PY2019 Interim Framework Evaluation Report

Home Assistance Program

October 29, 2020

SUBMITTED TO:
Independent Electricity System Operator

SUBMITTED BY:
NMR Group, Inc. in partnership with Nexant, Inc.

NMR Group, Inc.

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Acknowledgments

The evaluation team would like to thank the hundreds of participants that supported the evaluation team's surveys. Their cooperation with the evaluation team's efforts has produced high quality data that will serve Ontario conservation efforts for years to come.

The evaluation team would also like to thank all the staff of the program delivery vendor, auditors and contractors that the evaluation team interviewed. Their insights have been invaluable to the evaluation team's efforts to improve the Conservation Programs.

Finally, the evaluation team would like to thank Alice Herrera and Nam Nguyen at the Independent Electricity System Operator (IESO) for their assistance in coordinating this evaluation effort. With their support and guidance, the evaluation team was able to complete their activities as efficiently and successfully as possible.

Acronyms

Acronym	Definition
AC	Air Conditioner
AFT	Affordability Fund Trust
AV	Audiovisual
CDM	Conservation and Demand Management
CE Tool	Cost-Effectiveness Tool
CEF	Combined Energy Factor
CF	Correction Factor
CFF	Conservation First Framework
CI	Confidence Interval
DHW	Demand Hot Water
DSM	Demand Side Management
EM&V	Evaluated Measurement and Verification
ES QPL	ENERGY STAR Qualified Product List
EUL	Effective Useful Life
FAST	Field Audit Support Tool
FTE	Full-time equivalent
HAP	Home Assistance Program
HOU	Hours of Use
IDI	In-depth Interview
IESO	Independent Electricity System Operator
IF	Interim Framework

Acronym	Definition
IO	Input-Output
ISR	In-Service Rate
kW	Kilowatt
kWh	Kilowatt-hours
LDC	Local Distribution Company
LEAP	Low-Income Energy Assistance Program
LED	Light-emitting Diode
LPM	Litres Per Minute
LUEC	Levelized Unit Electricity Costs
MAL	Measures and Assumptions List
MW	Megawatt
MWh	Megawatt-hour
NPV	Net Present Value
NTGR	Net-to-Gross Ratio
OESP	Ontario Electricity Support Program
PAC	Program Administrator Cost Test
PIA	Prescriptive Input Assumption
PY	Program Year
RR	Realization Rate
StatCan	Statistics Canada
SUPC	Supply and Use Product Classification
SUT	Supply and Use Table
TRC	Total Resource Cost Test

Acronym	Definition
TRM	Technical Reference Manual

1. Executive Summary

NMR Group, Inc. (NMR), in partnership with subcontractor, Nexant, Inc., (collectively, "the NMR team") and under contract to the Independent Electricity System Operator (the IESO) performed an evaluation of the Home Assistance Program (HAP) for Program Year 2019 (PY2019).

1.1 Program Description

HAP is a centrally delivered program administered by the IESO. The program provides eligible low-income residential customers with the opportunity to install energy-efficient solutions that will help them reduce their energy consumption and costs and improve comfort. Income-qualified homeowners and tenants in both non-profit and private rental housing are eligible, as are building owners and managers of non-profit housing. The program offers free in-home audits, health and safety upgrades, and energy-efficiency measures at no cost to participants. Measures installed during the home audit or as part of a follow-up visit may include ENERGY STAR® light-emitting diodes (LEDs), smart power strips, high-efficiency showerheads, aerators, drying racks, energy-efficient refrigerators, window air conditioners, attic/basement insulation, and weather-stripping around doors and windows.

1.2 Evaluation Goals and Objectives

The HAP evaluation sought to address several research goals and objectives in PY2019, including the following:

- Verifying energy and demand savings;
- Estimating realization rates;
- Performing a limited process evaluation; and
- Analyzing job impacts for the program.

1.3 Results

The impact evaluation results for the HAP program are displayed in ***Table 1.1***. The overall realization rate (RR) for PY2019 is 86% for energy savings and 21% for demand savings. The overall program results are compared to previous program years in ***Section 4.3***.

Table 1.1 | HAP PY2019 Results

Metric		
Participation	Projects	9,988
	Homes	9,968
Gross Verified Savings	MWh	8647
	MW	0.9
Gross Realization Rate	MWh	0.86
	MW	0.21
Net Verified Annual Savings (First Year)	MWh	8,647
	MW	0.9
Net Verified Annual Savings (PY2022)	MWh	8,647
	MW	0.9
Net-to-Gross Ratio (NTGR)	--	1

1.4 Key Findings and Recommendations

The following section summarizes the PY2019 evaluation key findings and recommendations.

Finding 1: Discrepancies in reported demand savings were the primary source for the low realization rate for demand savings. The primary driver for the low demand savings realization rate was the use of connected demand savings values instead of the evaluated measurement and verification (EM&V) peak demand savings values for reported demand savings for some measures.

- ***Recommendation 1.*** Apply EM&V peak demand savings values for all measures with prescribed demand savings values beginning in PY2020. Verify that peak demand values are consistent for each measure type included in the tracking data. Ensure that values are not rounded in tracking databases to avoid mischaracterization of demand savings values. Verify that only measures with no peak demand savings report zero demand savings.

Finding 2: Savings attributed to lighting measures are decaying over time. Gross verified savings for lighting measures were lower on a per-unit basis than previous evaluation years due to substantiation sheet adjustments that increased baseline wattage values and lowered hours of use (HOU).

- ***Recommendation 2.*** As savings from lighting measures decay, the program will need to reallocate resources to push alternative measures and focus on deep-energy savings. Weatherization upgrades can provide important savings opportunities and health upgrades for participants. It will be important for the program to emphasize and implement weatherization upgrades to participants as savings from lighting measures continue to diminish over time.

Finding 3: Clearly communicating measure eligibility is critical. Participants who provided suggestions for program improvement most commonly suggested relaxing the eligibility requirements for specific upgrades and setting more accurate expectations regarding upgrades. Numerous respondents felt they were led to believe they would receive certain upgrades but were later told they were ineligible.

- ***Recommendation 3.*** Accurately set participants' expectations regarding upgrades. Clearly communicate eligibility requirements for upgrades prior to the audit and ensure that auditors are trained to explain eligibility requirements for upgrades. Encourage auditors to not overpromise on measures for which customers may not be eligible.

Finding 4: Additional cross-promotion opportunities exist. The IESO and program delivery vendor staff mentioned additional opportunities to cross-promote the program exist, including the Ontario Electricity Support Program (OESP).

- ***Recommendation 4.*** Consider additional ways to cross-promote the program, such as through OESP.

Finding 5: Power bar measures had extremely high realization rates. The evaluator found multiple discrepancies with smart power bars and power bars with integrated timers. Discrepancies included incorrect savings value references in the program tracking data and substantiation sheet, and inconsistencies in measure types between the project files (which listed smart power bars) and the tracking data (which listed power bars with integrated times).

- ***Recommendation 5.*** Ensure that the tracking data and the data collection forms align for each measure distributed to the participant. Ensure that auditors are installing the tier-2 smart power bars with audiovisual (AV) equipment (or include installation location in the data collection form). Verify that the correct energy savings values are applied to the correct measure. Note that the NMR team confirmed with the delivery vendor that power bars with integrated timers will not be offered by the program once the remaining stock has been depleted.

Finding 6: Project costs were generally well below the program cap. Seventy-one percent of the projects had an incentive less than $500 and 92% of the projects had an incentive less than $1,000, while the program's total measure cost cap per home was $13,000. This suggests that lower cost measures were much more commonly implemented than higher cost measures and there may be additional savings opportunities not implemented that involve higher cost measures.

- ***Recommendation 6.*** Ensure that the maximum amount of savings opportunities is identified and implemented at each home, within program cost limits. Higher cost measures should be considered when feasible as they may provide deeper savings per home.

Finding 7: Program marketing is working well but there is room for improvement. Participants heard about the program from a variety of channels (bill inserts, friends/family, online, community groups, etc.) and auditors reported nearly always informing customers about the program. However, auditors and contractors reported that the greatest barriers to program participation were lack of awareness that the program exists and skepticism that the program is indeed free.

- ***Recommendation 7.*** Continue to market the program through a variety of channels including online, through community groups, and by coordinating with Local Distribution Companies (LDCs) to promote the program. Consider adding additional or more varied participant testimonials to marketing literature and messaging that emphasizes the program is free. Ensure that auditors and contractors have enough literature to provide several copies to each customer so they can give them to friends and family.

Finding 8: Energy-efficiency education activities are likely resulting in savings. Over three-fifths of all responding participants said their auditor discussed additional ways to save energy at the time of the audit or left educational materials behind (65% and 63%, respectively), and of these participants, three-fourths (76%) said they had tried at least one of the additional ways to save energy since having the audit performed.

- ***Recommendation 8.*** Consider ways to analyze and quantify the energy savings resulting from the program's energy education activities such as through performing a billing analysis.

Finding 9: Participants, auditors, and contractors suggest offering additional equipment through the program. Participants most often suggested stoves/ranges, clothes washers/dryers, windows, heating equipment, and doors. Auditors and contractors suggested clothes washers/dryers, additional types of LEDs, exterior crawlspace insulation, painting for exterior wall insulation, increasing attic insulation requirements, and heat pump upgrades. The IESO and program delivery vendor staff indicated that the availability of the Affordability Fund Trust (AFT) has also created some dissatisfaction among customers who learn they are not eligible to receive some of the upgrades offered through the AFT, such as heat pumps.

- ***Recommendation 9a.*** Consider offering additional types of equipment, such as clothes washers and dryers, windows, doors, additional types of LEDs, "right-sized" appliances, heating equipment, and increasing attic insulation requirements.
- ***Recommendation 9b.*** Review measures offered through the AFT to identify whether any may be appropriate for inclusion in HAP.

Finding 10. Participants suggest offering higher-quality products for certain equipment types. Offering higher quality free upgrades was mentioned by one-fifth (20%) of participants with improvement suggestions. Seven percent of all respondents who received drying racks said their product broke, and 5% of all respondents who received LEDs said one or more light broke.

- ***Recommendation 10.*** Provide higher quality drying racks and LEDs.

Finding 11. HAP had direct, positive impacts to employment in Ontario from PY2019 activities. The analysis estimated that HAP will create 110 total jobs in Canada, of which 99 will be in Ontario. Forty-nine of these jobs would be direct, with indirect and induced job impacts propagating throughout the economy under normal economic circumstances (i.e. prior to the disruptions from COVID-19).

- ***Recommendation 11.*** Continue using the Statistics Canada (StatCan) Input-Output (IO) model in concert with in-depth surveying to understand the impacts from COVID-19 on job creation from PY2020 activities.

Finding 12: The overall program realization rate for energy savings was driven by lighting measures. Lighting savings accounted for two-thirds of the overall program gross energy savings. Given the volume of energy savings attributed to lighting, the lower realization rate for lighting measures (76%) lowered the realization rate of the program. Other measures, such hot water pipe insulation, indoor clothes drying racks, aerators, and showerheads, also contributed to the lower

realization rate. High realization rates for weatherization measures, appliances, and power bar end-uses alleviated some of the impacts on program savings.

Finding 13: Participant were largely satisfied with the program and its elements. Participants reported high satisfaction with the program overall (average rating of 4.3 on a scale from 1 to 5, where 1 meant “not at all satisfied” and 5 meant “completely satisfied”) as well as with the professionalism of their auditor (average rating of 4.6).

2. Introduction

The Independent Electricity System Operator (the IESO) retained NMR Group, Inc. (NMR), in partnership with subcontractor, Nexant, Inc., (collectively, "the NMR team") to conduct an evaluation of its Low Income, First Nations, and Residential Local programs and pilots offered under the Interim Framework (IF). This report includes results, findings, and recommendations for the Program Year 2019 (PY2019) evaluation and is specific to the Home Assistance Program (HAP).

2.1 Evaluation Goals and Objectives

The evaluation sought to address several research goals and objectives in PY2019, including the following:

- Verify energy and demand savings with a 90% level of confidence at 10% precision for the program;
- Estimate realization rates (RRs);
- Review the prescriptive input assumptions (PIAs), recommend any revisions (e.g., recommend the addition or removal of measures, or updated assumptions), and revise/develop substantiation documents;
- Conduct a limited process evaluation by addressing key research questions of interest to the program; and
- Conduct a jobs impact analysis to estimate the number of direct and indirect jobs attributable to the program.

2.2 Program Description

HAP provides eligible low-income residential customers with energy-efficient solutions that reduce their energy consumption, lower utility costs, and improve comfort. Income-qualified homeowners and tenants in both non-profit and private rental housing are eligible, as are building owners and managers of non-profit housing. The program offers free in-home audits, health and safety upgrades, and energy-efficiency measures at no cost to participants.

2.2.1 Delivery

Under the IF, HAP is a centrally delivered program designed and administered by the IESO. A program delivery vendor under contract with the IESO is responsible for managing the program's delivery, including marketing and outreach, managing and training an energy auditor and installation contractor network who performs in-home energy audits and installations of program-eligible equipment, and other daily program management activities. During the energy audits, the program participants receive educational materials and tips on saving energy, as well as any necessary training about upgrades installed.

2.2.2 Eligibility

To be eligible to participate in the program, the participant must (1) be a resident of an eligible non-profit housing property or (2) be an individual who owns, rents, or leases their residence; is listed as the primary or secondary utility account holder; and meets one of the following criteria:

- Has an annual household income for the previous year that does not exceed the program eligibility limit
- Received assistance from an eligible assistance program in the past 12 months
- Received a Low-Income Energy Assistance Program (LEAP) grant or was part of the Ontario Electricity Support Program (OESP) in the past 12 months
- Qualified to participate in a natural gas low-income Demand Side Management (DSM) program during the past 12 months.

2.2.3 Measures

The measures offered by HAP are classified into one of three tracks based on the type of measures in the project. The basic track encompasses measures that are easily installed on-site by the HAP auditor. However, basic measures that conserve water usage and insulate water heater piping and storage tanks are only provided to customers with electric water heaters. The extended track includes measures that require additional follow-up actions, such as confirmation of appliance delivery, and are not completed in the duration of the initial audit. The weatherization track indicates that some form of weatherization to the building shell has occurred; this track is only available for homes that are electrically heated. The measures offered by each track are listed in ***Figure 2.1***.

Figure 2.1 | Program Measures by Program Track

Track	Program Measures	Electric DHW Only	Electric Heat Only
Basic Measures	• Efficient showerheads	●	
	• Efficient aerators	●	
	• Block heater timer		
	• Indoor clothes drying rack		
	• Power bar		
	• Hot water pipe insulation	●	
	• Hot water tank wrap	●	
	• ENERGY STAR qualified LED light bulbs		
Extended Measures	• Dehumidifier replacement		
	• Window air conditioner replacement		
	• Refrigerator replacement		
	• Freezer replacement		
	• Programmable thermostat		●
	• Smart thermostat		●
Weatherization	• Attic insulation		●
	• Basement Insulation		●
	• Wall Insulation		●
	• Air Sealing		●
Health and Safety	Health and safety measures. The program can make repairs to prepare for an installation of a program eligible measure or to make an upgrade that would promote energy efficiency and alleviate any health and safety concerns. The values of such repairs and upgrades is limited to $750.		

3. Methodology

A summary of the impact evaluation, process evaluation, and jobs impact analysis methodologies is presented in this section. Detailed descriptions of these methodologies are provided in ***Appendix A***.

3.1 Impact Evaluation Methodology

To complete the impact evaluation, the NMR team performed various evaluation activities, including a review of the program tracking data, a review of the technical reference manuals (TRMs) from other jurisdictions, an analysis of installation service rates (ISRs) and hours of use (HOU) using data from participant surveys, and engineering desk reviews. The NMR team used the results from these evaluation activities to calculate the realization rates to compare evaluated savings and reported savings.

The following subsections provide context about each activity. A detailed description of the impact methodology is provided in ***Appendix A.1***.

3.1.1 Program Tracking Database Review

The NMR team analyzed the participant database and conducted a cross-cutting assessment to identify the evaluation priorities and to develop a sampling plan. The NMR team assigned priorities based on the following metrics:

- Measures that accounted for the largest share of savings
- Measures that have the most uncertainty around their estimated savings
- The amount of evaluation work done for each measure in previous evaluations

The NMR team also conducted a comprehensive review of the HAP tracking database in order to identify key measures, savings discrepancies, and other issues that impact the accuracy of reported savings. The review checked for consistency between measures and the 2019 Measures and Assumptions List (MAL) values and verified the accuracy of reported savings calculations based on the IESO's substantiation sheet algorithms for prescriptive measures.[1] The NMR team also leveraged the database to calculate gross and verified net savings for the entire population. ***Equation 3.1*** shows the program tracking data correction factor calculation, note that if there were no errors or inconsistencies in the reported savings calculations the correction factor would equal one.

Equation 3.1 | Program Tracking Data Correction Factor

$$\textit{Tracking Data Correction Factor (CF): Evaluation Calculated Savings} \div \textit{Reported Savings}$$

[1] The NMR team only reviewed weatherization measures during the engineering desk review analysis as these measures do not have a prescribed value in the MAL.

3.1.2 Secondary Data Review of TRMs

The NMR team used TRMs from four other jurisdictions as a reference to compare the algorithms and associated inputs to the IESO's substantiation sheets. The NMR team picked the following TRMs for comparison based on industry standards and similar climate zones to the IESOs region:

- Illinois Statewide Technical Reference Manual (referred to as IL TRM)[2]
- New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (NY TRM)[3]
- Efficiency Vermont Technical Reference Manual (VT TRM)[4]
- Massachusetts Technical Reference Manual (MA TRM)[5]

The NMR team assessed the accuracy, reasonableness, and recency of the inputs and savings parameters of the IESO substantiation sheets and adjusted inputs when applicable (see ***Appendix A*** for additional details). The NMR team re-created savings calculations based on the updated algorithms and input values to ensure that gross and net verified savings reflected the updated values. ***Equation 3.2*** shows the adjusted TRM correction factor calculation, note that if a measure did not receive any adjustments the correction factor would be equivalent to one.

Equation 3.2 | Adjusted TRM Correction Factor

$$\text{Adjusted TRM CF} : \text{Adjusted Program Savings} \div (\text{Program Tracking CF} \times \text{Reported Savings})$$

3.1.3 In-Service Rate (ISR) and Hours of Use (HOU) Analysis

The NMR team surveyed HAP participants to determine ISRs to verify the amount of measures that are actually installed and used on the premise and to determine the HOU for measures that are more directly impacted by occupant usage. The NMR team applied the ISR findings to calculate gross verified savings. The results from the HOU study may be supplemented with additional survey data collected in PY2020 and applied to savings calculations in subsequent program years. The results for the ISR and HOU aspects of the participant surveys are discussed in ***Section 4.4*** and ***Appendix B.4***, respectively.

3.1.4 Engineering Desk Reviews

The engineering desk reviews consisted of a review of a sample of 208 projects that the NMR team selected as part of the program tracking database review process. The program delivery vendor then provided the NMR team with documentation for the sampled projects. The NMR team conducted a thorough review of the detailed project documents, which consisted of application forms, invoices, appliance shipment confirmation, energy models, photos, and auditor data collection forms.

[2] https://s3.amazonaws.com/ilsag/IL-TRM_Effective_01-01-20_v8.0_Vol_3_Res_10-17-19_Final.pdf
[3] http://www3.dps.ny.gov/W/PSCWeb.nsf/All/72C23DECFF52920A85257F1100671BDD
[4] https://puc.vermont.gov/document/ev-technical-reference-manual
[5] https://www.masssavedata.com/Public/TechnicalReferenceLibrary

3.1.4.1 Prescriptive Measures

The NMR team assessed prescriptive measure quantities and measure descriptions based on the documentation provided for the sampled projects. The NMR team conducted additional research to determine the actual nominal energy usage for appliance measures based on existing and new equipment model numbers (when available) to more accurately reflect savings estimates from these measures. The NMR team used the program tracking data review, the review of other TRM's, and the desk review to calculate measure-specific realization rates, which the team then applied to the population. The NMR team generated measure-specific ISR values from participant survey results and then applied them to gross savings calculations. ***Equation 3.3*** shows the gross verified savings calculation for prescriptive measures. Note if there were no corrections as a result of the program tracking data review (***Equation 3.1***) nor adjustments made to the substantiation sheet savings values (***Equation 3.2***), the realization rate would only reflect any discrepancies found during the desk review (i.e., quantity discrepancies or installed measure inconsistencies).

Equation 3.3 | Gross Verified Savings – Prescriptive Measures

$$\textit{Gross Verified Savings} = \textit{Desk Review RR} \times \textit{Adjusted TRM CF} \times \textit{ISR} \times \textit{Measure Quantity}$$

3.1.4.2 Weatherization Measures

The NMR team verified weatherization measures – which include installation of insulation in attics, basements, and walls, as well as air sealing – through a review of HOT2000 energy model files. Savings for the weatherization measures are generally calculated from pre- and post-retrofit upgrades with HOT2000 energy modeling software. The NMR team performed a more detailed and comprehensive engineering analysis of the weatherization measures by reviewing the HOT2000 files and recalculating the savings based on the weatherization upgrades outlined in the project documentation. The NMR team compared savings results from the desk review to the reported savings to determine a realization rate, which we then applied to the reported savings for the population of weatherization projects. ***Equation 3.4*** shows the gross verified savings calculation for weatherization measures.

