table 7-3 Measure-level Annual Gross kWh Savings

Measure Type	*Ex Ante Annual kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*
9W LED	105,213	105,213	75,281	102,138	97%
0.5W LED night light	11,290	11,290	9,478	11,425	101%
1.5 GPM Showerhead	168,601	168,601	36,406	155,121	92%
1.5 GPM Kitchen aerator	41,916	41,916	8,552	38,525	92%
1.0 GPM Bathroom aerator	13,616	13,616	2,498	12,610	93%
1 Filter Tone Alarm	7,567	7,567	3,050	8,559	113%
Total	348,202	348,202	135,264	328,377	94%

7.2.2.2. Ex Post Gross kW Reductions

The estimated gross demand reduction resulting from the Schools Energy Education Program is summarized in Table 7-4 below. The gross kW realization rate for the program is 182%.

[19] ADM referenced the parent/guardian survey data collected by the implementation contractor to estimate the percentage of program participants in Indiana that have an electric hot water heater in their homes at 45% - down from 52% in PY2019.

Table 7-4 Program-Level Gross kW Reduction

Ex Ante Gross kW Savings	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
23.65	23.65	10.97	43.06	182%

Table 7-5 below shows the measure-level estimated gross demand reduction resulting from the program. The relatively high kW gross realization rate is accounted for by the 3062% kW gross realization rate of filter tone alarms.

Table 7-5 Measure-Level Gross kW Reduction

Measure Type	*Ex Ante Gross kW Savings*	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
9W LED	11.60	11.60	8.30	11.10	96%
0.5W LED night light	0.00	0.00	0.00	0.00	-
1.5 GPM Showerhead	8.20	8.20	1.77	7.57	92%
1.5 GPM Kitchen aerator	1.90	1.90	0.39	1.76	93%
1.0 GPM Bathroom aerator	1.25	1.25	0.23	1.20	96%
1 Filter Tone Alarm	0.70	0.70	0.28	21.43	3062%
Total	23.65	23.65	10.97	43.06	182%

7.3. Estimation of Ex Post Net Savings

7.3.1. Methodology for Estimating Ex Post Net Energy Savings

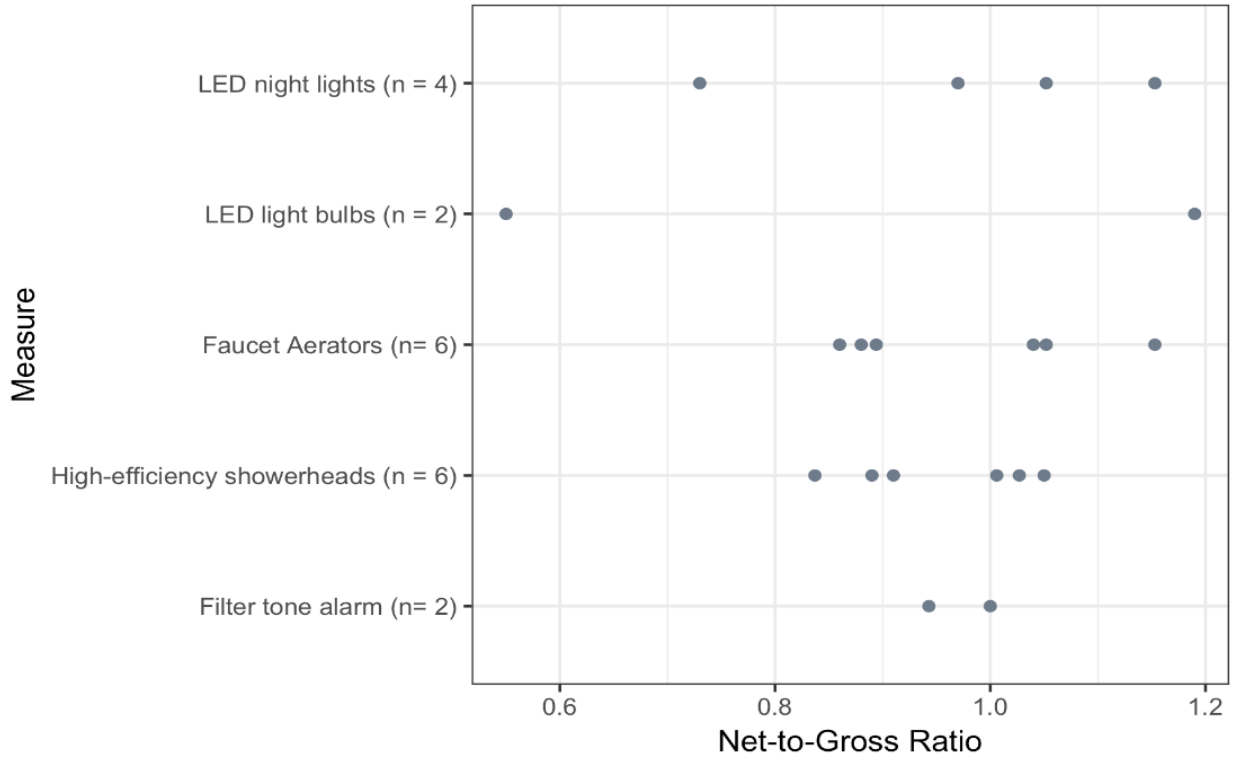
ADM estimated net savings for the I&M Schools Energy Education Program by performing a literature review of secondary net-to-gross values for other similar energy efficient school kit programs. Table 7-6 summarizes the studies reviewed. ADM reviewed the 2016 I&M evaluation results as well as five other evaluations of programs operating in the South and Midwest.