Equation 3.4 | Gross Verified Savings – Weatherization Measures

$$\textit{Gross Verified Savings} = \textit{Reported Savings} \times \textit{Realization Rate}$$

3.1.4.3 Net Verified Energy and Demand Savings

The NMR team applied a net-to-gross ratio (NTGR) value of 1.0 to maintain consistency with previous program year evaluations of HAP. This method is also consistent with other low-income, direct installation programs in other jurisdictions. The NTGR of 1.0 indicates that participants would not have installed the energy-efficiency measures without program intervention. Note that due to a NTGR of 1.0, the gross verified savings are equivalent to the net first year savings for the program.

3.2 Process Evaluation Methodology

3.2.1 Sampling, Interviews, and Surveys

The process evaluation focused on program design and delivery. The NMR team evaluated program processes through interviews and surveys with relevant program actors, including the IESO staff, program delivery vendor staff, auditors, contractors, and participants. For each respondent type, the NMR team developed a customized interview guide or survey instrument to ensure responses produced comparable data and to allow the NMR team to draw meaningful conclusions.

For each respondent type, ***Table 3.1*** shows the survey methodology, the total population that the NMR team invited to participate in the survey or interviews, the total number of completed surveys, and the sampling error at the 90% confidence interval (CI).

Table 3.1 | Process Evaluation Primary Data Sources

Respondent Type	Methodology	Completed	Population	90% CI Error Margin
HAP IESO Staff and Program Delivery Vendor Staff	Phone In-depth Interviews (IDIs)	6	6	0%
HAP Participants	Web	846	3,774	3%
HAP Auditors and Contractors	Web	12	12	0%

The following subsections provide context about each group interviewed or surveyed. A detailed description of the process evaluation methodology is provided in ***Appendix A.2***.

3.2.2 IESO and Program Delivery Vendor Staff Interviews

The NMR team interviewed five IESO staff and the program delivery vendor staff to obtain a detailed understanding of HAP in PY2019. To complete these interviews, the IESO EM&V staff sent a notification e-mail to the appropriate IESO staff and program delivery vendor staff about the interview request, and then the NMR team followed up directly to schedule and complete the interviews. Interview topics for the IESO staff and program delivery vendor staff addressed program roles and responsibilities, program design and delivery, marketing and outreach, market actor engagement, program strengths and weaknesses, and suggestions for improvement.

3.2.3 Participant Survey

The NMR team e-mailed all 3,774 unique participants in the sample to request their participation in the survey. A total of 876 HAP participants responded to this request and completed the survey. The NMR team developed the survey sample from program records provided by the IESO EM&V staff. Given the large number of program participants, the NMR team randomly selected a subset of participants for inclusion in the survey sample. Survey topics for participants addressed in-service rates; HOU; how participants learned about and applied to the program; motivations for doing the upgrades; education and materials provided by the energy auditor; suggested energy-saving actions that participants implemented; satisfaction with various aspects of the program process; suggestions

for program improvement, including additional equipment or services to consider; job impacts; and demographics.

3.2.4 Auditor and Contractor Survey

The NMR team e-mailed all 12 unique auditors and contractors in the sample to request their participation in the survey. All 12 auditors and contractors responded to this request and completed the survey. The NMR team developed the sample list used to complete these HAP auditor and contractor surveys using an abbreviated list of contacts provided to the team by the program delivery vendor staff. Survey topics for the auditors and contractors addressed role in the program, firmographics, the application process, training and education received, outreach and marketing to customers, program barriers, suggestions for program improvement, and job impacts.

3.3 Jobs Impact Analysis Methodology

The analysis of job impacts utilized the Statistics Canada[6] (StatCan) Input-Output (IO) model to estimate direct and indirect job impacts. IO models are used to analyze the propagation of exogenous economic shocks throughout an economy. The models represent relationships, or flows, of inputs and outputs between industries. When an energy-efficiency program such as HAP is funded and implemented it creates a set of "shocks" to the economy, such as demand for specific products and services, and additional household expenditures from energy bill savings. The shocks propagate throughout the economy and their impacts can be measured in terms of variables such as economic output and employment. A detailed description of the job impact analysis methodology is provided in ***Appendix A.3***.

The model output generated three types of job impact estimates:

Direct impacts: jobs created during the initial round of spending from the exogenous shock. For the demand shock for energy-efficient products and services, direct impacts would be from firms adding employees to perform audits, install measures, and handle administrative duties. For the household expenditure shock, direct impacts would be from jobs created due to additional household spending.

Indirect impacts: job impacts due to inter-industry purchases as firms respond to the new demands of the directly affected industries. These include jobs created up supply chains due to the demand created by the energy-efficiency program—such as in the manufacturing of goods or the supply of inputs.

Induced impacts: job impacts due to changes in the production of goods and services in response to consumer expenditures induced by households' incomes (i.e., wages) generated by the production of the direct and indirect requirements.

The IO model provides estimates for each type of job impact in the unit of person-years, or a job for one person for one year. It further distinguishes between two types of job impacts:

[6] Statistics Canada is the Canadian government agency commissioned with producing statistics to help better understand Canada, its population, resources, economy, society, and culture.

- **Total number of jobs:** this covers both employee jobs and self-employed jobs (including persons working in a family business without pay). The total number of jobs includes full-time, part-time, temporary jobs and self-employed jobs. It does not take into account the number of hours worked per employee.
- **Full-time equivalent (FTE) number of jobs:** this includes only employee jobs that are converted to full-time equivalence based on the overall average full-time hours worked in either the business or government sectors.

Model run results are presented in terms of the above job impact types (direct, indirect, and induced) and also the type of job (total jobs vs. FTEs). These results—along with the model input shock values—are presented and discussed in ***Section 6***.

4. Impact Evaluation

The following subsections outline the impact evaluation results. Details regarding the impact methodology can be found in ***Section 3*** and ***Appendix A.1***. Additional impact-related results can be found in ***Appendix B***.

4.1 High-Level Results

4.1.1 Net Verified First Year Energy Savings Key Results

- The overall program realization rate is 86% for energy savings in PY2019.
- Lighting measures achieved a realization rate of 76%; however, these measures still accounted for most of the HAP savings in PY2019 (67%).
- Hot water pipe insulation measures had a low realization rate (15%); however, these measures accounted for less than 1% of net savings.
- Indoor clothes drying racks had a realization rate of 81% and represented 5.8% of total net verified first year savings for the program.
- Weatherization measures achieved a realization rate of 108%, but only accounted for 2.7% of total program savings.
- Smart power bars and power bars with integrated timers had extremely high realization rates (5,785% and 2,163%, respectively).
- The appliance end-use category had a realization rate of 112% and attributed 7.6% to total program savings.

4.1.2 Net Verified First Year Demand Savings Key Results

- The overall program realization rate is 21% for demand savings in PY2019.
- Lighting measures had a realization rate of 10% for demand savings; however, these measures still represented 43% of total program demand savings.
- Indoor clothes drying racks achieved a realization rate of 146% and achieved nearly 38% of total demand savings for HAP in PY2019.
- Appliances had an 82% realization rate and accounted for 13% of program savings.
- There were 8,941 records for various measures that applied connected demand savings rather than peak demand savings, which covered 80,465 total measures. These measures represent 86% of all reported demand savings (3,611 kilowatts (kW)).
- There were 10,905 records for various measures that listed a reported demand savings value of zero instead of the prescribed demand savings value for the measure. The NMR team rectified this discrepancy in the calculation of net verified first year demand.

- All smart power bars and power bars with integrated timers had no demand savings reported in the tracking data (a total of 6,518 records, accounting for 7,648 power bars).

4.2 Net Verified and Reported Savings Assessment

The verified net first year energy savings for HAP were dominated by lighting end-use measures, which covered two-thirds (67.1%) of total program savings (***Figure 4.1***). The proportion of lighting savings compared to overall program savings is similar to PY2017 HAP evaluation, which was 69% of total program net first year verified savings.[7] Miscellaneous, power bars, and appliances were the next largest end-use categories for PY2019. Building shell upgrades—insulation and air-sealing—only accounted for 2.6% of net first year savings for HAP, which is almost an 8% decrease from the proportion of net first year savings from PY2017 (or 226,804 kilowatt-hours (kWh)/year vs. 800,349 kWh/year).

Figure 4.1 | Percent of PY2019 HAP Net 1st Year Energy Savings by End-Use (kWh/year)

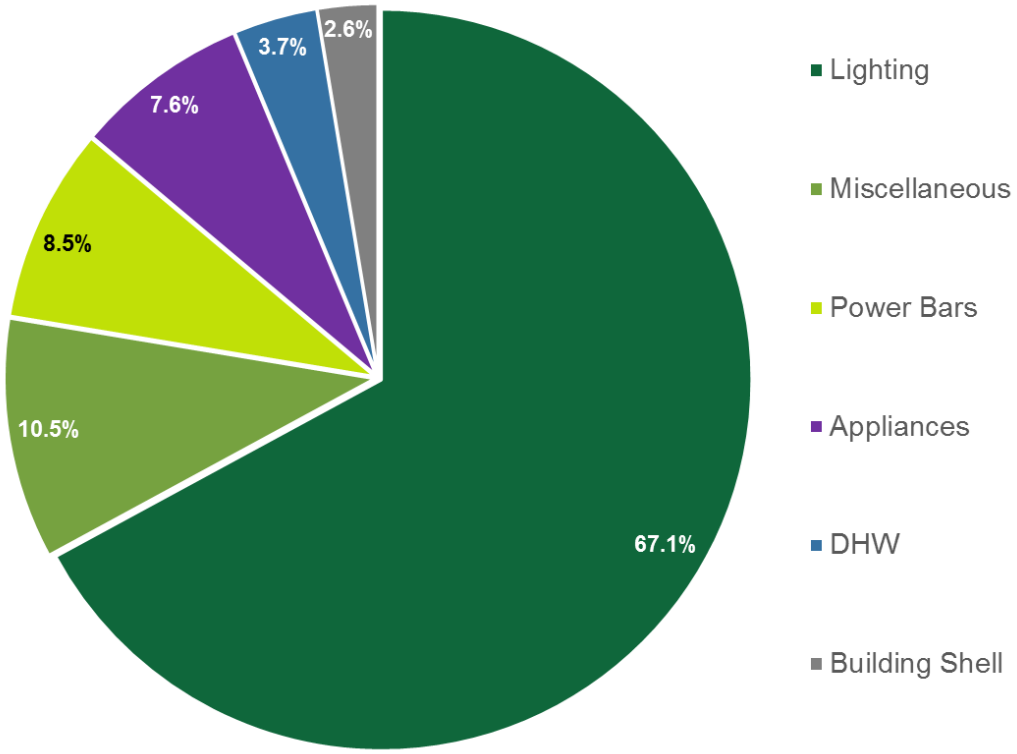
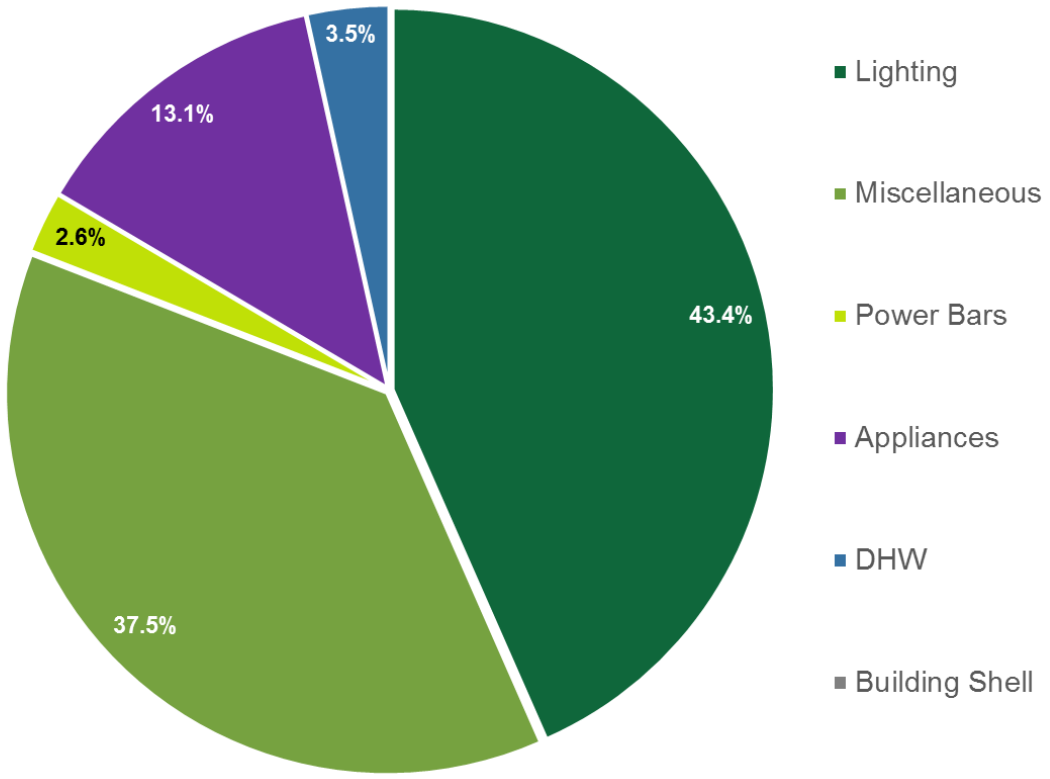


Figure 4.2 displays the proportion of verified net first year demand savings by end-use category for HAP. The net first year demand savings were primarily attributed to lighting and miscellaneous end-use categories, specifically indoor clothes drying racks (43% and 38%, respectively). The appliance end-use category covered another 13% of net first year verified demand savings for HAP.

[7] http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2017/2017-Home-Assistance-Program-Evaluation-Report.pdf?la=en

Figure 4.2 | Percent of PY2019 HAP Net 1st Year Demand Savings by End-Use (kW/year)



4.2.1 Program Level Savings

Table 4.1 presents reported and net first year energy and demand savings for the entire program for PY2019. The program realization rate is 86% for energy savings and 21% for demand savings. Measure level impacts for both energy and demand savings are detailed in the subsections below.

Table 4.1 | Program Level Reported and Net First Year Savings

Program Metric	Energy (MWh)	Demand (MW)
PY2019 Reported	10,067	4.2
PY2019 Verified Net first Year Savings	8,647	0.9
Realization Rate	86%	21%

4.2.2 Measure-Level Results Summary

The measure-level impact evaluation results are presented by end-use category in the following subsections. Aggregated impact results, substantiation sheet updates, effective useful life (EUL) updates, and incremental cost updates are provided by measure in ***Appendix B***.

4.2.2.1 Lighting

Table 4.2 presents the reported and verified net first year energy savings for lighting measures offered by HAP. There are various light bulb products that are offered by the program for direct installation based on the replaced bulb type. The overall realization rate for lighting measures was 76%. The lower realization rate was a result of savings adjustments to the substantiation sheets based on the TRM review, which included increased baseline wattage values and adjusted-HOU values in the savings equation. See ***Appendix B.2.1*** for details on adjustments to lighting measures. The impact of adjustments to lighting measures represent a primary driver to the programs overall realization rate as lighting measures represent two-thirds of total verified savings for the program.

Table 4.2 | PY2019 Lighting Energy Savings

Appliance	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
<=11W ENERGY STAR Qualified LED A Shape	6,447,800	4,765,739	74%	55.1%
<=11W ENERGY STAR Qualified LED MR 16	45,196	38,807	86%	0.4%
<=14W ENERGY STAR Qualified LED A Shape	79,537	58,792	74%	0.7%
<=16W ENERGY STAR Qualified LED PAR 20	21,068	18,071	86%	0.2%
<=16W ENERGY STAR Qualified LED PAR30 & PAR38	124,418	106,654	86%	1.2%
<=23W ENERGY STAR Qualified LED A Shape	519,885	500,218	96%	5.8%
<=23W ENERGY STAR Qualified LED PAR	46,622	39,938	86%	0.5%
<=6W ENERGY STAR Qualified LED MR 16 / PAR 16	205,277	175,926	86%	2.0%
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	111,348	92,289	83%	1.1%
LED Downlight with Light Output >600 and <800 lumens	7,096	3,834	54%	0.0%
LED Downlight with Light Output >800 lumens	3,193	1,677	53%	0.0%
Lighting Total	**7,611,440**	**5,801,944**	**76%**	**67.1%**

Table 4.3 displays the reported and net first year demand savings for lighting end-uses. The realization rate for lighting demand savings is extremely low (10%) due to the use of connected demand savings rather than EM&V demand savings values. The application of connected demand savings occurred for approximately 51% of bulbs that had reported demand savings values and contributed to the majority of the overstated reported demand savings. There were 213 bulbs that did not have reported demand savings; however, the NMR team accounted for the first year and net persistent demand savings for these measures by applying the prescriptive net first year savings determined in the verification process.

Table 4.3 | PY2019 Lighting Demand Savings

Appliance	Reported Demand (kW)	Net First Year Demand (kW)	RR	Proportion of Verified HAP Savings
<=11W ENERGY STAR Qualified LED A Shape	3,198	319	10%	35.7%
<=11W ENERGY STAR Qualified LED MR 16	23	3	11%	0.3%
<=14W ENERGY STAR Qualified LED A Shape	36	4	11%	0.4%
<=16W ENERGY STAR Qualified LED PAR 20	8	1	15%	0.1%
<=16W ENERGY STAR Qualified LED PAR30 & PAR38	58	7	12%	0.8%
<=23W ENERGY STAR Qualified LED A Shape	277	34	12%	3.7%
<=23W ENERGY STAR Qualified LED PAR	20	3	14%	0.3%
<=6W ENERGY STAR Qualified LED MR 16 / PAR 16	111	12	11%	1.3%
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	56	6	11%	0.7%
LED Downlight with Light Output >600 and <800 lumens	3	0	8%	<0.0%
LED Downlight with Light Output >800 lumens	2	0	7%	<0.0%
Lighting Total	**3,791**	**389**	**10%**	**43.4%**

4.2.2.2 Appliances

The NMR team calculated net verified first year savings for appliances using the project file data and equipment-specific information collected by HAP auditors. The NMR team applied model number lookups to incorporate project-specific values into the desk reviewed savings calculations, instead of default reported savings input assumptions, for the installed equipment, and where possible, the existing equipment. This model-specific data typically included the size or capacity of the equipment and its annual energy consumption. Realization rates for energy savings were generally high among appliances (112%), particularly with freezers. Appliances accounted for 7.6% of total net first year program energy savings (***Table 4.4***).

Table 4.4 | PY2019 Appliance Energy Savings

Appliance	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 – 21.2 l/day)	106,832	90,288	85%	1.0%
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 – 25.4 l/day)	5,360	5,359	100%	0.1%
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 – 35.5 l/day)	1,098	1,098	100%	0.0%
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	51,191	133,437	261%	1.5%
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	43,466	77,671	179%	0.9%
Refrigerator Replacement (ENERGY STAR Qualified 10.0 – 12.5 cu ft)	53,820	55,653	103%	0.6%
Refrigerator Replacement (ENERGY STAR Qualified 15.5 – 16.9 cu ft)	82,000	81,179	99%	0.9%
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	230,862	202,038	88%	2.3%
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	2,111	2,151	102%	0.0%
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	4,387	4,031	92%	0.0%
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	5,104	4,696	92%	0.1%
Appliances Total	**586,231**	**657,600**	**112%**	**7.6%**

The realization rates were lower than the energy realization rates for appliances, but accounted for 13% of the program net first year demand savings (***Table 4.5***). All appliances had some measures that reported connected demand values. However, window air conditioner (AC) and dehumidifier measures had a much higher proportion of units that applied connected demand savings (58% and 41%) than refrigerator and freezer measures (13% and 3%).

Table 4.5 | PY2019 Appliance Demand Savings

Appliance	Reported Demand (kW)	Net First Year Demand (kW)	RR	Proportion of Verified HAP Savings
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 – 21.2 l/day)	47	28	60%	3.2%
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 – 25.4 l/day)	3	2	64%	0.2%
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 – 35.5 l/day)	1	0	76%	0.0%
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	5	19	349%	2.1%
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	5	11	216%	1.2%
Refrigerator Replacement (ENERGY STAR Qualified 10.0 – 12.5 cu ft)	6	7	116%	0.8%
Refrigerator Replacement (ENERGY STAR Qualified 15.5 – 16.9 cu ft)	10	11	106%	1.2%
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	31	27	85%	3.0%
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	7	3	35%	0.3%
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	15	5	31%	0.5%
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	13	5	42%	0.6%
Appliances Total	**143**	**117**	**82%**	**13.0%**

Refrigerators. The NMR team calculated verified savings based on project-specific annual energy consumption derived from model number lookups for the installed refrigerators and the existing equipment, while the reported savings used the minimum requirements for meeting the ENERGY STAR efficiency specifications. The application of actual annual energy consumption values provides a more accurate savings estimate that does not rely solely on using the minimum ENERGY STAR specifications. Refrigerators accounted for 338,870 kWh in energy savings and 44.6 kW in demand savings.

Freezers. The NMR team calculated verified savings for freezers in a similar way to refrigerators, which leveraged model numbers to look up annual energy consumption and compared it against the ENERGY STAR minimum values used in deemed savings. The high realization rates for freezers seem to be partially due to the fact that the specific models offered by the program are on the low end of the size categories that freezers are grouped into, and therefore have lower energy consumption than the midpoint of each category, which is used to calculate the prescribed savings. In addition, the model number look up for specific annual energy consumption attributed to the high realization rate. Freezers accounted for 211,107 kWh in energy savings and 29.5 kW in demand savings.

Dehumidifiers. Typically, the NMR team limited the data used to verify savings for dehumidifiers to the project specific capacity of the equipment (liters per day). The efficiency of the dehumidifiers offered by the program was consistent with the minimum ENERGY STAR specifications, so verified savings were relatively consistent with deemed savings. Dehumidifiers accounted for 96,745 kWh in net first year savings and 30 kW in net first year demand savings.

Window Air Conditioners. Like other appliances, the NMR team calculated verified savings for window air conditioners by looking up the capacity and efficiency of the installed equipment. These metrics were relatively consistent with the ENERGY STAR minimum specifications used in deemed savings. Window air conditioners accounted for 10,877 kWh in net first year energy savings and 13 kW in net first year demand savings.

4.2.2.3 Weatherization – Building Shell

The realization rate for weatherization measures was 108% (***Table 4.6***). This represents an increase from PY2017 HAP evaluation (94%). However, the net first year savings is only 227 megawatt-hours (MWh) for PY2019 compared to 800 MWh in PY2017. There were 70 weatherization projects in PY2019 compared to 151 in PY2017. This represents a reduction in the savings per participant that receives weatherization upgrades and highlights an opportunity to increase the size, scale, and frequency of weatherization projects administered by HAP in future years as the program looks for savings beyond lighting measures.

The NMR team calculated verified savings with the HOT2000 energy modeling tool that is used by HAP auditors to input the shell details of the participant building. Shell upgrades are only offered to participants with electric heat. HAP auditors create two models of the home: (1) an initial model that represents the existing conditions of the home observed during the initial audit and (2) the final model that includes the values from air sealing and insulation improvements as a result of the program. The tool compares the modeled energy usage of the initial and final energy models, which the NMR team replicated to verify savings. There are no demand savings associated with building shell measures.

Table 4.6 | PY2019 Building Shell Energy Savings

Shell Component	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
Air Sealing	43,488	35,503	82%	0.4%
Attic Insulation	63,469	65,252	103%	0.8%
Basement Insulation	53,011	61,156	115%	0.7%
Wall Insulation	2,567	2,567	100%	0.0%
Hot 2000 Output	48,427	62,327	129%	0.7%
Building Shell Total	**210,962**	**226,804**	**108%**	**2.6%**

4.2.2.4 Power Bars

Table 4.7 presents the net verified first year savings results for power bar measures. There are two different power bar measures offered through the program, one with an integrated timer that shuts the device off at a programmed time and a smart power bar that includes a more sophisticated infrared or occupancy sensor that shuts off the equipment based on occupant behavior. The two types of power bars also have very different prescribed savings associated with them, but in the program tracking data all power bars listed the lower prescribed savings value associated with the integrated timer type. In addition, there were instances of project files that indicated a smart power bar was provided to participants while the tracking data indicated an integrated timer was provided to the same participants. This occurred in 57 out of 147 reviewed projects where integrated timers were installed (39%), which greatly impacted the realization rate of integrated timer power bars.

Finally, the NMR team updated the smart power bar substantiation sheet based on the TRM review. The NMR team updated the substantiation sheet to reflect a tier 2 advanced power bar installed with audiovisual (AV) equipment, rather than a tier 1 advanced power strip with an unknown installation location. The NMR team confirmed the product and installation scenario with the program delivery vendor staff. With the culmination of tracking data discrepancies, reported savings discrepancies, and substantiation sheet savings adjustments, the realization rates for the power bar measures are very high.

Table 4.7 | PY2019 Power Bar Energy Savings

Shell Component	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
Power Bar w/ Integrated Timer	23,684	512,345	2163%	5.9%
Smart Power Bar	3,845	222,422	5785%	2.6%
Power Bar Total	**27,529**	**734,767**	**2669%**	**8.5%**

There were no reported demand savings for integrated timers (6,580 units) or smart power bars (1,068 units) in the tracking data. Due to this issue in the tracking data, the NMR team could not calculate a realization rate. The demand savings were corrected for power bars in the verification process, and accounted for 2.6% of the program's net verified first year demand savings (***Table 4.8***).

Table 4.8 | PY2019 Power Bar Demand Savings

Shell Component	Reported Demand (kW)	Net First Year Demand (kW)	RR	Proportion of Verified HAP Savings
Power Bar w/ Integrated Timer	-	16	N/A	1.8%
Smart Power Bar	-	7	N/A	0.8%
Power Bar Total	**-**	**23**	**N/A**	**2.6%**

4.2.2.5 Domestic Hot Water

Domestic hot water (DHW) measures are only offered to participants with electric water heating systems. The NMR team primarily verified savings for water heating measures by confirming the measure types and quantities in the project files matched the program tracking data. The lower realization rates for pipe wrap measures was due to reported savings calculations referencing the total linear feet of insulation installed, which is standard data collection practice by auditors in the field, while the reported savings input assumptions values in three feet increments. This resulted in an overestimation of reported savings by a multiple of three. The NRM team made additional adjustments to the deemed savings values of pipe wrap, aerators, and showerheads during the substantiation sheet review and update (see ***Appendix B*** for TRM adjustment details).

Table 4.9 displays the impact results for domestic hot water end-use measures. The overall realization rate for this end-use category was low (54%), but only accounts for 3.7% of net verified first year savings for HAP.

Table 4.9 | PY2019 DHW Energy Savings

DHW Measure	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
Efficient Aerators (bathroom) < 3.8 litres per minute (Lpm)	44,477	28,566	64%	0.3%
Efficient Aerators (kitchen) < 5.7 Lpm	94,627	86,096	91%	1.0%
Efficient Showerhead (handheld) < 4.8 Lpm	160,318	89,758	56%	1.0%
Efficient Showerheads (standard) < 4.8 Lpm	99,089	80,478	81%	0.9%
Hot Water Tank Pipe Wrap - ½" (per foot)	154,209	22,025	14%	0.3%
Hot Water Tank Pipe Wrap - ¾ " (per foot)	33,937	6,995	21%	0.1%
Hot Water Tank Wrap – Fiberglass R10	2,778	2,554	92%	0.0%
DHW Total	**589,434**	**316,473**	**54%**	**3.7%**

Table 4.10 presents the reported and net verified first year demand savings for the domestic hot water end-use measures. There were several measures that did not include reported demand savings values, including aerators (758 units), showerheads, (511 units), and pipe insulation (1,771 linear feet). This generally resulted in very high measure level realization rates, even after reported savings input assumption adjustments; however, due to the discrepancy of overstated reported savings for pipe insulation measures, the overall realization rate for the hot water end-use was 99%.

Table 4.10 | PY2019 DHW Demand Savings

DHW Measure	Reported Demand (kW)	Net First Year Demand (kW)	RR	Proportion of Verified HAP Savings
Efficient Aerators (bathroom) < 3.8 Lpm	3	3	96%	0.3%
Efficient Aerators (kitchen) < 5.7 Lpm	5	8	181%	0.9%
Efficient Showerhead (handheld) < 4.8 Lpm	8	9	108%	1.0%
Efficient Showerheads (standard) < 4.8 Lpm	5	8	152%	0.9%
Hot Water Tank Pipe Wrap - ½" (per foot)	9	2	26%	0.3%
Hot Water Tank Pipe Wrap - ¾ " (per foot)	2	1	38%	0.1%
Hot Water Tank Wrap – Fiberglass R10	0	0	180%	0.0%
DHW Total	**31**	**31**	**99%**	**3.5%**

4.2.2.6 Miscellaneous Measures

Table 4.11 displays the results for the remaining measures offered by HAP. Like hot water measures, the NMR team verified savings for the miscellaneous measures by confirming the measure type and the quantity installed matched between the project files and the program tracking data, as well as through the substantiation sheet reviews. The realization rate for block heater timers is directly correlated with the ISR findings, while the indoor clothes racks and line voltage thermostats also included updates to the substantiation sheets as a result of the TRM review (See ***Appendix B.2*** for more detail). Programmable thermostats were only offered to participants with electric heat.

Table 4.11 | PY2019 Miscellaneous Measures Energy Savings

Measure	Reported Savings (kWh)	Net Verified 1st year Savings (kWh)	RR	Proportion of Verified HAP Savings
Block Heater Timer	301,983	271,751	90%	3.1%
Indoor Clothes Drying Rack	620,315	501,989	81%	5.8%
Programmable Thermostat – Line Voltage	104,481	121,020	116%	1.4%
Programmable Thermostat – Low Voltage	14,535	14,535	100%	0.2%
Total	**1,041,315**	**909,295**	**87%**	**10.5%**

Table 4.12 presents the reported and net verified first year demand savings for the miscellaneous measure category. Most measures in this end-use category do not claim demand savings, with the exception of indoor clothes drying racks. The realization rate for drying racks is high (146%) even though the TRM review resulted in a decrease of per-unit demand savings. The high realization rate is a result of 2,952 (46%) clothes racks distributed by the program with no reported demand savings.

Table 4.12 | PY2019 Miscellaneous Measures Demand Savings

Measure	Reported Demand (kW)	Net First Year Demand (kW)	RR	Proportion of Verified HAP Savings
Block Heater Timer	-	-	-	-
Indoor Clothes Drying Rack	230	336	146%	37.5%
Programmable Thermostat – Line Voltage	-	-	-	-
Programmable Thermostat – Low Voltage	-	-	-	-
Total	**230**	**336**	**146%**	**37.5%**

4.3 Comparison of Impact Results with Previous Evaluation Years

Table 4.13 presents the results of HAP activities over the past few years.[8] The program participation has ramped up over time, but that has not resulted in more verified energy savings.

The primary reason for the decay of savings over time is adjustments for lighting measures and adjustments to other measures delivered by HAP that often result in reduced energy and demand savings due to increased baselines. In addition, the amount of verified energy savings attributed to weatherization projects dropped by nearly 600 MWh in PY2019 compared to PY2017.

Additional factors that impacted net verified first year savings include updated gross verified per-unit savings (***Appendix B***), the correction of smart power bar vs. power bar with integrated timer discrepancy, the application of peak demand values rather than connected demand, and ISR updates.

The Program Participation values in ***Table 4.13*** are reflective of the number of unique Application IDs (also known as projects) identified in the program's Tracking Data. In PY2019, there were 20 instances where the same single-family household had more than one Application ID; because of this, these households are represented twice in the Program Participation total. A participant may receive more than one Application ID if a second site visit is required to the same household. Given this, a total of 9,968 unique households participated in the program in PY2019.

[8] The program administered a limited impact evaluation in PY2018.

Table 4.13 | Comparison of Program Performance over Time

Program Metric	PY2016	PY2017	PY2018*	PY2019
Program Participation (Projects)	5,066	6,910	4,609	9,988
Program Reported Energy Savings (MWh)	10,485	15,136	10,842	10,067
Program Reported Demand Savings (MW)	5	8	165	4.20
Program Realization Rate, Energy	1	1	0.65	0.86
Program Realization Rate, Demand	0	0	0.01	0.21
Net-to-Gross Ratio	1	1	1.00	1.00
Program Net First Year Energy Savings (MWh)	7,590	8,241	7,047	8,647
Program Net First Year Demand Savings (MW)	1	1	0.99	0.90
Net Verified Lifetime Energy Savings (MWh)	125,109	149,839	N/A	117,753

*PY2018 was a limited impact evaluation that leveraged previous years evaluations to develop realization rates for net verified first year savings.

Figure 4.3, *Figure 4.4*, and *Figure 4.5* show how the net verified first year savings, net lifetime savings, and net verified first year demand have changed at the participant level over time. Values are derived by taking the aggregated verified net first year savings values over the number of participants for each year and each category. All categories have seen reductions in PY2019.

Figure 4.3 | Verified First Year Net Energy Savings Per Participant (kWh/year)

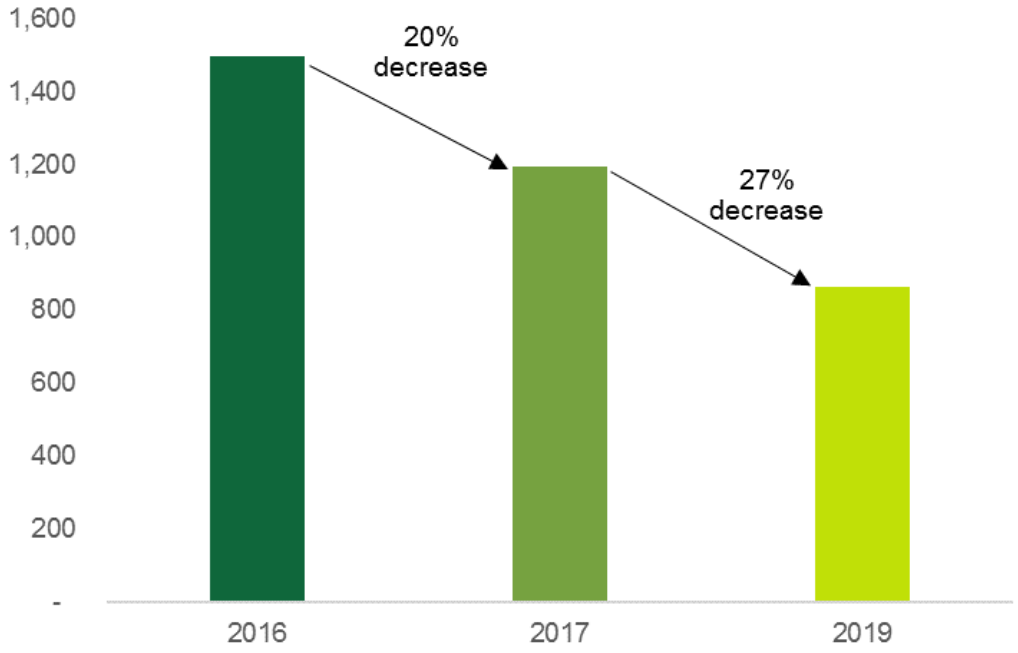


Figure 4.4 | Net Verified Lifetime Energy Savings Per Participant (kWh)

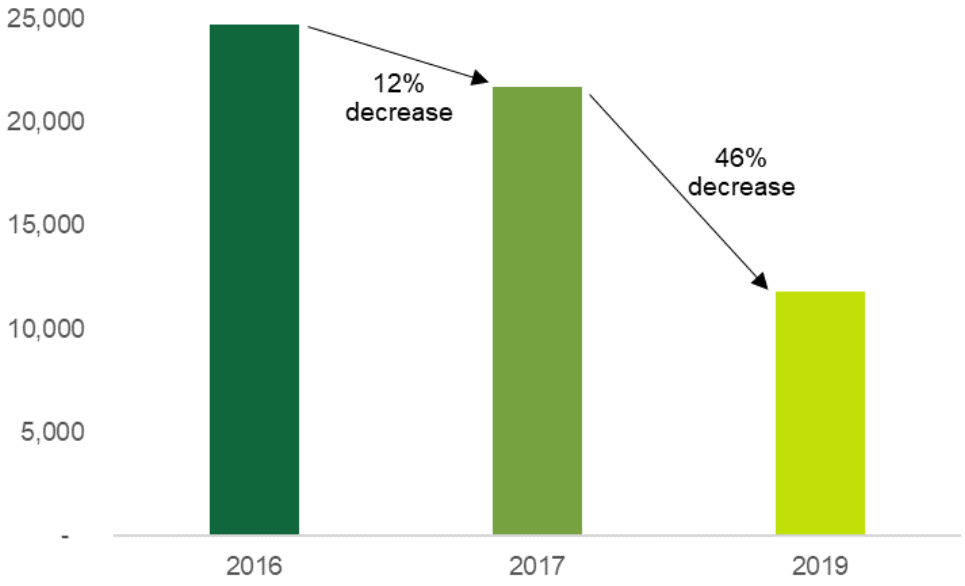
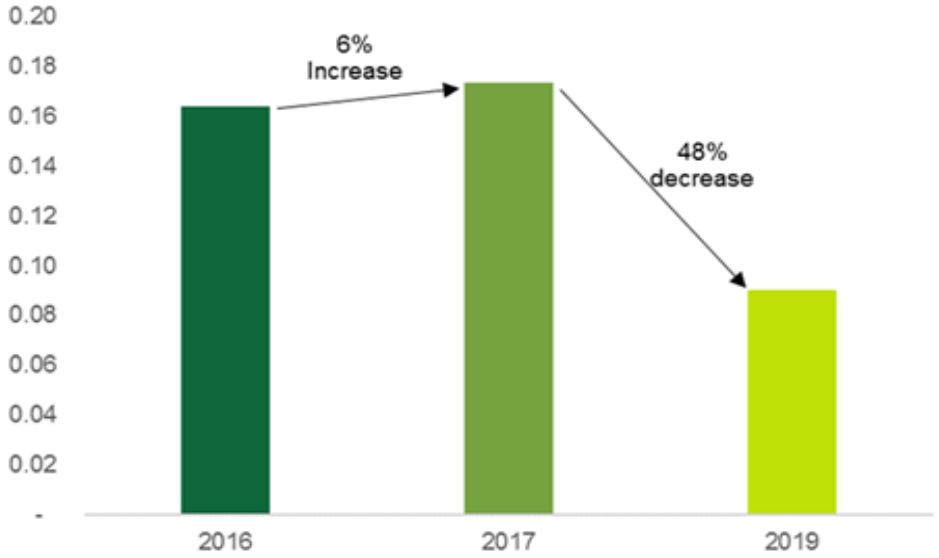


Figure 4.5 | Verified First Year Net Demand Savings per Participant (kW/Year)



4.4 In-Service Rates

Figure 4.6 displays the energy-efficiency upgrades respondents confirmed receiving. Most respondents (86%) received LEDs; on average, respondents received 18 LEDs. Additionally, most respondents received a power bar (72%) and/or a drying rack (70%). Nearly one-fourth (23%) of respondents received a refrigerator.

Figure 4.6 | Energy-Efficiency Upgrades that Program Participants Received (n=846)

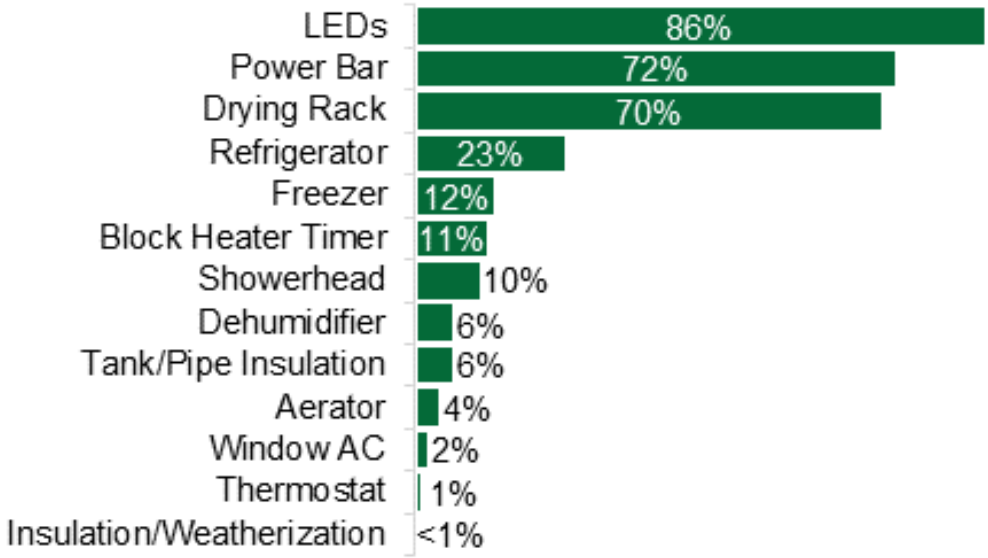


Figure 4.7 displays the in-service rates (ISR) for respondents' upgrades. All (100%) of the freezers, dehumidifiers, and thermostats respondents received were still installed and functional at the time of the survey, and nearly all the refrigerators (99%) and LEDs (97%) were still installed. Around nine out of ten shower heads (92%), block heat timers (90%), power bars (89%), and drying racks (89%) were still installed at the time of the survey. In addition, most of the aerators (87%) and window ACs (86%) were still installed at the time of the survey.