Table 7-6 Summary of Evaluations Reviewed

Utility	*State*	*Year*
Ameren Missouri	Missouri	2016
Duke Energy	North and South Carolina	2015
ComEd	Illinois	2017
I&M	Indiana	2016
Duke	Kentucky	2015
Energy New Orleans	Louisiana	2015

Table 7-7 summarizes the findings of the review of program measure net-to-gross ratios. As shown, the findings were reasonably consistent across studies for most measures. LED light bulbs were the exception. For this measure, two net-to-gross ratios were found: 55% and 119%. The latter value was the finding of the 2016 I&M evaluation. It is worth noting that this estimate was based on a small sample size due to the limited availability of contact information and the response rate.

Table 7-7 Distribution of Net-to-Gross Ratios by Program Measure



ADM applied the average net-to-gross ratio found across studies for use in estimating the net savings of the I&M Schools Energy Education Program. Table 7-8 presents the measure-level net-to-gross ratios referenced.

Table 7-8 Measure-Level Net-to-Gross Ratios (Exclusive of Non-Participant Spillover)

Program Measure	*Number of Studies*	*Average Value*
LED light bulbs	2	87%
LED night lights	4	98%
Faucet Aerators	6	98%
High-efficiency showerheads	6	95%
Filter tone alarm	2	97%

7.3.1.1. Methodology for Estimating Non-Participant Spillover

To estimate PY2021 non-participant spillover, ADM:

- Calculated the PY2019 non-participant spillover ratio as equal to the total PY2019 portfolio non-participant spillover kWh savings divided by the total PY2019 portfolio ex post gross kWh savings.
- Multiplied the PY2019 non-participant spillover ratio by the total PY2020 portfolio ex post gross kWh savings.
- Calculated the PY2020 portfolio non-participant spillover kW by applying a flat load shape to the estimated PY2020 kWh non-participant spillover (NPSO kW = NPSO kWh / 8760).

- Allocated the PY2020 non-participant spillover kWh and kW to the individual programs in proportion to program expenditures.
- Calculated a non-participant rate equal to PY2020 non-participant spillover / PY2020 program gross savings.
- Applied the non-participant rate to PY2021 gross savings.