Figure 4.7 | Energy-Efficiency Upgrade In-Service Rates

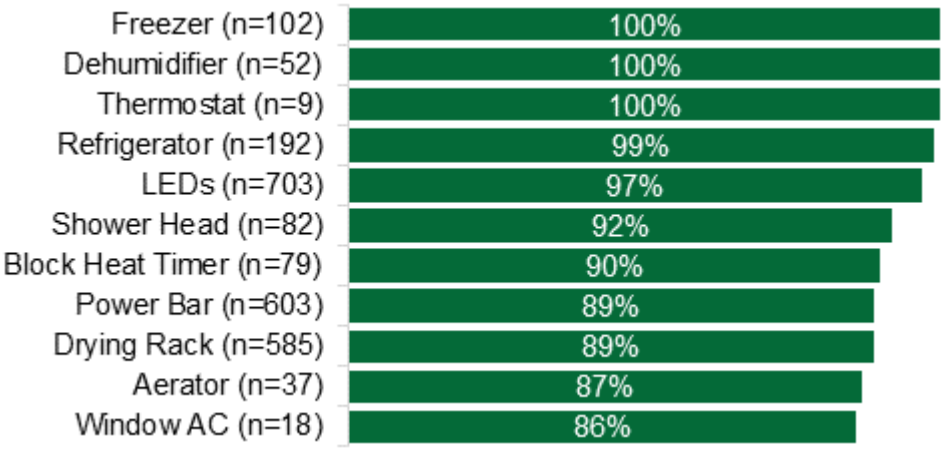
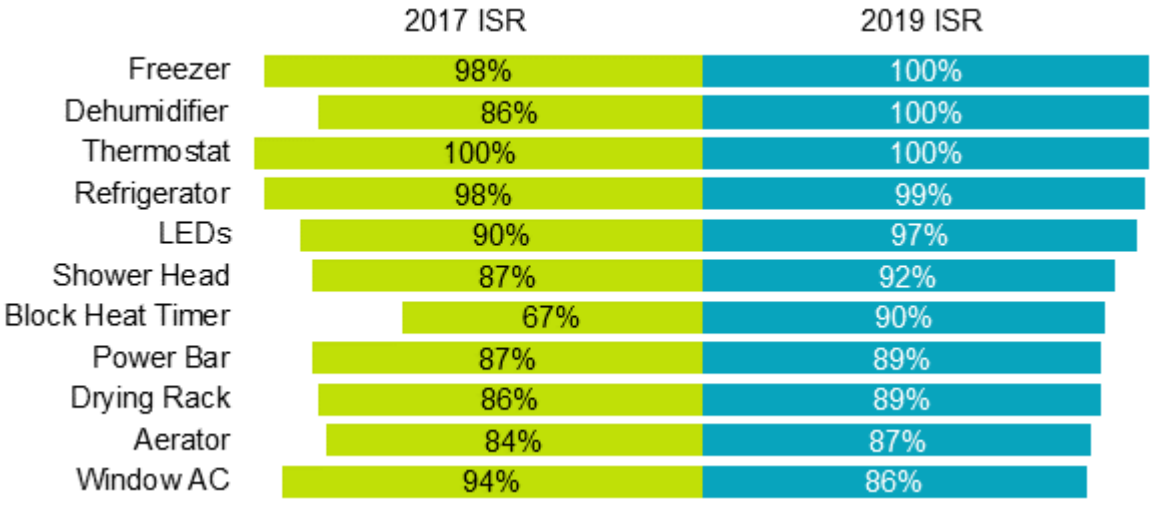


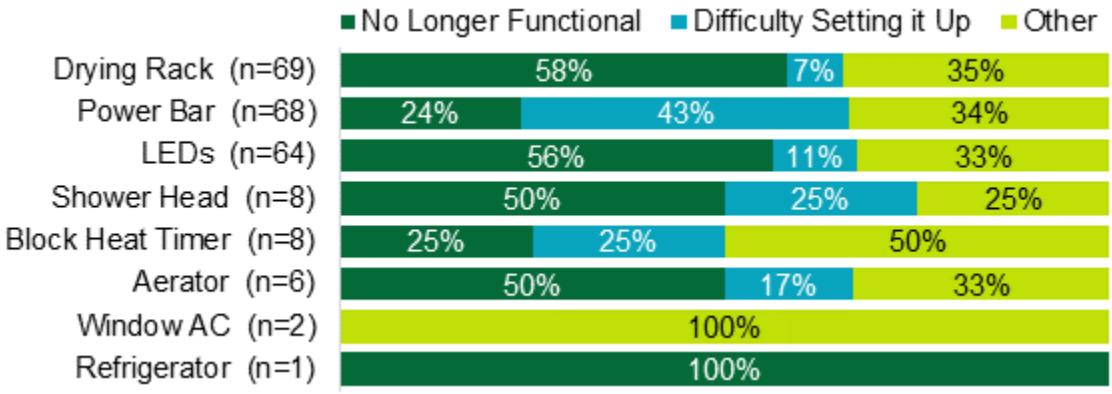
Figure 4.8 shows that ISRs for most measures increased between PY2017 and PY2019. The upgrades for which the ISR increased the most include block heat timers (from 67% to 90%), dehumidifiers (from 86% to 100%), and LEDs (from 90% to 97%). The only upgrades for which the ISR did not increase include thermostats and window air conditioners. The thermostat ISR stayed the same at 100%, and the window air conditioner ISR decreased from 94% to 86%.

Figure 4.8 | Comparison of PY2017 and PY2019 In-Service Rates



The most common reason respondents gave for uninstalling or removing upgrades was that they were no longer functional, broken, or defective. As shown in ***Figure 4.9***, one-half or more of respondents who removed drying racks (58%), LEDs (56%), or aerators (50%), and the one respondent who removed their refrigerator, said the upgrades were no longer functional. Many respondents had difficulty setting up their power bars. Over two-fifths (43%) of respondents who removed their power bars did so for this reason. Other common reasons why upgrades were not installed include saving them for future use or simply not liking them.

Figure 4.9 | Reasons Respondents Uninstalled or Removed Upgrades



5. Process Evaluation

This section outlines the process evaluation results. Details regarding the process methodology can be found in ***Section 3.2*** and ***Appendix A.2***. An illustrative logic model outlining the program processes can be found in ***Appendix C***.

5.1 IESO and Program Delivery Vendor Staff Perspectives

The following subsections highlight the feedback received from the IESO and program delivery vendor staff about the design and delivery of HAP in PY2019.

5.1.1 High-Level Results

High-level results from the IESO and program delivery vendor staff IDIs include the following:

- Both the IESO and the program delivery vendor staff indicated the communication and coordination associated with the program's delivery has been working well.
- IESO and program delivery vendor staff indicated that the program was successful in targeting key customer segments.
- Common program barriers mentioned by staff included customers having competing priorities and lack of time to participate, customer confusion about which measures they are eligible to receive and which programs they are eligible to participate in, challenges in identifying eligible customers, discomfort with the participation agreement, lack of significant province-wide marketing in PY2019, and eligibility requirements for non-electric customers.
- Program improvement suggestions mentioned by staff included continuing to make the program as easy as possible to participate in, ensuring that customers are clear about what upgrades they are eligible for, and looking for more opportunities to cross-promote the program, such as through the OESP.

5.1.2 Program Design

IESO staff indicated that the overall goal of the program is to deliver impactful energy savings to the low-income residential sector. They stressed that the program is designed to effectively serve customers who otherwise would not have access to energy-efficiency upgrade opportunities due to economic barriers.

IESO staff indicated that when the IF came into effect in PY2019, it had no major impacts on the program design because HAP had already transitioned to a central delivery approach in PY2018. However, IESO staff indicated that some improvements have been made to the program processes under the new framework, such as streamlining the application process and improving the income eligibility verification process, which is now verified onsite, further ensuring the privacy of all customers. IESO staff have heard positive feedback about these changes from customers, which they believe has led to additional program uptake.

5.1.3 Program Engagement and Delivery

Program delivery vendor staff described the delivery process, indicating that they are responsible for all aspects of program delivery, from engaging with eligible customers to performing energy assessments and overseeing the measure installation process. The program delivery vendor staff reported coordinating closely with the IESO staff on all customer outreach strategies. Additionally, the program delivery vendor is responsible for maintaining an auditor and contractor network that is sufficient to meet demand for the program throughout the province. Both the IESO and program delivery vendor staff indicated that communication and coordination associated with the program's delivery has been working well.

IESO staff indicated that customers also engage with the program through other channels, such as through the program's website, where they can submit a request to receive more information. Another common referral source is the Affordability Fund Trust (AFT), which has a similar program design and is available to moderate income customers who are not eligible for low-income programs.[9] If customers engage with AFT first and learn that they are not eligible for it, they are referred to HAP.

IESO and program delivery vendor staff also reported working to build relationships with and promote the program through different organizations and community groups, including the IESO's Energy Assistance Programming Working Group, gas utilities (e.g., Enbridge), and social housing and housing services groups involved at the local and regional levels.[10] The IESO and the program delivery vendor provide these contacts with guidance on how to effectively make referrals to the program.

5.1.4 Program Strengths

IESO and program delivery vendor staff indicated that the program had significant outreach to all areas of the province. They believe the program has successfully targeted key customer segments and that it is doing so in a cost-effective manner.

IESO staff also noted that the program has been strengthened by the central delivery model, which has reduced program costs, increased administrative and logistical efficiencies, allowed for better collaboration with gas utilities, and made it easier to get in touch with hard-to-reach customers. This has helped to deploy the program on a large scale.

IESO staff indicated that one of the greatest strengths of the program is that it provides an important service through offering efficiency upgrade opportunities to customers who otherwise would not be able to make these efficiency improvements on their own. The program also often provides ancillary benefits related to home comfort and safety. IESO staff stressed that HAP has been very effective at reaching tens of thousands of homes per year. They also noted that, in future program years, there still remains a significant opportunity to serve additional customers who have not yet participated in the program.

[9] AFT is offered by the government of Ontario, not by the IESO. Program website: www.affordabilityfund.org/home/

[10] Energy Assistance Programming Working Group website: www.ieso.ca/en/Sector-Participants/Engagement-Initiatives/Working-Groups/Energy-Assistance-Programming-Working-Group

IESO staff do not hear many complaints from customers about the application, which they said is relatively simple. They hear a lot of positive feedback from customers, especially when customers are eligible to receive the extended upgrades and/or weatherization. IESO and program delivery vendor staff noted that customer satisfaction surveys have indicated high satisfaction.

5.1.5 Program Barriers

IESO and program delivery vendor staff discussed some common program barriers. Increasing customer referrals is a continuous challenge. Low-income customers often have many other competing priorities in addition to managing their energy use. Additionally, customers are not eligible to participate more than once, which means the eligible pool of potential participants diminishes as time passes.

As mentioned above, customers who are eligible for HAP are not eligible for AFT, which is a similar program offered by the government of Ontario to moderate income customers. Both IESO and program delivery staff said the availability of this program, which is very similar in design to HAP, has created some confusion and dissatisfaction among low-income customers who learn they are not eligible to receive all the same no-cost measures offered through AFT (such as heat pumps).

IESO staff reported that one drawback of the transition to the central delivery model is that it can be more challenging to identify eligible customers who might be most in need of program support. For example, when the local distribution companies (LDCs) delivered the program prior to PY2018, they had ready access to customer billing data, which could help identify high-usage customers.

The program delivery vendor staff said that the program's participation agreement also has a lengthy set of terms and conditions, which some customers find intimidating or are not comfortable with accepting. Program delivery vendor staff indicated they have worked to find appropriate ways to help customers understand the agreement, but it can still be an impediment to participation.

Another barrier that program delivery vendor staff mentioned was the lack of province-wide marketing for the program in PY2019. The program delivery vendor staff said that a lot of customers heard about the program through their outreach efforts or through word of mouth, but, moving forward, province-wide marketing is increasing and will be an important component of customer engagement.

Finally, IESO staff noted there may be a missed opportunity because the incentive finance structures leave out customers with oil or propane heating since the program requires electricity savings.

5.1.6 Program Improvement Suggestions

IESO staff and program delivery vendor staff said they continuously look for ways to make the program participation easier for customers. For example, they are currently working to improve the program's referral process. Historically, the community groups working with the IESO to promote the program were instructed to explain the program to customers and then refer them to the program delivery vendor. Going forward, they are testing out an approach where these groups refer interested customers directly to the program delivery vendor, who will provide detailed information about the program.

IESO staff also indicated that the feedback received from the participant satisfaction surveys provides many insights into program improvement opportunities. For example, customers are sometimes confused about what measures they will receive. This suggests there may be a need to improve the program messaging to ensure customers understand what they are eligible for. An effective way to set more accurate expectations is to make sure customers understand how old their equipment needs to be to qualify to receive an upgrade and then verify that the customers' equipment meets the requirements.

Finally, program delivery vendor staff suggested there may be an opportunity to cross-promote the program with the OESP, which is an Ontario Energy Board program that offers income-eligible customers a credit on their monthly electric bills.[11] All customers who qualify for OESP are automatically eligible for HAP, but program delivery vendor staff indicated there is currently no official process to tell customers about the program when they qualify for OESP.

5.2 Auditor and Contractor Perspectives

The following subsections highlight the feedback received from the HAP auditor and contractor survey. Results are presented as counts given the small sample size.

5.2.1 High-Level Results

High-level results from the auditor and contractor survey include the following:

- Auditors and contractors were very satisfied with the training and support provided by the program delivery vendor (average rating of 4.8 on a scale from 1 to 5, where 1 meant "not at all satisfied" and 5 meant "very satisfied").
- Auditors and those who were both auditors and contractors nearly always informed customers about the program (average rating of 4.3 for auditors and 4.5 for auditors and contractors on a scale of 1 to 5, where 1 meant "never" and 5 meant "always").
- Most respondents did not assist their customers with the program application. Only three of 12 respondents received training on the application process, and only two respondents assisted their customers with the applications.
- The greatest barriers to program participation mentioned by respondents were lack of awareness among customers that the program exists (mentioned by eight respondents) and skepticism among customers that the program is indeed free (mentioned by five respondents).
- Auditors and contractors provided recommendations for program improvement with most of the recommendations relating to offering additional equipment or services (mentioned by all 12 respondents). Specifically, respondents often suggested clothes washers/dryers, additional types of LEDs, exterior crawlspace insulation, painting for exterior wall insulation, increasing attic insulation requirements, and heating equipment such as heat pump upgrades.

[11] OESP website: https://ontarioelectricitysupport.ca/FAQ

5.2.2 Program Experience

Twelve respondents completed the survey, including five auditors, five contractors, and two individuals who were both an auditor and contractor. Respondents included those who indicated they would be willing to participate in the survey for this evaluation.[12] ***Figure 5.1*** displays the year respondents began working on the program. Five respondents began between 2010 and 2012, four began between 2013 and 2017, and three began in 2018.

Figure 5.1 | Year Began Working with HAP (n=12)

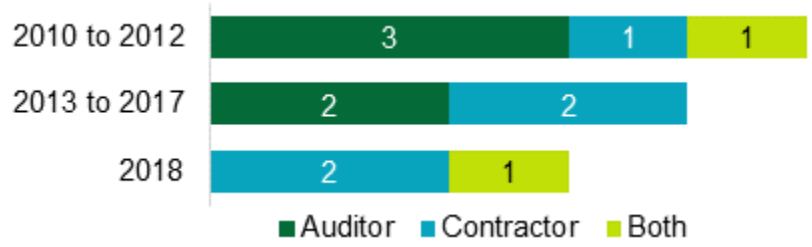


Figure 5.2 displays the number of projects respondents reported completing in PY2019 through HAP. All twelve respondents worked on single-family homes in PY2019; nine respondents also worked on multifamily homes. Most respondents (7) completed between 100 and 500 single-family projects in PY2019. Most respondents (5) who worked on multifamily homes completed less than 100 multifamily projects in PY2019. Including both single-family and multifamily projects, auditors completed 573 projects on average, contractors completed 1,446 projects on average, and respondents who served both as an auditor and contractor completed 285 projects on average in PY2019.

Figure 5.2 | Number of HAP Projects (n=12)

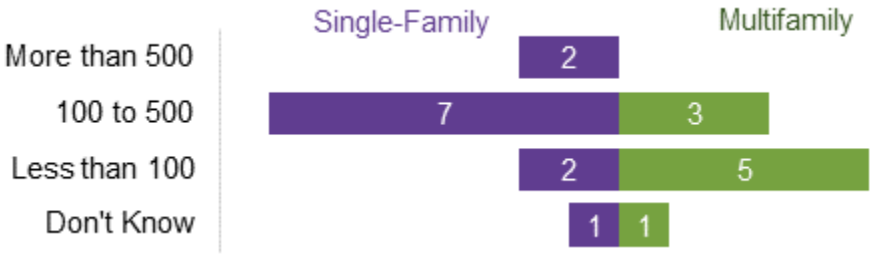


Figure 5.3 displays the respondents' type of business. Auditors' businesses include energy advisors (3), environmental businesses (1), and home inspection businesses (1). Four of the five auditors are a "one-man shop." Contractors' businesses include residential building and construction (2); repair, maintenance, and operations (2); and appliance delivery and recycling (1). Contractors' businesses have between two and 15 employees, with an average of six. On average, respondents' companies have been in operation for eleven years.

[12] The contact list that the program delivery vendor provided to the NMR team was a sample of the larger auditor and contractor network for the program, which includes approximately 70 Energy Advisors and approximately 25 contractors involved in the measure delivery.

Figure 5.3 | Type of Business (n=12)

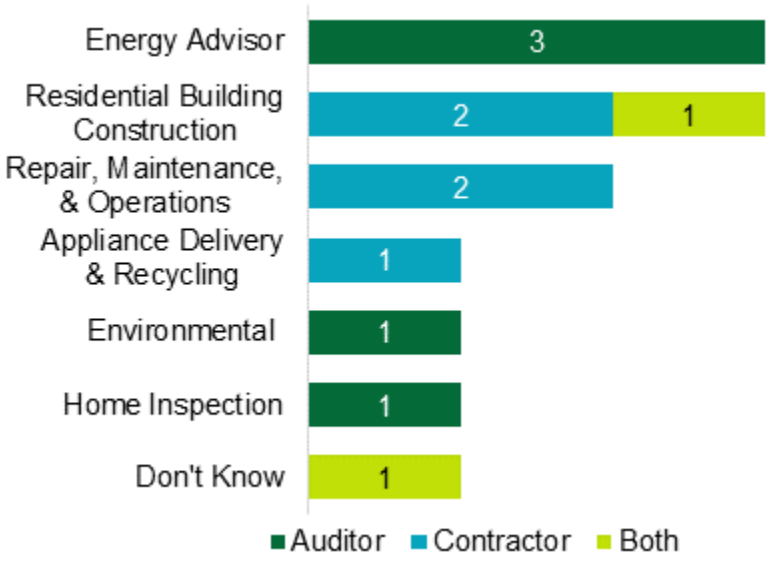


Figure 5.4 displays the type of work respondents performed for the program. All the auditors conducted audits, and three of the five auditors performed direct measure installations. Contractors installed appliances (3), performed weatherization upgrades (2), and installed thermostats (2). Of the two respondents who served both as an auditor and contractor, one performed audits and direct measure installations, while the other performed weatherization upgrades. Only two respondents, both auditors, assisted their customers with the HAP program application; these respondents found the application process to be easy and straightforward.

Figure 5.4 | Type of Work Performed for HAP (n=12, Multiple Response)

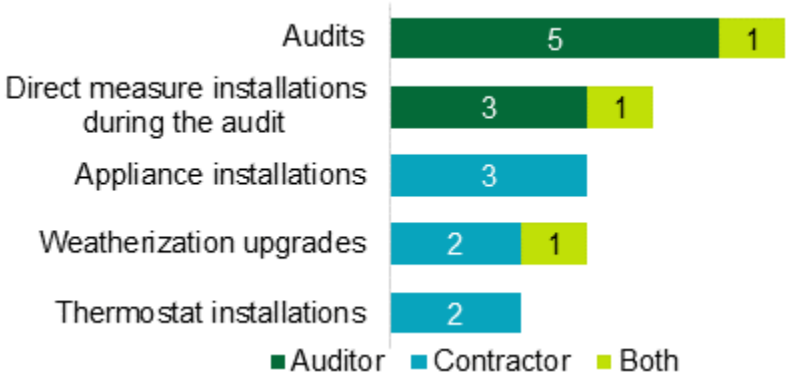
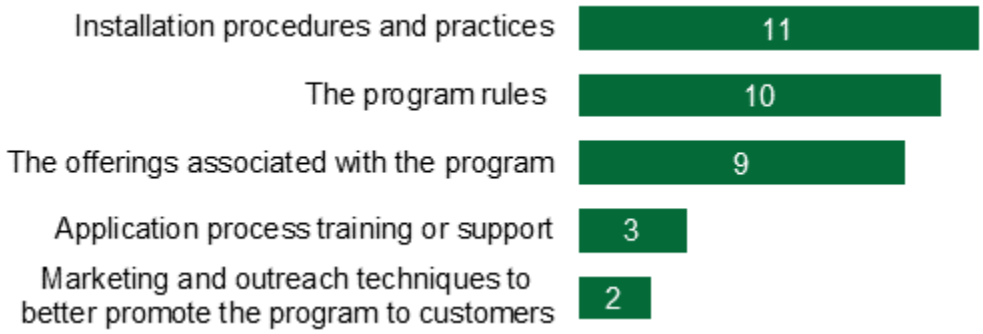


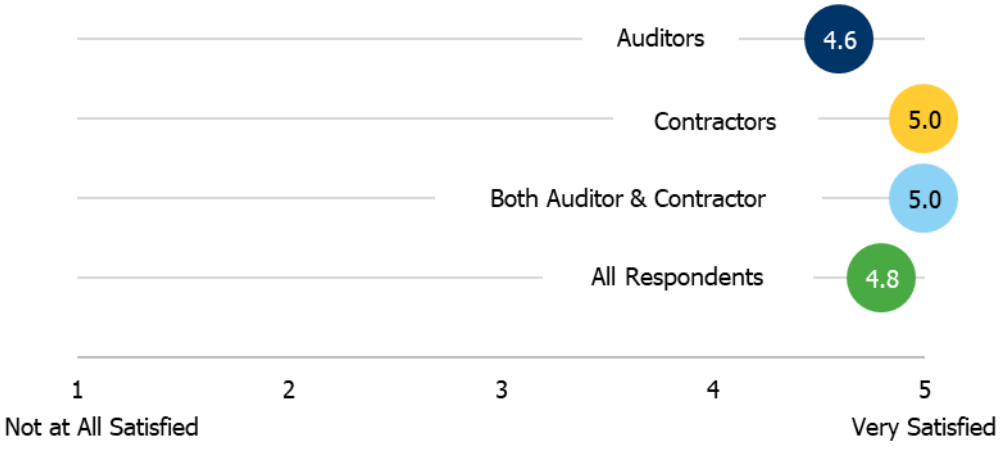
Figure 5.5 displays the types of training respondents received from the program delivery vendor. Most respondents received training on installation procedures and practices (11), program rules (10), and the offerings associated with the program (9). Only three respondents received training on the application process. Additionally, only two respondents (one auditor and one contractor) received training on marketing and outreach techniques. Only two respondents requested additional training: one requested more information about the entire process and the other requested training with others in the field across Canada.

Figure 5.5 | Type of Training from Program Delivery Vendor (n=12, Multiple Response)



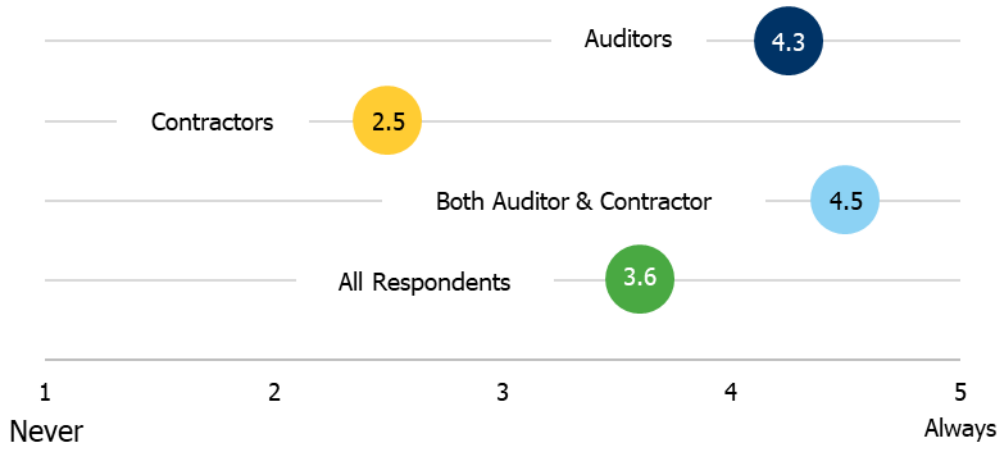
As shown in *Figure 5.6*, respondents were very satisfied with the training they received from the program delivery vendor. On a scale from 1 to 5, where 1 meant "not at all satisfied" and 5 meant "very satisfied," the average satisfaction rating among all respondents was 4.8. One-half (6) of the respondents provided feedback on communications and support they had received for the program. All six respondents said that staff had been supportive in areas such as being available for questions, providing answers in a timely fashion, providing clear instructions, and helping to coordinate bookings. Several respondents added comments praising staff, including, "Communications and support provided by the program delivery vendor have been flawless," and, "The HAP was a great team to work with; very supportive and organized."

Figure 5.6 | Satisfaction with Training (n=12)



Using a scale from 1 to 5, where 1 meant "never" and 5 meant "always," respondents indicated how often they inform customers about the program. ***Figure 5.7*** displays the average rating among respondents by their role. Respondents who served as an auditor and respondents who served both as an auditor and a contractor frequently inform customers about the program: the average ratings among these groups were 4.3 and 4.5, respectively. In comparison, contractors inform customers about the program less frequently, with an average rating of 2.5. This feedback from the contractors aligns with their roles and responsibilities for the program, which are focused primarily on measure installation following the initial visit by the auditor. Combined, the average rating among all respondents was 3.6.

Figure 5.7 | How Often Respondents Inform Customers about HAP (n=12)



5.2.3 Barriers to Program Participation

Respondents indicated there were several barriers that prevent customers from participating in the program. ***Figure 5.8*** displays the barriers respondents identified and ***Figure 5.9*** displays their recommendations for overcoming the barriers. The most common barrier—mentioned by eight respondents—was a lack of program awareness. To overcome this barrier, respondents recommended more marketing, including advertising the program in hydro bills, providing literature about the program, and encouraging word of mouth marketing from trusted sources. One respondent suggested providing enough marketing materials to hand out several to each customer so they could give them to friends and family.

The second most common barrier—mentioned by five respondents—was skepticism that the program is indeed free. For example, one respondent said, "They are concerned that it might be a scam. 'Nothing comes free,' is one of the comments I typically get on the field." Additionally, three respondents said customers do not think the upgrades will save them any money, two said customers do not think the upgrades are worth the trouble of participating, and two said getting efficiency upgrades is not a priority given customers' other responsibilities. Respondents recommended adjustments to program messaging to overcome these barriers, such as emphasizing that the program is free, including participant testimonials in marketing materials, and providing more information regarding the effectiveness and cost saving potential of the upgrades. Other messaging

adjustments that were mentioned by one respondent each included avoiding references to home comfort and setting more accurate expectations regarding upgrades. To illustrate, one respondent explained, “Not all houses can be made comfortable through the program due to inadequate heating systems or envelope components that can’t be upgraded,” and another stated, “Energy advisors need to stop promising clients the moon.”

One respondent mentioned that many customers heat with oil, propane, and wood, and it was unclear if these customers qualified for the program. This respondent recommended adding the approved heating types to the program delivery vendor website. This respondent also recommended adding the list of towns the program delivery vendor covers and local contractors’ contact numbers to the website as a means of encouraging program participation.[13] Another respondent identified customer health issues as a barrier to participation.

Figure 5.8 | Barriers to HAP Participation (n=12, Multiple Response)

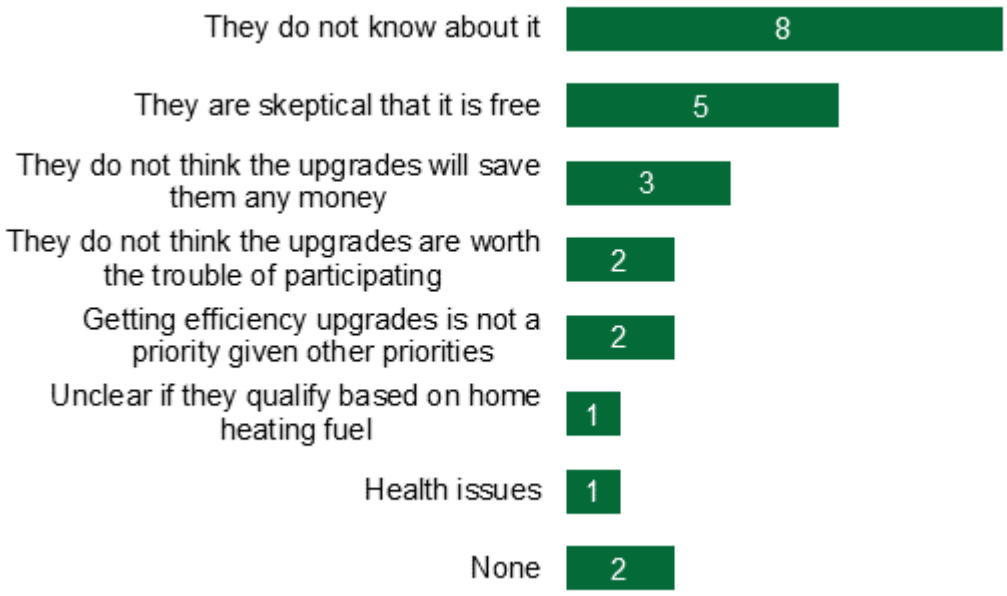
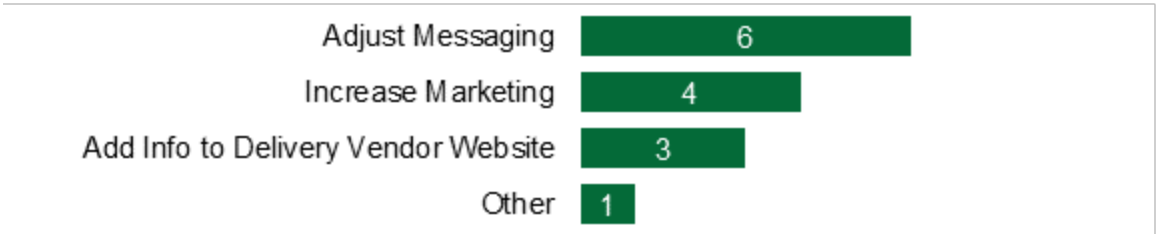


Figure 5.9 | Recommendations for Overcoming Barriers to Program Participation (n=9, Multiple Response)



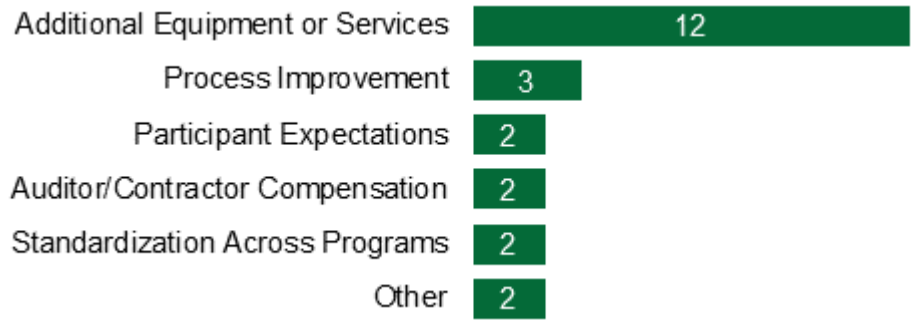
[13] Note that the program is available to eligible customers across Ontario regardless of the town or city.

5.2.4 Recommendations for Program Improvement

Respondents offered several recommendations for improving the program. As shown in ***Figure 5.10***, most of the recommendations were for additional equipment or services (mentioned by all 12 respondents). Specifically, respondents suggested clothes washers/dryers, additional types of LEDs, exterior crawlspace insulation, painting for exterior wall insulation, and increasing attic approvals to R-60.[14] In addition, a respondent recommended "right sizing" appliances to meet customer needs, stating, "We are often asked to replace a 16 cubic-foot chest freezer with a 16 cubic-foot chest freezer in a house where the customer does not need the same size and could actually benefit from energy and money savings." Another respondent recommended heat pump upgrades, such as adding ductless heat pumps to baseboard heating systems and inline heat pumps with ducted electric furnaces. One respondent explained that some customers have nowhere to stay overnight when basements and crawl spaces are spray foamed, and suggested offering funding for overnight accommodations. This respondent also suggested offering funding to frame and drywall basements in order to allow for spray foam insulation.

Three respondents offered other suggestions for process improvements, including (1) reducing the timeframe for the entire process, (2) mailing LEDs after the audit, and (3) having auditors e-mail contractors about property issues (e.g., ventilation and moisture issues, accessibility for trailers) right after the audit, while the information is still fresh in their minds. Two recommendations pertained to auditor and contractor compensation: (1) improve the wage structure and (2) increase contractor pay to compensate for increases in the cost of materials and additional expenses associated with jobs in rural areas (e.g., travel and overnight accommodation). Two recommendations pertained to standardization across the multiple programs available to residents: (1) standardizing financial eligibility criteria and (2) standardizing program offerings. As one respondent put it, "There are offerings in other programs that complicate our delivery of the program and put in to question its legitimacy. If stoves, washers, dryers, and dishwashers are offered in the AFT from utility to utility, there should be a standard set for all programs."[15] Finally, other recommendations included (1) more affiliation with Natural Resources Canada and (2) awarding the program delivery vendor the Enbridge program for Upper Ottawa Valley.

Figure 5.10 | Recommendations for Improving HAP (n=10, Multiple Response)



[14] The respondent who made this suggestion pointed out that the new building code was increasing attics to R-60.

[15] Note that the program mentioned by this respondent is officially titled the Affordability Fund Trust (AFT). Program website: www.affordabilityfund.org

5.3 Participant Perspectives

The following subsections highlight the feedback received from the HAP participant survey. Results are presented either as percentages or counts, depending on sample size.

5.3.1 High-Level Results

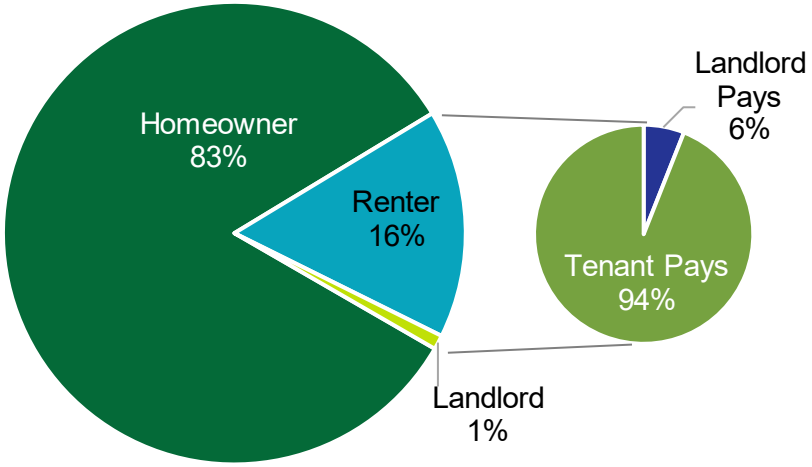
High-level results from the participant survey include the following:

- Most respondents heard about the program through bill inserts (37%) or from friends/family (23%) and applied online (53%).
- Their primary motivation for applying was to save energy or lower energy bills (average rating of 4.7 on a scale from 1 to 5, where 1 meant the motivating factor played “no role at all” and 5 meant it played “a great role”).
- Over three-fifths of respondents said their energy auditor discussed additional ways to save energy at the time of the audit (65%). Of these respondents, over three-fourths (76%) had tried at least one of them since having the audit performed; only around one-fifth (21%) had not tried any.
- Respondents are largely satisfied with the program overall (average rating of 4.3 on a scale from 1 to 5, where 1 meant “not at all satisfied” and 5 meant “completely satisfied”). They were especially satisfied with the professionalism of their auditor (average rating of 4.6). While energy savings from the upgrades was the program aspect participants were least satisfied with, this was still rated highly (average rating of 4.0).
- Fifteen percent of respondents offered suggestions for improving the program. The most common suggestions were to relax the eligibility requirements for specific upgrades (34%), offer higher quality free upgrades (20%), and set accurate expectations regarding upgrades (17%) as numerous respondents felt they were led to believe they would receive certain upgrades but were later told they were ineligible.
- Participants often recommended stoves/ranges, clothes washers/dryers, windows, and doors for inclusion in the program.

5.3.2 Participant Profile

As shown in ***Figure 5.11***, most respondents (83%) are homeowners, 16% are renters, and 1% are landlords. Among rented homes, tenants are responsible for paying the electric bill for the majority (94%) of cases.

Figure 5.11 | Relationship to Home and Responsibility for Electric Bill (n=846)



Respondents' homes are predominantly primary residences (99%) that are occupied year-round (94%). ***Figure 5.12*** and ***Figure 5.13*** display characteristics of respondents' homes, including the type of dwelling and the year it was built. Over two-thirds (71%) of respondents' homes are single-family houses. Around one-half of respondents' homes (48%) were built prior to 1970.

Figure 5.12 | Type of Home (n=846)

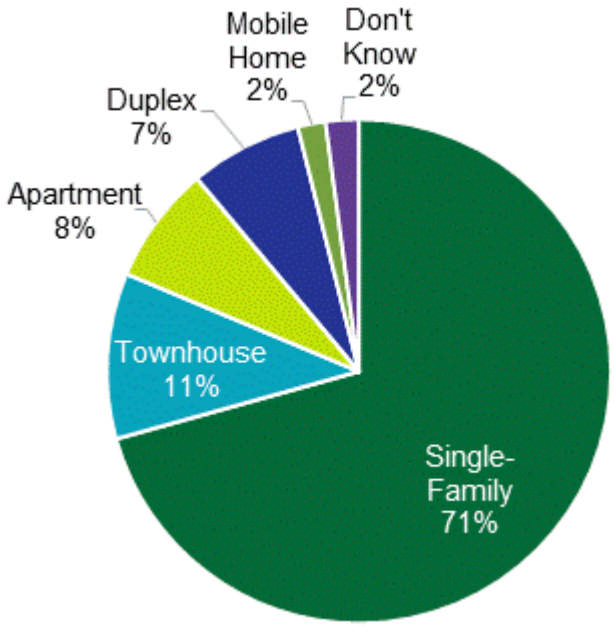
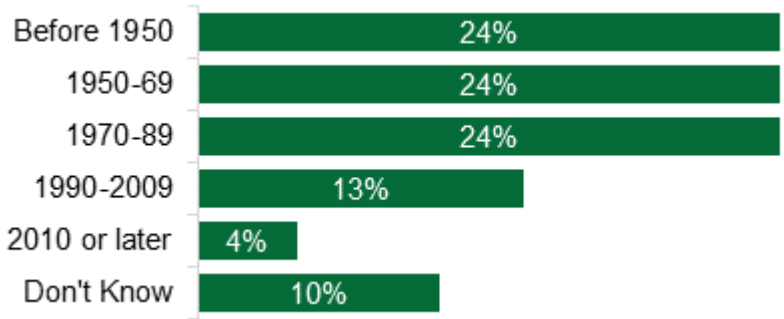


Figure 5.13 | Year Home Built (n=846)



The average household size among respondents was 2.6. ***Figure 5.14*** and ***Figure 5.15*** display the number and age of occupants in the respondents' households. Over one-fourth (26%) of respondents live alone. Children under the age of 18 and/or seniors aged 65 or older reside in approximately one-third of households (32% and 34%, respectively).

Figure 5.14 | Number of Occupants (n=839)

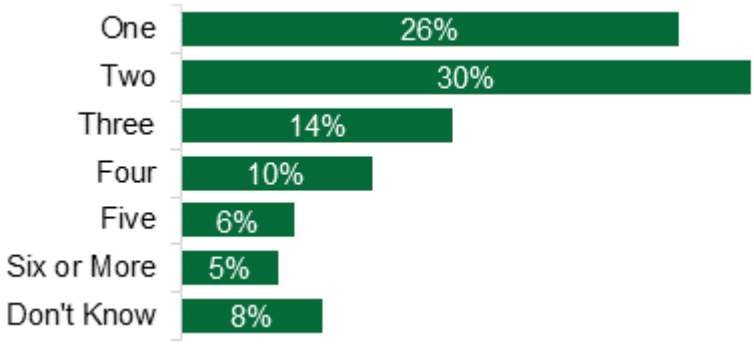


Figure 5.15 | Age of Occupants (n=839)

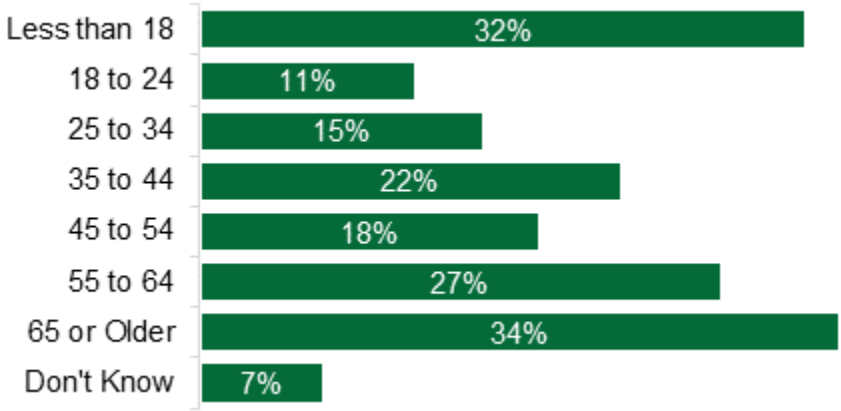
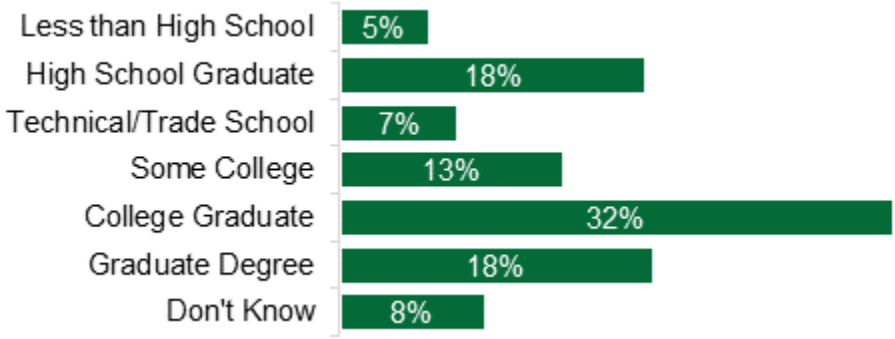


Figure 5.16 displays respondents' highest education level. One-half of respondents (50%) have a college degree or higher.

Figure 5.16 | Highest Education Level (n=839)



5.3.3 Program Awareness and Motivation

Figure 5.17 and ***Figure 5.18*** show how respondents heard about and applied to the program. Most respondents heard about the program through bill inserts (37%) or from friends or family (23%). Over one-half (53%) of respondents applied for the program online.