The total residential estimated PY2021 non-participant spillover was 6,457 kWh and 0.73 kW.

7.3.2. Results of Ex Post Net Energy Savings Estimation

The ex post annual net energy savings and ex post net demand reductions resulting from the 2021 Schools Energy Education Program are reported in the following sections.

7.3.2.1. Non-Participant Spillover Results

The non-participant spillover assigned to the Schools Energy Education Program was 6,457 kWh and .73 kW.

7.3.2.2. Ex Post Net kWh and kW Savings

Table 7-9 summarizes the program-level kWh and kW savings. The net savings value is based on the application of the researched net-to-gross ratios, plus non-participant spillover. The annual net energy savings totaled 312,770 kWh, and the net-to-gross ratio is 95%.

Table 7-9 Program-Level kWh and kW Savings

Category	*kWh*	*kW*
Ex Ante Gross Savings	348,202	23.65
Gross Audited Savings	348,202	23.65
Gross Verified Savings	135,264	10.97
Ex Post Gross Savings	328,377	43.06
Gross Realization Rate	94%	182%
Ex Post Free Ridership	22,063	2.47
Ex Post Non-Participant Spillover	6,457	0.73
Ex Post Participant Spillover	0	0.00
Ex Post Net Savings	312,770	41.33
Net-to-Gross Ratio	95%	96%
Ex Post Net Lifetime Savings	2,355,040	n/a

Table 7-10 summarizes the net ex post measure-level kWh savings of the Schools Energy Education Program.

Table 7-10 Measure-level Annual Net kWh Savings

Measure	*Ex Ante Annual kWh Savings*	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*	*Ex Post Net Lifetime kWh Savings*
9W LED	105,213	105,213	75,281	102,138	97%	90,869	89%	181,737
0.5W LED night light	11,290	11,290	9,478	11,425	101%	11,378	100%	34,134
1.5 GPM Showerhead	168,601	168,601	36,406	155,121	92%	150,932	97%	1,509,318
1.5 GPM Kitchen aerator	41,916	41,916	8,552	38,525	92%	38,505	100%	385,054
1.0 GPM Bathroom aerator	13,616	13,616	2,498	12,610	93%	12,604	100%	126,037
1 Filter Tone Alarm	7,567	7,567	3,050	8,559	113%	8,483	99%	118,760
Total	348,202	348,202	135,264	328,377	94%	312,770	95%	2,355,040

8. Work Direct Install

This chapter presents the results of both the impact and process evaluations of the Work Direct Install Program that Indiana Michigan Power (I&M) offered to its non-residential customers during the period of January 2021 through February 2021.

The objectives of the evaluation are to:

- Assess gross and net energy (kWh) savings and peak demand (kW) reductions that resulted from participation in the program during the program year;
- Document sources of program awareness among participants;
- Assess satisfaction among customers that participated; and
- Provide recommendations for program improvement as appropriate.

8.1. Program Description

The Work Direct Install Program targets energy efficiency improvements in small commercial/retail establishments, food service facilities and grocery store/supermarkets with demand of less than 150 kW by providing onsite energy assessments and incentives for energy efficient lighting and refrigeration equipment. The program measures are installed by a program qualified trade ally.

Work Direct Install incentives are designed to cover up to 70% of the installed measure cost and are payable to the trade ally or the customer. Incentives are provided on a per unit of equipment basis. Participating customers may also receive Work Prescriptive or Work Custom incentives.

Incentives are capped at $3,000 per site and $21,000 per company, across all programs.

8.2. Estimation of Ex Post Gross Savings

ADM applied the overall gross realization rate developed for the evaluation of the PY2020 program to the PY2021 activity.

8.2.1. Results of Ex Post Gross Savings Estimation

8.2.1.1. Ex Post Gross kWh Savings

The realized gross kWh savings of the Work Direct Install Program for the sampled projects are summarized in Table 8-1.