Figure 5.17 | How Participants Heard about HAP (n=846; Multiple Response)

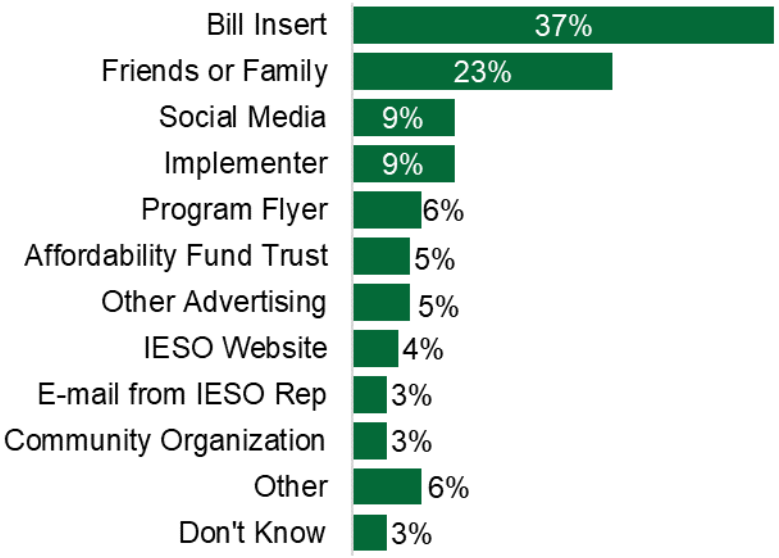


Figure 5.18 | How Participants Applied for HAP (n=846)

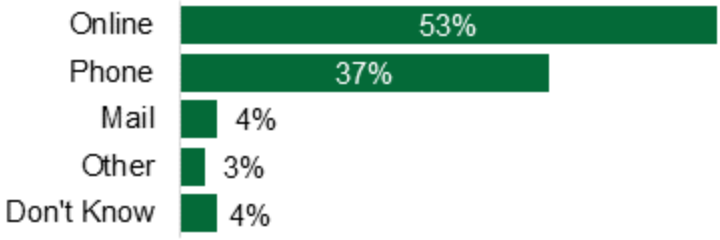
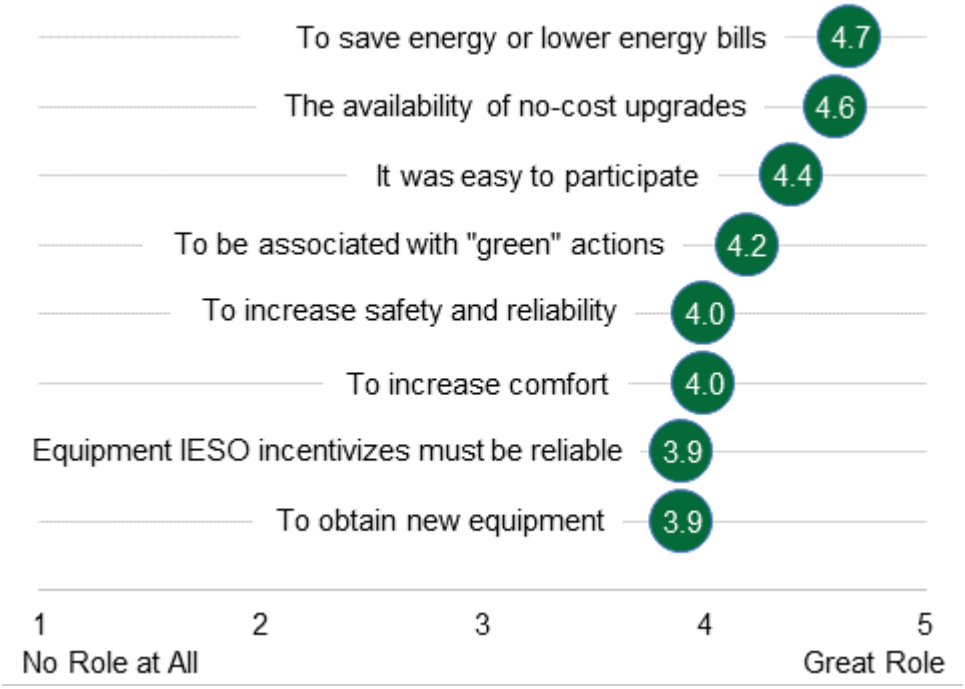


Figure 5.19 displays respondents' average ratings for the level of influence various factors had on their decision to participate in the program. Respondents rated the influence of each factor using a scale from 1 to 5, where 1 meant "no role at all" and 5 meant "a great role." The most influential factor was to save energy or lower energy bills, with an average rating of 4.7. The availability of the no-cost upgrades and the ease of participating were also highly influential, with average ratings of 4.6 and 4.4, respectively.

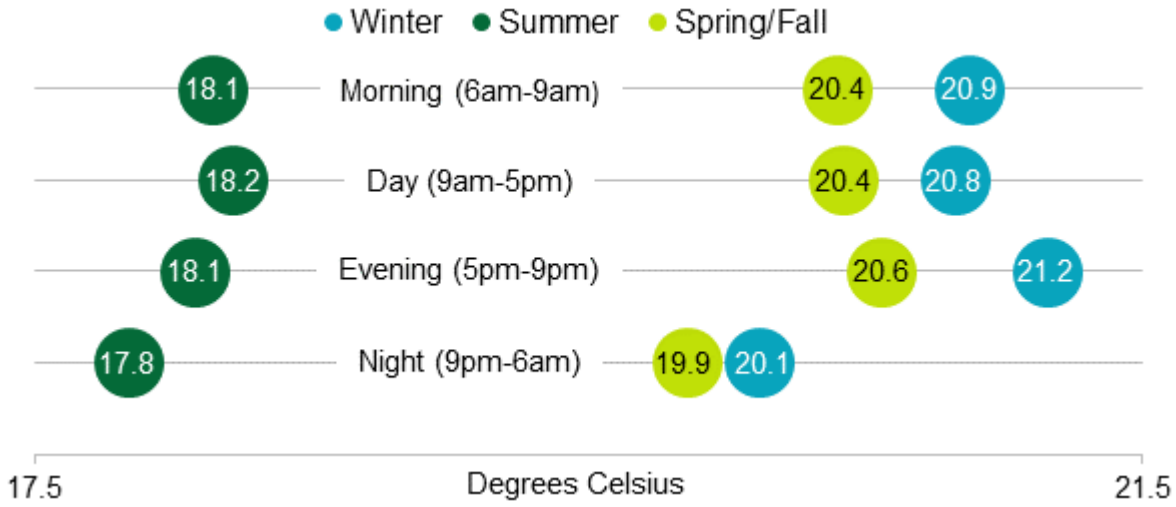
Figure 5.19 | Factors Influencing HAP Participation (n=846)



5.3.4 Program Education and Behavioural Changes

Figure 5.20 displays the average temperature (in degrees Celsius) that respondents set their thermostats to during various times of the day and year. Not surprisingly, respondents set their thermostats lowest during the summer and highest during the winter. Additionally, respondents set their thermostats lowest at night (9pm-6am). During spring/fall and winter, respondents set their thermostats highest during the evening (5pm-9pm). During the summer, respondents set their thermostats highest during the day (9am-5pm).

Figure 5.20 | Participant Thermostat Settings (n=752*)



*Average n among temperature-time responses; excludes outliers.

Energy auditors provided various resources to participants at the time of the audit. As shown in ***Figure 5.21***, over four-fifths of respondents (87%) said the auditor explained the efficiency upgrades performed the day of the audit. Additionally, over two-thirds of respondents (71%) said the auditor offered guidance about additional upgrades for which they may be eligible. Just over three-fifths of respondents said the auditor discussed additional ways to save energy or left educational materials behind (65% and 63%, respectively). Respondents found these resources useful (the average rating was 4.2 on a scale from 1 to 5, where 1 meant "not at all useful" and 5 meant "very useful.")

Figure 5.21 | Resources Provided by Energy Auditor (n=846; Multiple Response)

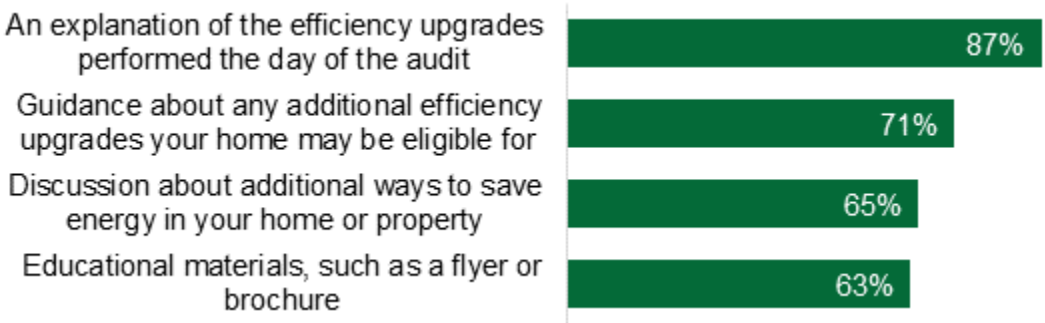
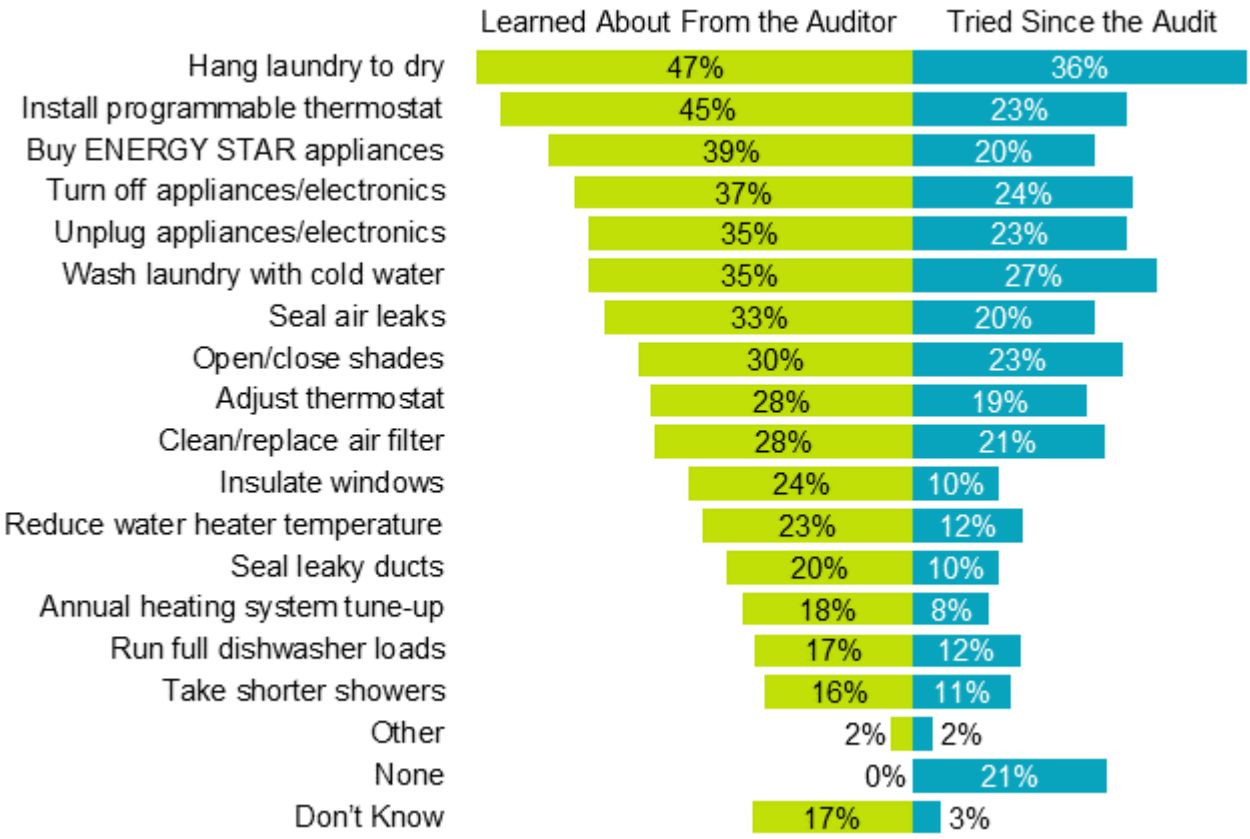


Figure 5.22 displays the additional energy-saving methods respondents said their auditor suggested. The most frequently suggested method was to hang laundry to dry: nearly one-half (47%) of respondents said their auditor suggested this. Between one-third and one-half of respondents said their auditor suggested installing a programmable thermostat (45%), upgrading to ENERGY STAR appliances (39%), turning off or unplugging appliances and electronics (37% and 35%, respectively), washing laundry with cold water (35%), and sealing air leaks (33%).

Over three-fourths (76%) of respondents whose auditor discussed additional ways to save energy had tried at least one of them since having the audit performed; only around one-fifth (21%) of these respondents had not tried any. The most common energy saving actions respondents mentioned trying since the audit included hanging laundry to dry (36%), washing laundry with cold water (27%), and turning off appliances and electronics (24%).

Figure 5.22 | Additional Ways to Save Energy (n=547)



5.3.5 Satisfaction

Most respondents were satisfied with the program. *Figure 5.23* displays respondents' average satisfaction ratings with various aspects of the program and the program overall on a scale from 1 to 5, where 1 meant "not at all satisfied" and 5 meant "completely satisfied." The average rating for the program overall was 4.3. Some respondents added comments praising the program, including, "The program is great, very helpful especially for those who have financial difficulties." Others expressed their thanks, with comments such as, "Very grateful," "I just want to say thank you for the Program

and all the staffs," and "Thank you Energy Saver program!" Over four-fifths (84%) of respondents said they were likely to recommend the program to others.

The program aspect that respondents were most satisfied with was the professionalism of the auditor: the average rating was 4.6. In fact, several respondents added comments praising their auditor. For example, one respondent commented, "They were very friendly, professional, and knowledgeable. They answered all of my questions." Another respondent said, "He was very kind, and extremely informative. Would definitely give that employee 5 stars." While energy savings from the upgrades had the lowest average satisfaction rating, this aspect of the program still had a relatively high rating, at 4.0.

Figure 5.23 | Satisfaction with Program Aspects (n=846)

5.3.6 Recommendations for Program Improvement

Fifteen percent of respondents (130 of 846) offered suggestions for improving the program, as shown in ***Figure 5.24***.

T most common suggestion was to relax eligibility requirements for specific upgrades. Over one-third (34%) of respondents who offered improvement suggestions were disappointed that they did not qualify for upgrades such as refrigerators, freezers, insulation, thermostats, and air conditioners. To illustrate, one respondent commented, "I did not qualify for a new freezer or air conditioner, which is why I applied." Another respondent said, "Don't qualify for furnace upgrade, window or insulation installation, which would be significant energy savings." A third respondent said, "I don't understand

why I wasn't eligible for the upgrades that were suggested. I was left feeling disillusioned about the program that implied I would be eligible for many upgrades."

One-fifth (20%) of respondents with improvement suggestions recommended higher quality upgrades. Seven percent of all respondents who received drying racks said theirs broke, and 5% who received LEDs said one or more broke. One respondent commented, "The drying rack just fell apart when I was taking it out of the package and further broke as I used it. It's a very cheaply made product. And I was so happy with getting this and then it fell apart."

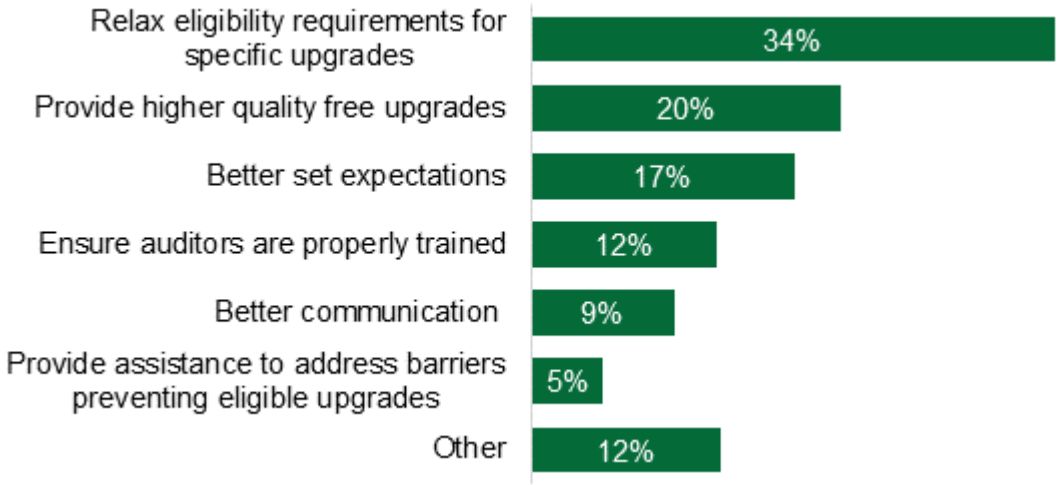
Seventeen percent of respondents with improvement suggestions indicated that the program could do a better job at setting expectations. A number of respondents felt they had been led to believe they would receive certain upgrades but were later told they were ineligible. For example, one respondent recommended "better training of staff and ensure false promises are not made." Another respondent said, "I was told by the contractor that we are eligible to replace some of the appliances but was rejected later."

Twelve percent of respondents with improvement suggestions recommended ensuring auditors are sufficiently trained. These respondents had negative experiences with their auditors, such as unprofessionalism, lack of communication, overlooking areas of the home during the audit, and not following up as expected. For example, one respondent commented, "He did nothing but complain about [the program delivery vendor] and his job and tell me my house was uncomfortable."

Around one in ten (9%) respondents with improvement suggestions recommended better communication regarding the status of post-audit upgrades for which they were eligible. For example, one respondent stated, "After several back and forth phone communications with the program coordinator over the course of several months clarifying some incorrect information that they received from the auditor, they promised that they would send my file for review and would respond back to me. I waited several months without hearing back." Another respondent said, "Reply to questioning e-mails would have been nice, as well as an explanation of why we suddenly didn't qualify. In the long run, we were denied, after many months of waiting for a reply."

Five percent of respondents with improvement suggestions desired assistance to address barriers preventing them from getting eligible upgrades, including asbestos removal. Twelve percent of respondents made other suggestions, including assistance setting up power bars and thermostats, wanting to receive refrigerators the same size as the existing refrigerator, allowing participants to reapply to the program when they become eligible for specific upgrades, and ensuring that customers living in rural areas have equal access to the program.

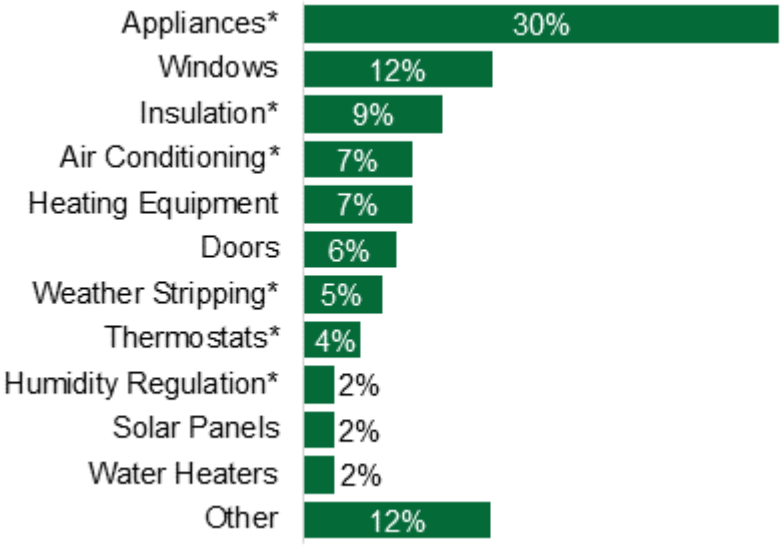
Figure 5.24 | Suggestions for Program Improvement (n=130; Multiple Response)



Nearly one-third of respondents (261 of 846) provided a total of 405 suggestions for additional energy-efficiency equipment or services for inclusion in HAP. ***Figure 5.25*** displays the categories of additional equipment or services respondents recommended; asterisks denote whether some or all the upgrades in the category are already included in the program. One-fourth of the recommended upgrades are already included in the program, such as refrigerators, freezers, insulation, window ACs, weather stripping, thermostats, dehumidifiers, faucet aerators, low-flow showerheads, water heater insulation, and block heat timers. This suggests that respondents who recommended these measures were unaware of their inclusion, potentially because they were ineligible for them.

The most frequently mentioned type of additional equipment respondents suggested was appliances (30% of suggestions), including stove/ranges, clothes washers/dryers, refrigerators, freezers, dishwashers, and microwave ovens. Additional equipment respondents suggested that are not already offered by the program include windows (12% of suggestions), heating equipment (7%), doors (6%), solar panels (2%), and water heaters (2%).

Figure 5.25 | Additional Equipment or Services (n=405)



*Some or all the upgrades in this category are already offered by the program.

6. Jobs Impact Analysis

This section outlines the jobs impact analysis results. Details regarding the jobs impact analysis methodology can be found in ***Section 3.3*** and ***Appendix A.3***.

6.1 High-Level Results

- The analysis used an input-output model to estimate that HAP will create 110 total jobs in Canada, of which 99 will be in Ontario.
- Most of the jobs stem from the demand created for energy-efficient products and services related to program delivery.

The analysis estimated that HAP will create 110 total jobs in Canada, of which 99 will be in Ontario. Of the 110 estimated total jobs, 49 were direct, 34 were indirect, and 27 were induced. In terms of FTEs the numbers are slightly less, with 80 FTEs created in Ontario and 88 in total across the country. Of these 88 FTEs, 42 were direct, 27 indirect, and 19 induced. In total, HAP job impacts were 10.6 jobs created per million dollars of investment (i.e. program budget).

Input-Output models are informative for understanding the potential magnitudes and dynamics of economic shocks created by policies and programs. While useful, the StatCan IO Model is a simplified representation of the Canadian economy and thus has limitations. The model is based on the assumption of fixed technological coefficients. It does not take into account economies of scale, constraint capacities, technological change, externalities, or price changes. This makes analyses less accurate for long term and large impacts, where firms would adjust their production technology and the IO technological coefficients would become outdated. Assuming that firms adjust their production technology over time to become more efficient implies that the impact of a change in final demand will tend to be overestimated. For household consumption, the model is based on the assumptions of constant consumption behaviour and fixed expenditure shares relative to incomes.

Section 6.2 details the values of the inputs used as shock values for the model runs. ***Section 6.3*** presents the analysis, including details of job impacts and assumptions. ***Section 6.4*** discusses responses to the HAP auditor and contractor survey related to job impacts.

6.2 Input Values

The model was used to estimate the impacts of two economic shocks – one representing the demand for energy-efficient products and services from HAP and the other from the increased household expenditures due to bill savings (and net of program funding). ***Table 6.1*** shows the input values for the demand shock representing the products and services related to HAP. Each measure installed as part of HAP was categorized according to the StatCan IO Supply and Use Product Classifications (SUPCs).

The first five rows of the table contain the categories corresponding to products, which were the measures installed in homes. The last two rows contain the services. Of the five product measures, Major appliances had the highest total cost at $2.9 million and Electric light bulbs and tubes was second highest at $2.2 million. Each measure's cost was divided into labour and non-labour. Electric

light bulbs and tubes and Other miscellaneous manufactured products did not have any assumed labour costs for measure installation. The Non-metallic mineral products category was mainly insulation, for which labour represented 70 percent of the total cost. Small electric appliances included thermostats, which had installation costs around 50% of the total. The installation cost for the Major appliances category was roughly 13%.

For the two service categories in ***Table 6.1***, Office administrative services included general overhead and administrative services associated with program delivery, such as program management and staffing, call centre operations, and IESO admin labour. The Other professional, scientific and technical services included the audits. The total demand shock represents the sum of the audit fees. The labour and non-labour amounts are not specified for these services, as the IO Model has assumptions incorporated for the relative proportions of each for these categories.

Table 6.1 | Summary of Input Values for Demand Shock

Category Description	Non-Labour ($ Thousands)	Labour ($ Thousands)	Total Demand Shock ($ Thousands)
Major appliances	2,579	328	2,907
Electric light bulbs and tubes	2,232	-	2,232
Small electric appliances	511	511	1,023
Non-metallic mineral products	42	98	140.00
Other miscellaneous manufactured products	485	-	485.00
Office administrative services	-	-	1,531.00
Other professional, scientific and technical services	-	-	2,061
Total			**10,378.00**

Table 6.2 shows the calculations and input value for the household expenditure shock.[16] This shock represents the net additional amount that households would inject back into the economy through spending. The model does not distinguish between participants and non-participants in the residential sector, so the net amount of additional money households (as a whole) would have available is the difference between the bill savings (Net Present Value (NPV) = $12.7 million) and the portion of all energy-efficiency programs funded by the residential sector (35%, or $3.6 million). The difference is $9.1 million and represents the additional money that households could either spend on goods and services or save, pay off debt, or otherwise not inject back into the economy. The surveys administered to participants as part of the HAP process evaluation included several questions about

[16] The model is actually run with a normalized value of $1 million in extra household expenditures and the job results can be scaled by the actual demand shock.

what households would do with the money that they saved on their electricity bills. From the survey responses, we estimated that 28% of household bill savings would be spent. Thus, the household expenditure shock would be $2.53 million, as shown in ***Table 6.2***.

Table 6.2 | Summary of Input Values for Household Expenditure Shock

Description	Demand Shock ($ Thousands)
NPV of energy bill savings	12,746
Residential portion of program funding	(3,603)
Net bill savings to residential sector	**9,143**
Percent spent on consumption (vs. saved)	28%
Total Shock	**2,527**

6.3 Model Results

The StatCan IO Model generated results based on the input values detailed in ***Section 6.2***. ***Table 6.3*** shows the results of the model run for the demand shock for products and services. This shock represented the majority of the job impacts. As the two right columns show, the model estimated that the demand shock will result in the creation of 90 total jobs (measured in person-years) in Canada, of which 82 will be in Ontario. Of the 90 jobs, 38 were direct, 29 were indirect, and 23 were induced. In terms of FTEs, the numbers are slightly less, with 68 FTEs created in Ontario and 74 in total across the country. Of these 74 FTEs, 34 were direct, 23 indirect, and 17 induced. As the table shows, the direct job impacts were realized exclusively in Ontario. As we move to indirect and induced jobs, impacts are dispersed outside of the province.

Table 6.3 | Job Impacts from Demand Shock

Job Impact Type	FTE (in person-years) - Ontario	FTE (in person-years) - Total	Total Jobs (in person-years) - Ontario	Total Jobs (in person-years) - Total
Direct	34	34	38	38
Indirect	20	23	26	29
Induced	14	17	18	23
Total	**68**	**74**	**82**	**90**

Table 6.4 shows the results of the model run for the household expenditure shock. The total shock value was $2.53 million—compared to the demand shock of $10.4 million—and the job impacts were generally proportional. The extra household spending would yield 8 direct FTEs and 11 direct total jobs in Canada. Total jobs were 14 for direct and 20 in total for Canada.

Table 6.4 | Job Impacts from Personal Expenditure Shock

Job Impact Type	FTE (in person-years) - Ontario	FTE (in person-years) – Total	Total Jobs (in person-years) - Ontario	Total Jobs (in person-years) -Total
Direct	7	8	10	11
Indirect	3	4	4	5
Induced	2	2	3	4
Total	**12**	**14**	**17**	**20**

The other factors included in the research questions were the impact of program funding on the non-residential sector and the impact from reduced electricity consumption. Assuming that businesses absorb the increases in electricity costs to fund the program, there would be no impact on jobs. There would be an impact on direct GDP (value-added), equivalent to the profit loss resulting from the increase in electricity bills from program funding. The StatCan IO Model has production functions that cannot be adjusted, so electricity price changes would be modeled by making the assumption that surplus would be reduced by the extra amount spent on electricity.

The economic impact of the reduction of electricity production as a result of the increase in energy efficiency must be examined closely. Technically speaking, it can be estimated using StatCan Input-Output multipliers[17] without running the model. The multiplier is 4.2[18] (per $ million) and the NPV of decreased electricity bills (retail) was $12.7 million. Thus, the model would predict that the reduction in electricity production would cause a job loss of 53 person-years over the course of 20 years (the longest EUL in the portfolio of HAP measures). However, the IO model is linear, and not well suited to model small decreases in electricity production. Total electricity demand has been increasing over time and is projected to continue increasing.[19] HAP first year energy savings represented 0.01% of total demand in 2019. This relatively small decrease in overall consumption may work to slow the rate of consumption growth over time but would likely not result in actual job losses in the utility industry or upstream suppliers. The linearity of the IO model means that it will provide estimates regardless of the size of the impact. Given the nature of electricity production, it is reasonable to conclude that the linear IO multiplier is not appropriate for estimating job impacts. This analysis assumes that job losses from decreased electricity production are negligible.

Table 6.5 shows the total estimated job impacts by type—combining ***Table 6.3*** and ***Table 6.4***. Forty-eight out of the 49 estimated total direct jobs were in Ontario. A slightly smaller share of the indirect and induced jobs was in Ontario, with 30 out of 34 indirect and 21 out of 27 induced total jobs within the province. The FTE estimates are slightly less, with a total of 80 FTEs (of all types) created in Ontario and 88 FTEs added throughout Canada. All but one of the direct FTEs (41 of 42) were added in Ontario, with this number representing just over 53% of the total FTEs added in Ontario and 47% of FTEs added in Canada.

[17] Table 36-10-0595-01. The relevant industry is Electric power generation, transmission and distribution [BS221100].

[18] Statistics Canada. Table 36-10-0595-01 Input-output multipliers, provincial and territorial, detail level
DOI: https://doi.org/10.25318/3610059501-eng

[19] Annual Planning Outlook – A view of Ontario's electricity system needs; 2020. IESO.

Table 6.5 | Total Job Impacts by Type

Job Impact Type	FTE (in person-years) - Ontario	FTE (in person-years) – Total	Ontario	FTE (in person-years) – Total	Total Jobs per $1M Investment (in person-years)
Direct	41	42	48	49	4.7
Indirect	23	27	30	34	3.3
Induced	16	19	21	27	2.6
Total	**80**	**88**	**99**	**110**	**10.6**

Table 6.6 shows the job impacts in more detail, with jobs added by type and by industry category. Industries are sorted from top to bottom by those with most impacts to least, with industries that showed no impacts not included in the table. The table shows that the industry with the largest impacts was Professional, scientific and technical services. This reflects the need to hire more auditors, as this was the same service classification in the demand shock input containing the audit services. Retail trade and Wholesale trade were the industries with the next most added jobs, with 16 and 8 total jobs added, respectively.

Table 6.6 | Job Impacts by Industry

Job Impact Type	FTE (in person-years) - Ontario	FTE (in person-years) - Total	Total Jobs (in person-years) - Ontario	Total Jobs (in person-years) - Total
Professional, scientific and technical services	37	38	43	44
Retail trade	11	1	15	6
Wholesale trade	7	8	7	8
Finance, insurance, real estate, rental and leasing and holding companies	5	6	6	7
Accommodation and food services	3	4	5	6
Administrative and support, waste management and remediation services	3	3	4	5
Manufacturing	3	4	3	4
Other services (except public administration)	2	2	3	3
Transportation and warehousing	2	3	2	3
Health care and social assistance	1	1	2	2
Information and cultural industries	1	2	1	2
Repair construction	1	1	2	2
Arts, entertainment and recreation	1	1	1	2
Non-profit institutions serving households	1	1	1	1

Job Impact Type	FTE (in person-years) - Ontario	FTE (in person-years) - Total	Total Jobs (in person-years) - Ontario	Total Jobs (in person-years) - Total
Other municipal government services	1	1	1	1
Crop and animal production	-	-	-	1
Government education services	1	1	1	1
Educational services	-	-	1	1
Total*	**80**	**88**	**99**	**110**

* Columns may not add to totals due to rounding. Real values are rounded to nearest whole number and the whole numbers do not sum exactly to the whole number total in every column.

6.4 Survey Responses on Job Impact Questions

The HAP auditor and contractor survey contained job impact-related questions for auditors and contractors related to the impact of HAP on their firms and employment levels. Two questions in particular were informative to understand the nature of the impacts to respondents, which would be considered direct impacts. These two questions are below, with relevant illustrative verbatim survey responses included:

Did the 2019 Home Assistance Program help or hinder the growth of your business in any way? If so, please explain how.

1. The program helped the growth of my business in the following ways:

- "Provided more business to allow us to expand in revenue and staffing."
- "Increased number of employees, Increased Sales"
- "Provided my business with a steady stream of work in an industry that is often hot and cold or on and off."

The program hindered the growth of my business in the following ways:

- "Not really a hindrance but the lack of longer term contracts often hinders the ability to commit to staff on longer term."

2. Did the 2019 Home Assistance Program have an impact on the number of people you hired in the last year? Yes, the program impacted the number of people hired in the last year in the following ways:

Positive Impacts:

- "Yes, the growth of the program required us to hire 3-4 additional staff."
- "Hired an additional 5 employees directly…"
- "We hired another 4 people because of this program"

Negative Impacts:

- “I was unable to hire additional employees due to the need for combination audits with the [gas utility] programs.”

Responding auditors and contractors indicated that the program had allowed them to add personnel to meet the demand for new work from HAP. The direct job gains estimated by the model are generally supported by the responses, which reveal the nature of the actual impact on firms. The respondents that indicated potentially negative issues related to adding personnel indicated a lack of longer-term contracts hindering employment and “the need for combination audits” with other programs. These issues could be examined further if there was a focus on redesigning certain aspects of the program to enhance job impacts.

7. Key Findings and Recommendations

The following section summarizes the PY2019 evaluation key findings and recommendations.

Finding 1: Discrepancies in reported demand savings were the primary source for the low realization rate for demand savings.

The primary driver for the low demand savings realization rate was the use of connected demand savings values instead of the evaluated measurement and verification (EM&V) peak demand savings values for reported demand savings for some measures.[20] Measures that applied connected demand savings included lighting, aerators, showerheads, freezers, dehumidifiers, refrigerators, and window ACs. Note that not every record for each measure type applied connected demand savings; it was unclear why some records used connected values and other records used peak demand values for the same measure type.

There were also several measures that did not apply a reported demand savings value but should have had demand savings applied. Although neither discrepancy is applied holistically to a specific measure (accept power bar measures), these discrepancies appear to be systematic in nature and result in overestimating demand savings.

- ***Recommendation 1.*** Apply EM&V peak demand savings values for all measures with prescribed demand savings values beginning in PY2020. Verify that peak demand values are consistent for each measure type included in the tracking data. Ensure that values are not rounded in tracking databases to avoid mischaracterization of demand savings values. Verify that only measures with no peak demand savings report zero demand savings.

Finding 2: Savings attributed to lighting measures are decaying over time.

Net verified first year savings for lighting measures were lower on a per-unit basis than previous evaluation years due to substantiation sheet adjustments that increased baseline wattage values and lowered HOU. Lighting measures were attributed an ISR rate of 97% based on the results from participant surveys, which also lowered per-unit savings.

- ***Recommendation 2.*** As savings from lighting measures decay, the program will need to reallocate resources to push alternative measures and focus on deep-energy savings. Weatherization upgrades can provide important savings opportunities and health upgrades for participants. It will be important for the program to emphasize and implement weatherization upgrades to participants as savings from lighting measures continue to diminish over time.

[20] Connected demand relates to the total electric power-consuming rating of the device where peak demand has a peak demand factor applied to determine peak demand savings. The IESO defines peak demand as the highest electric requirement occurring in a given period (e.g., an hour, a day, month, season, or year). For an electric system, it is equal to the sum of the metered net outputs of all generators within a system and the metered line flows into the system, less the metered line flows out of the system.

Finding 3: Clearly communicating measure eligibility is critical.

Relaxing the eligibility requirements for specific upgrades was the most common suggestion participants made for improving the program (34%). Another common suggestion was to set more accurate expectations regarding upgrades (17%).[21] Numerous respondents felt they were led to believe they would receive certain upgrades but were later told they were ineligible. Many felt disappointed that they could not receive upgrades such as refrigerators, freezers, insulation, thermostats, and air conditioners.

- ***Recommendation 3.*** Accurately set participants' expectations regarding upgrades. Clearly communicate eligibility requirements for upgrades prior to the audit and ensure that auditors are trained to clearly communicate eligibility requirements for upgrades. Encourage auditors to not overpromise on measures for which customers may not be eligible.

Finding 4: Additional cross-promotion opportunities exist.

The IESO and program delivery vendor staff mentioned additional opportunities to cross-promote the program exist, including the Ontario Electricity Support Program (OESP). Low-income customers are already referred to HAP if they find that they do not qualify for the Affordability Fund Trust (AFT), which is a similar program offered to moderate income customers.

- ***Recommendation 4.*** Consider additional ways to cross-promote the program, such as through OESP.

Finding 5: Power bar measures had extremely high realization rates.

The NMR team found multiple discrepancies with smart power bars and power bars with integrated timers. The NMR team observed in the program tracking data that the smart power bar measures incorrectly referenced the savings value associated with power bars with integrated timers. The NMR team discovered an additional discrepancy during the engineering desk reviews: the project files indicated a smart power bar was installed, but the tracking data listed a power bar with an integrated timer.

Separate from the observed discrepancies in the tracking data, The NMR team found an additional discrepancy in the substantiation sheet for smart power bars. The substantiation sheet referenced savings values for a tier-1 smart power bar installed in an unknown location; however, the program only distributes tier-2 smart power bars and only installs them with audiovisual (AV) equipment. The savings adjustment, coupled with the observed discrepancies, attributed power bars with an extremely high realization rate.

- ***Recommendation 5.*** Ensure that the tracking data and the data collection forms align for each measure distributed to the participant. Ensure that auditors are installing the tier-2 smart power bars with AV equipment (or include installation location in the data collection form). Verify that the correct energy savings values are applied to the correct measure. Note that the NMR team confirmed with the program delivery vendor that power bars with integrated timers will not be offered by the program once the remaining stock has depleted.

[21] Note that the base for this feedback is the 15% of all responding participants who offered improvement suggestions.

Finding 6: Project costs were generally well below the program cap.

Seventy-one percent of the projects had an incentive less than $500 and 92% of the projects had an incentive less than $1,000, while the program's total measure cost cap per home was $13,000. This suggests that lower cost measures were much more commonly implemented than higher cost measures. Consequently, there may be additional savings opportunities not implemented that involve higher cost measures.

- ***Recommendation 6.*** Ensure that the maximum amount of savings opportunities is identified and implemented at each home, within program cost limits. Higher cost measures should be considered when feasible as they may provide deeper savings per home.

Finding 7: Program marketing is working well but there is room for improvement.

Participants heard about the program from a variety of channels with the most common being bill inserts (37%) and from friends and family (23%). Auditors and those who act as both auditors and contractors nearly always informed customers about the program (average rating of 4.3 for auditors and 4.5 for auditors and contractors on a scale of 1 to 5, where 1 meant "never inform the customer" and 5 meant "always inform the customer"). However, auditors and contractors reported that the greatest barriers to program participation were lack of awareness that the program exists (mentioned by eight respondents) and skepticism that the program is indeed free (mentioned by five respondents).

- ***Recommendation 7.*** Continue to market the program through a variety of channels including online, through community groups, and by coordinating with LDCs to promote the program. Consider adding additional or more varied participant testimonials to marketing literature and messaging that emphasizes that the program is free. Ensure that auditors and contractors have enough literature to provide several copies to each customer so they can give them to friends and family.

Finding 8: Energy-efficiency education activities are likely resulting in savings.

Over three-fifths of all responding participants said their auditor discussed additional ways to save energy at the time of the audit or left educational materials behind (65% and 63%, respectively). Of these participants, three-fourths (76%) said they had tried at least one of them since having the audit performed; only around one-fifth (21%) had not tried any. The most common energy saving actions these respondents mentioned trying since the audit included hanging laundry to dry (36%), washing laundry with cold water (27%), and turning off appliances and electronics (24%).

- ***Recommendation 8.*** Consider ways to analyze and quantify the energy savings resulting from the program's energy education activities such as through performing a billing analysis.

Finding 9: Participants, auditors, and contractors suggest offering additional equipment through the program.

Equipment types that are not included in the program but were suggested for inclusion by participants most often included stoves/ranges, clothes washers/dryers, windows, heating equipment, and doors. All twelve of the responding auditors and contractors recommended offering additional equipment or services. Specifically, they suggested clothes washers/dryers, additional types of LEDs, exterior

crawlspace insulation, painting for exterior wall insulation, increasing attic insulation requirements, and heating equipment such as heat pump upgrades. One respondent also mentioned the importance of right-sizing appliances so that they are the appropriate size for customer needs. The IESO and program delivery vendor staff indicated that the availability of the AFT has also created some dissatisfaction among customers who learn they are not eligible to receive some of the upgrades offered through the AFT, such as heat pumps.

- ***Recommendation 9a.*** Consider offering additional types of equipment, such as clothes washers and dryers, windows, doors, additional types of LEDs, "right-sized" appliances, heating equipment, and increasing attic insulation requirements.
- ***Recommendation 9b.*** Review measures offered through the AFT to identify whether any may be appropriate for inclusion in HAP.

Finding 10. Participants suggest offering higher-quality products for certain equipment types.

Offering higher quality free upgrades was mentioned by one-fifth (20%) of participants with improvement suggestions.[22] Seven percent of all respondents who received drying racks said their product broke, and 5% of all respondents who received LEDs said one or more light broke.

- ***Recommendation 10.*** Provide higher quality drying racks and LEDs.

Finding 11. HAP had direct, positive impacts to employment in Ontario from PY2019 activities. These impacts would propagate to other provinces and across a broader set of industries in a normal economy.

The analysis estimated that HAP will create 110 total jobs in Canada, of which 99 will be in Ontario. Of the 110 estimated total jobs, 49 were direct, 34 were indirect, and 27 were induced. Forty-eight of the 49 direct jobs were in Ontario. A slightly smaller share of the indirect and induced jobs was in Ontario, with 30 out of 34 indirect and 21 out of 27 induced total jobs within the province. This indicates that under normal economic conditions (i.e. prior to the disruptions from COVID-19), one would expect the impacts from the program to propagate through the economy via indirect and induced effects—and have positive job impacts outside of Ontario. Impacts for PY2020 would be more difficult to estimate given the complications introduced by the COVID-19 pandemic.