Table 8-1 Ex Ante kWh and Ex Post kWh of Sampled Projects

Ex Ante Gross kWh Savings	*Ex Post Gross kWh Savings*	*Gross Realization Rate*
292,490	272,412	93%

The ex post annual gross kWh savings for the Work Direct Install Program during the period January 2021 through February 2021 are presented in Table 8-2.

Table 8-2 Ex Post Annual Gross kWh

Ex Ante Gross kWh Savings	*Gross Audited kWh Savings*	*Gross Verified kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*
215,811	215,812	215,812	205,560	95%

8.2.1.2. Ex Post Gross kW Reductions

The ex post peak kW reduction for the Work Direct Install Program during the period January 2021 through February 2021 are presented in Table 8-3.

Table 8-3 Ex Post Peak kW

Ex Ante Gross kW Savings	*Gross Audited kW Savings*	*Gross Verified kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*
27.49	27.49	27.49	13.40	49%

8.3. Estimation of Ex Post Net Savings

8.3.1. Methodology for Estimating Ex Post Net Energy Savings

ADM applied the PY2020 net savings factors to estimate the PY2020 net savings.

8.3.2. Results of Ex Post Net Energy Savings Estimation

Table 8-4 summarizes the net ex post kWh savings and the net ex post kW demand reduction of the Work Direct Install Program.

Table 8-4 Ex Post Net kWh and kW Savings

Category	*kWh*	*kW*
Ex Ante Gross Savings	215,811	27.49
Gross Audited Savings	215,812	27.49
Gross Verified Savings	215,812	27.49
Ex Post Gross Savings	205,560	13.40
Gross Realization Rate	95%	49%
Ex Post Free Ridership	10,512	0.58
Ex Post Non-Participant Spillover	0	0.00
Ex Post Participant Spillover	0	0.00
Ex Post Net Savings	195,048	12.82
Net-to-Gross Ratio	95%	96%

9. Cost Effectiveness Evaluation

The following cost effectiveness tests were performed for each program: Total Resource Cost (TRC) test, Utility Cost Test (UCT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The benefits and costs associated with each test are defined in Table 9-1.

Table 9-1 Summary of Benefits and Costs Included in each Cost Effectiveness Test

Variable	*Definition*	*PCT*		*UCT*		*RIM*		*TRC*	
		Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	Incentives paid to customers.	✓			✓		✓		
Program Installation Costs	Installation costs paid by program.				✓		✓		✓
Bill Savings / Lost Revenue	Reduction in electricity costs faced by customers as a result of implementation of program measures. Equal to revenue lost to the utility.	✓					✓		
Avoided Energy Costs	Energy-related costs avoided by utility.			✓		✓		✓	
Avoided Capacity Costs	Capacity-related costs avoided by utility, including T&D.			✓		✓		✓	
Incremental Costs	Incremental costs associated with measure implementation, as compared with what would have been done in absence of program.		✓						✓
Program Overhead Costs	Program costs other than incentive or installation costs.				✓		✓		✓

9.1. PY2021 Cost Effectiveness Evaluation

Table 9-2 through Table 9-8 summarize key financial benefit and cost inputs for the various tests along as well as the test results for each residential program.

Table 9-2 Home Appliance Recycling Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 25,400			$ 25,400		$ 25,400		
Program Installation Costs				$ 36,643		$ 36,643		$ 36,643
Bill Savings (NPV)	$ 115,366							
Lost Revenue (NPV)						$ 141,380		
Avoided Energy Costs (NPV)			$ 85,835		$ 85,835		$ 85,835	
Avoided Capacity Costs (NPV)			$ 21,899		$ 21,899		$ 21,899	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 21,430		$ 21,430		$ 21,430
Total Benefits	$ 140,766		$ 107,735		$ 107,735		$ 107,735	
Total Costs	$ -		$ 83,473		$ 224,852		$ 58,073	
Test Score	N/A		1.29		0.48		1.86	

Table 9-3 Home Energy Products - Lighting Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 331,420			$ 331,420		$ 331,420		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 501,146							
Lost Revenue (NPV)						$ 543,192		
Avoided Energy Costs (NPV)			$ 303,049		$ 303,049		$ 303,049	
Avoided Capacity Costs (NPV)			$ 91,087		$ 91,087		$ 91,087	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ 180,225						$ 180,225
Program Overhead Costs				$ 201,857		$ 201,857		$ 201,857
Total Benefits	$ 832,566		$ 394,136		$ 394,136		$ 394,136	
Total Costs	$ 180,225		$ 533,277		$ 1,076,469		$ 382,083	
Test Score	4.62		0.74		0.37		1.03	

Table 9-4 Low Income Home Energy Reports Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ -			$ -		$ -		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 4,416							
Lost Revenue (NPV)						$ 4,416		
Avoided Energy Costs (NPV)			$ 2,266		$ 2,266		$ 2,266	
Avoided Capacity Costs (NPV)			$ 659		$ 659		$ 659	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 2,933		$ 2,933		$ 2,933
Total Benefits	$ 4,416		$ 2,925		$ 2,925		$ 2,925	
Total Costs	$ -		$ 2,933		$ 7,349		$ 2,933	
Test Score	N/A		1.00		0.40		1.00	

Table 9-5 Home Energy Engagement Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ -			$ -		$ -		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 673,077							
Lost Revenue (NPV)						$ 770,416		
Avoided Energy Costs (NPV)			$ 445,877		$ 445,877		$ 445,877	
Avoided Capacity Costs (NPV)			$ 80,043		$ 80,043		$ 80,043	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 268,749		$ 268,749		$ 268,749
Total Benefits	$ 673,077		$ 525,920		$ 525,920		$ 525,920	
Total Costs	$ -		$ 268,749		$ 1,039,165		$ 268,749	
Test Score	N/A		1.96		0.51		1.96	

Table 9-6 Home Weatherproofing Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ -			$ -		$ -		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ -							
Lost Revenue (NPV)						$ -		
Avoided Energy Costs (NPV)			$ -		$ -		$ -	
Avoided Capacity Costs (NPV)			$ -		$ -		$ -	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 30,782		$ 30,782		$ 30,782
Total Benefits	$ -		$ -		$ -		$ -	
Total Costs	$ -		$ 30,782		$ 30,782		$ 30,782	
Test Score	N/A		0.00		0.00		0.00	

Table 9-7 Schools Energy Education Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ -			$ -		$ -		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 140,314							
Lost Revenue (NPV)						$ 176,705		
Avoided Energy Costs (NPV)			$ 109,587		$ 109,587		$ 109,587	
Avoided Capacity Costs (NPV)			$ 38,507		$ 38,507		$ 38,507	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 73,896		$ 73,896		$ 73,896
Total Benefits	$ 140,314		$ 148,094		$ 148,094		$ 148,094	
Total Costs	$ -		$ 73,896		$ 250,601		$ 73,896	
Test Score	N/A		2.00		0.59		2.00	

Table 9-8 Work Direct Install Program Cost Test Inputs and Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost
Incentives	$ 23,730			$ 23,730		$ 23,730		
Program Installation Costs				$ 6,797		$ 6,797		$ 6,797
Bill Savings (NPV)	$ 118,299							
Lost Revenue (NPV)						$ 163,252		
Avoided Energy Costs (NPV)			$ 109,069		$ 109,069		$ 109,069	
Avoided Capacity Costs (NPV)			$ 14,534		$ 14,534		$ 14,534	
Avoided T&D Costs (NPV)			$ -		$ -		$ -	
Incremental Costs		$ 39,032						$ 39,032
Program Overhead Costs				$ 13,271		$ 13,271		$ 13,271
Total Benefits	$ 142,029		$ 123,603		$ 123,603		$ 123,603	
Total Costs	$ 39,032		$ 43,798		$ 207,049		$ 59,100	
Test Score	3.64		2.82		0.60		2.09	