- ***Recommendation 11.*** Continue using the Statistics Canada (StatCan) Input-Output (IO) in concert with in-depth surveying to understand the impacts from COVID-19 on job creation from PY2020 activities. The StatCan IO Model has a three-year data lag, so the impact of the pandemic will likely not be incorporated into the model structure until 2023. If IESO is interested in understanding the impacts of HAP for PY2020, the approach could incorporate a more robust survey component to obtain both quantitative and qualitative data related to job impacts. The benefits of using macroeconomic models often lie in the users' ability to compare across different time periods or different shocks—and not simply in the one-time point estimate of impacts. Using the recommended approach would allow the comparison of PY2020 and PY2019 in terms of job

[22] Note that the base for this feedback is the 15% of all responding participants who offered improvement suggestions.

impacts in a 'normal' year, while gaining an understanding of the impact of COVID-19 on auditors and contractors.

Finding 12: The overall program realization rate for energy savings was driven by lighting measures.

Lighting savings accounted for two-thirds of the overall program gross energy savings. Given the volume of energy savings attributed to lighting, the lower realization rate for lighting measures (76%) lowered the realization rate of the program. Other measures, such hot water pipe insulation, indoor clothes drying racks, aerators, and showerheads, also contributed to the lower realization rate. High realization rates for weatherization measures, appliances, and power bar end-uses alleviated some of the impacts on program savings.

Finding 13: Participant were largely satisfied with the program and its elements.

Participants are largely satisfied with the program overall (average rating of 4.3 on a scale from 1 to 5, where 1 meant "not at all satisfied" and 5 meant "completely satisfied"). They were especially satisfied with the professionalism of their auditor (average rating of 4.6). While participants were least satisfied with energy savings from the upgrades, this aspect of the program was still rated highly (average rating of 4.0).

Appendix A – Detailed Methodology

A.1 Impact Methodology

This section provides additional details about the impact evaluation methodology. A summary of the methodology was provided in ***Section 3***.

A.1.1 Impact Sampling

The NMR team sampled HAP at the project level to generate data for the desk reviews. Initially, the projects were examined to determine what measures and combination of measures were most common across projects to ensure that strata could be created without excluding any measure categories. Projects were then binned based on the level of deemed gross savings for the entire project. These bins were the high savers (projects whose summed measure savings were in the top 20% of savings), medium savers (projects whose summed measure savings were in-between 21% and 80% of total distributed savings) and low savers (projects whose summed measure savings were in the lowest 20% of total distributed savings). The NMR team used the projects that resulted in the top 20% of program savings to sample from for the desk review. Using the projects from the top 20%, NMR then used the probability proportional to size (PPS) technique to develop the sample, resulting in a final sample size of 208. PPS allows the chance of project selection to be in proportion with the projects deemed savings, ensuring that the desk review sample includes the most program savings possible.

Table A.1 | Desk Review Sample Summary

n	Avg. # of Measures per Project	Avg. kWh Deemed Savings per Project
208	6	2,495

A.2 Process Methodology

This section provides additional details about the process evaluation methodology. A summary of the methodology was provided in ***Section3.2***. During the process evaluation, the NMR team collected primary data from key program actors, including the IESO staff, the program delivery vendor, participants, auditors, and contractors (***Table A.2***). The NMR team collected the data using different methods, depending on what was most suitable for a particular respondent group (e.g., web surveys or telephone-based-IDIs). This data, when collected and synthesized, provides a comprehensive understanding of the delivery of the PY2019 program.

The NMR team directly carried out or managed all process evaluation data collection activities and developed all survey instruments, interview guides, and sample files for use in the interviews and surveys. The survey instruments and interview guides were approved by the IESO EM&V staff, and the data used to develop the sample files came from program records supplied either by the IESO EM&V staff or the program delivery vendor.

The NMR team conducted the in-depth telephone interviews with the IESO staff and the program delivery vendor staff using in-house staff (rather than through a survey lab). The NMR team fielded

HAP participant and HAP auditor and contractor surveys as web-based surveys in partnership with the Nexant survey lab based in Toronto. The NMR team designed the survey instruments and developed the sample lists. The Nexant survey lab then programmed and distributed the surveys using Qualtrics survey software. The NMR team worked closely with the Nexant survey lab to test the programming of all surveys and to perform quality checks on all data collected.

Table A.2 | Process Evaluation Primary Data Sources

Respondent Type	Methodology	Fielding Firm	Completed	Population	90% CI Error Margin
HAP IESO Staff and Program Delivery Vendor Staff	Phone IDIs	NMR Staff	6	6	0%
HAP Participants	Web	Nexant Survey Lab	846	3,774	3%
HAP Auditors and Contractors	Web	Nexant Survey Lab	12	12	0%

The following subsections provide additional details about the process evaluation methodology.

A.2.1 IESO Staff and Program Delivery Vendor Staff Interviews

The NMR team interviewed five IESO staff and the program delivery vendor staff to gain a detailed understanding of HAP in PY2019 (***Table A.3***). The purpose of the interviews was to better understand program design, delivery, and barriers, and solicit suggestions for improvement.

The interview topics included program roles and responsibilities, program design and delivery, marketing and outreach, market actor engagement, program strengths and weaknesses, and suggestions for improvement.

The NMR team identified the appropriate staff to interview in consultation with the IESO EM&V staff. Each interview took approximately 30 minutes to complete. The NMR team conducted IDIs via phone with the IESO staff and the program delivery vendor staff from April 16 to June 2 of 2020.

Table A.3 | HAP IESO Staff and Program Delivery Vendor Staff Interview Disposition

Disposition Report	Count
Completes	6
No Response	0
Unsubscribed	0
Partial Complete	0
Bad Contact Info (No Replacement Found)	0
Total Invited to Participate	6
Total in Population	6

A.2.2 Participant Survey

The NMR team surveyed 846 HAP participants from a sample of 3,774 unique contacts (***Table A.4***). The purpose of the survey was to better understand HAP participant perspectives related to program experience.

The survey topics included in-service rates; HOU; how participants learned about and applied to the program; motivations for doing the upgrades; education and materials provided by the energy auditor; suggested energy-saving methods that participants implemented; satisfaction with various aspects of the program process; suggestions for program improvement, including additional equipment or services to consider; job impacts; and demographics.

The NMR team developed the sample from program records provided by the IESO EM&V staff. Given the large number of program participants, the NMR team randomly selected a subset of participants for inclusion in the survey sample.

The NMR team delivered the survey over the web in partnership with the Nexant survey lab using Qualtrics survey software. The NMR team conducted survey implementation between June 3 and June 17 of 2020. The survey took an average of 16 minutes to complete after removing outliers.[23] The NMR team sent weekly e-mail reminders to non-responsive contacts over the course of web survey fielding.

Table A.4 | HAP Participant Survey Disposition

Disposition Report	Count
Completes	846
No Response	2,581
Unsubscribed	34
Partial Complete	170
Bad Contact Info (No Replacement Found)	143
Total Invited to Participate	3,774

A.2.2.1 Participant Sampling Plan

The NMR team sampled the HAP participants at the project level to generate data for the participant web survey. We utilized a stratified sample using Neyman Allocation to estimate the minimum number of sample points per strata while obtaining the desired confidence levels of 90%.[24] Initially, the projects were examined to determine what measures and combination of measures were most common across projects to ensure that strata could be created without excluding any measure categories. Projects were then binned based on the level of deemed gross savings for the entire project. These bins were the high savers (participants whose summed measure savings were in the

[23] Note that the survey was designed to allow the respondent to come back to the survey at a later time to complete it if they preferred. The average survey time was calculated with this in mind and assumed that any survey that took 40 minutes or more to complete was likely completed by a respondent who took a break before completing the survey.

[24] See Chapter 11 of the Uniform Methods Project for examples of Neyman Allocation in evaluation. https://www.nrel.gov/docs/fy17osti/68567.pdf

top 20% of savings), medium savers (participants whose summed measure savings were in-between 21% and 80% of total distributed savings) and low savers (participants whose summed measure savings were in the lowest 20% of total distributed savings). The NMR team used the 20/60/20 savings splits as the sampling strata thereby ensuring that participants across the binned savings categories would be significantly represented in the sample. ***Table A.5*** shows the original sample plan. As seen in ***Table A.5***, the survey response was very successful, resulting in 846 survey completes.

Table A.5 | HAP Participant Sample Plan Summary

Project Strata	Project Count	Measure Count	90% Error Margin
Top 20% of Savings	81	480	4.4%
Mid 60% of Savings	74	266	1.8%
Bottom 20% of Savings	10	213	1.0%

A.2.3 Auditor and Contractor Survey

The NMR team surveyed 12 HAP auditors and contractors from a sample of 12 auditors and contractors (***Table A.6***). The purpose of the survey was to better understand HAP auditor and contractor perspectives related to program delivery.

The interview topics included role in the program, firmographics, the application process, training and education received, outreach and marketing to customers, program barriers, suggestions for program improvement, and job impacts.

The NMR team developed the survey sample with support from the program delivery vendor, who provided a subset of 12 willing auditors and contractors from a larger population of over 70 energy auditors and over 25 contractors. The NMR team employed a census-based approach to reach the largest number of respondents possible given the small number of unique contacts.

The NMR team delivered the survey over the web in partnership with the Nexant survey lab using Qualtrics survey software. Survey implementation was conducted between June 3 and June 22 of 2020. The survey took an average of 19 minutes to complete after removing outliers.23 The NMR team sent weekly e-mail reminders to non-responsive contacts over the course of web survey fielding.

Table A.6 | HAP Auditor and Contractor Survey Disposition

Disposition Report	Count
Completes	12
No Response	0
Unsubscribed	0
Partial Complete	0
Bad Contact Info (No Replacement Found)	0
Total Invited to Participate	12

A.3 Jobs Impact Methodology

This section provides additional details about the job impact methodology. A summary of the methodology was provided in ***Section 3.3***.

The analysis of job impacts utilized the StatCan IO model to estimate direct and indirect job impacts. IO models are used to analyze the propagation of exogenous economic shocks throughout an economy. The models represent relationships, or flows, of inputs and outputs between industries. A system of linear equations represents how certain industries' outputs become the inputs for other industries, while other outputs become consumer goods. When an energy-efficiency program such as HAP is funded and implemented it creates a set of "shocks" to the economy, such as demand for specific products and services, and additional household expenditures from energy bill savings. The shocks propagate throughout the economy and their impacts can be measured in terms of variables such as economic output and employment.

A.3.1 Statistics Canada IO Model

The Industry Accounts Division of StatCan maintains two versions of a Canadian IO model: a national, and an interprovincial model.[25] The models are classical Leontief-type open-IO models,[26] where some production is consumed internally by industries, while the rest is consumed externally. The models provide detailed information on the impact of exogenous demands for industry outputs. The impacts are quantified in terms of production, value-added components (such as wages and surplus), expenditures, imports, employment, energy use, and pollutant emissions by industry. The StatCan IO Model is composed of input, output, and final demand tables. IO tables are published annually with a lag of approximately three years, so the model used for this analysis represents the Canadian economy from 2016. The model has been used to model employment impacts from a wide range of economic shocks, including structural changes to the Canadian economy,[27] the bovine spongiform encephalitis (BSE) crisis in the early-mid 2000's,[28] and the construction of hydropower projects.[29]

The supply and use tables (SUTs) for the Canadian IO model break the economy down into 240 industries and 500 SUPCs. They represent the economic activity of a specific Canadian province, or of the whole country. The SUTs show the structure of the Canadian economy, with goods and services flowing from production or import (supply tables) to intermediate consumption or final use (use tables). Intermediate consumption refers to domestic industries using goods and services to produce other products and services. Final use includes consumption of products by households,

[25] Statistics Canada - Industry Accounts Division System of National Accounts; (2009). User's Guide to the Canadian Input-Output Model. Statistics Canada. Ret

[26] Ghanem, Ziad; (2010). The Canadian and Inter-Provincial Input-Output Models: The Mathematical Framework. Statistics Canada – Industry Accounts Division.

[27] Gera, S & Masse, P; (1996). Employment Performance in the Knowledge-Based Economy, Gouvernement du Canada - Industrial Organization 14, Gouvernement du Canada - Industry Canada.

[28] Samarajeewa, S. et al.; (2006). Impacts of BSE Crisis on the Canadian Economy: An Input-Output Analysis. Prepared for the Annual Meeting of the Canadian Agricultural Economics Society.

[29] Desrochers, R. et al.; (2011). Job Creation and Economic Development Opportunities in the Canadian Hydropower Market. Canadian Hydropower Association.

non-profit institutions serving households, and governments; capital formation; changes in inventory; and exports. Provincial SUTs are similar to national SUTs, but for the addition of interprovincial trade to go along with the international imports and exports.

StatCan offers the IO Model as a service but not as a product. StatCan economists work with researchers to develop the data and inputs to develop and answer specific research questions using the model. The end product is a set of outputs from running the model.

A.3.2 Approach

The process for using the StatCan IO model followed three steps:

1. Developed specific set of research questions to address with the IO model, reflecting the exogenous shocks caused by the program.
2. Developed model inputs, which consisted of exogenous shock values (in dollars) to simulate the effects of HAP.
3. Ran the model and interpreted the results.

The following sections cover each step in more detail.

A.3.2.1 Developed Specific Research Questions

The first step in modeling the job impacts from HAP was to determine which specific research questions (RQs) the model would answer. In a scenario without the existence of HAP, customers receive electricity from IESO and pay for it via the monthly billing process. Delivering HAP introduces a set of economic supply and demand shocks to different sectors of the economy. The four research questions below illustrate these shocks:

1. **What are the job impacts from new demand for energy-efficient measures and related program delivery services?** Funds collected for HAP generate a demand for efficient equipment and appliances. They also generate a demand for services related to program delivery, such as audits at customer premises, call centre operations, and general overhead for program implementation and staffing. This demand creates jobs among firms that supply these products and services.
2. **What are the job impacts from household energy bill savings?** Once energy-efficient equipment is installed in households, the customers realize annual energy savings for the useful life of the measures. Households can choose to put this money into savings or to spend it on goods and services in the economy. This additional money and the decision to save or spend has implications for additional job creation. For instance, additional household spending on goods and services generates demand that can create jobs in other sectors of the economy.
3. **What are the job impacts from funding the energy-efficiency program?** IESO energy-efficiency programs are funded via volumetric bill charges for all customers – both residential and non-residential. This additional charge can reduce the money that households have for savings and for spending on other goods and services. It also impacts non-residential customers. This additional bill charge results in a negative impact on jobs in the Canadian economy.

4. **What are the job impacts from reduced electricity production?** The energy-efficient measures will allow households to receive the same benefit while using less electricity. The program as a whole will reduce the demand for electricity in the residential sector. This reduced demand could have upstream impacts on the utility industry (e.g., generation) and related industries, such as companies in the generator fuel supply chain.

A.3.3 Developed Model Inputs

The second step in modeling job impacts was to gather the data required for the StatCan IO model to answer each of the research questions. Model input data included the dollar values of the exogenous shocks from program delivery. The sources of data for each research question were as follows:

1. **Demand for energy-efficient measures and related program delivery services.** The StatCan IO Model divides the Canadian economy into 240 industry classifications and 500 SUPCs. Each measure installed as part of the program was classified into one of the SUPCs. The dollar value for each product-related demand shock was calculated using the measure cost and quantity data from the impact evaluation (see ***Section 3***).

   Services that were part of the delivery process were also classified into SUPCs. The vast majority of these services were either audits or program administrative services. Customer audits had flat fees for calculating the value of the demand shock and the value of administrative services was obtained from program budget actuals.

   It was necessary to specify the amount of each demand shock attributed to labour versus non-labor. For the product categories, we used the labour versus non-labor cost estimate proportions from the measure research conducted as part of the cost-effectiveness analysis. For the service categories, the IO model contained underlying estimates that defined the portion of labour versus overhead (non-labour).

2. **Household energy bill savings.** This value was calculated for the model as the net present value (NPV) of the discounted future stream of energy bill savings by participants. It was calculated by multiplying net energy savings[30] (in kWh) in each future year by that future year's retail rate ($/kWh). This calculation was performed for each future year through the end of the measure's expected useful life (EUL). Savings beyond the EUL were assumed to be zero. Measure-level energy saving estimates were obtained from the impact evaluation. The other calculation parameters (discount rate, measure EULs, and retail rate forecast) align with the cost-effectiveness analysis.

Customers' intentions for whether to spend or save the money saved on energy bills was obtained via a short section on the customer surveys. The percentages that indicated what the customers would do with the bill savings were obtained from the participant surveys through the following two questions:

> *J1. What do you anticipate you will do with the money saved on electricity bills from the energy-efficient equipment upgrades?*

[30] The net-to-gross ratio for HAP is 1, so the net energy savings are the same as gross savings.

1. Pay down debt or put the money into savings
2. Purchase more goods and/or services
3. Split – put some money into savings/debt payments and use some money to purchase more goods/services
4. Other. Please specify.
98. Don't know
99. I'd rather not answer

[BASE: IF RESPONDENT WILL SPLIT MONEY SAVED IN VARIOUS WAYS (J1=3)]
J2. Approximately what would be the split between savings/debt payments and purchasing more goods/services? [ALLOW MULTIPLE RESPONSE OPTION]
1. Percent saved or used to pay down debt [NUMERIC RESPONSE BETWEEN 0 and 100]
2. Percent used to purchase more goods and services [NUMERIC RESPONSE BETWEEN 0 and 100]
98. Don't know
99. I'd rather not say

For estimating job impacts, the key input value was the amount of bill savings that customers would spend—as opposed to save.

3. **HAP funding.** IESO energy-efficiency programs are funded by a volumetric charge on electricity bills and, volumetrically, residential customers accounted for 35 percent of consumption and non-residential customers accounted for 65 percent in 2019.[31] The overall program budget was distributed between these two customer classes by these percentages.
4. **Reduced electricity production.** The NPV of retail savings (estimated as part of RQ2) was also the input for examining a potential impact of producing less electricity.

A.3.3.1 Run Model and Interpret Results

Determining the total job impacts from HAP required considering possible impacts from each the four shocks represented by the research questions. Addressing the four research questions above required only two runs of the StatCan IO model, as certain components of the shocks could be consolidated and others addressed without full runs of the model. The two shocks that were modeled were as follows:

1. Demand shock as outlined in RQ1, representing the impact of the demand for energy-efficient products and services due to HAP.
2. Household expenditure shock representing the net amount of additional spending that the residential sector will undertake. This was estimated by taking the NPV of energy bill savings and

[31] Annual Planning Outlook – A view of Ontario's electricity system needs; 2020. IESO.

subtracting the residential contribution to program funding. Thus, the model run combined RQ2 with the residential component of RQ3.

The model output generated three types of job impact estimates: direct, indirect, and induced impacts—as described in ***Section 3.3***.

Appendix B – Additional Impact Evaluation Results

This appendix includes additional results associated with the impact evaluation activities.

B.1 Detailed Impact Results

Table B.1 presents the detailed measure-level results of the impact evaluation. The savings values in the table represent the measure-level savings for the entire population. The quantity of measures installed in PY2019 is also included. The proportion of total program savings is also included to show the representative impact of each measure's energy and demand savings on HAP. Realization rates for energy and demand are displayed in the following tables.

Table B.1| Aggregate Measure-Level Energy and Demand Savings

Measure	Quantity Installed*	Reported Savings-Energy (kWh)	Reported Savings - Demand (kW)	Verified Savings-Energy (kWh)	Verified Saving-Demand (kW)	Percent of Program Savings - Energy (kWh)	Percent of Program Saving-Demand (kW)
<=11W ENERGY STAR Qualified LED A Shape	135,174	6,447,800	3,198.0	4,765,739	319.3	55.1%	35.7%
<=11W ENERGY STAR Qualified LED MR 16	1,267	45,196	22.7	38,807	2.6	0.4%	0.3%
<=14W ENERGY STAR Qualified LED A Shape	1,678	79,537	35.7	58,792	3.9	0.7%	0.4%
<=16W ENERGY STAR Qualified LED PAR 20	459	21,068	8.1	18,071	1.2	0.2%	0.1%
<=16W ENERGY STAR Qualified LED PAR30 & PAR38	2,206	124,418	58.3	106,654	7.1	1.2%	0.8%
<=23W ENERGY STAR Qualified LED A Shape	8,481	519,885	277.3	500,218	33.5	5.8%	3.7%

Measure	Quantity Installed*	Reported Savings-Energy (kWh)	Reported Savings - Demand (kW)	Verified Savings-Energy (kWh)	Verified Saving-Demand (kW)	Percent of Program Savings - Energy (kWh)	Percent of Program Saving-Demand (kW)
<=23W ENERGY STAR Qualified LED PAR	883	46,622	19.5	39,938	2.7	0.5%	0.3%
<=6W ENERGY STAR Qualified LED MR 16 / PAR 16	5,445	205,277	110.6	175,926	11.8	2.0%	1.3%
Air Sealing	40	43,488	-	35,503	-	0.4%	0.0%
Attic Insulation	37	63,469	-	65,252	-	0.8%	0.0%
Audit Funding	9,936	-	-	-	-	0.0%	0.0%
Basement Insulation	21	53,011	-	61,156	-	0.7%	0.0%
Block Heater Timer (just timer)	1,263	301,983	-	271,751	-	3.1%	0.0%
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 - 21.2 l/day)	440	106,832	47.1	90,288	28.2	1.0%	3.2%
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 - 25.4 l/day)	27	5,360	2.7	5,359	1.7	0.1%	0.2%
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 - 35.5 l/day)	6	1,098	0.5	1,098	0.4	0.0%	0.0%
Efficient Aerators (bathroom) < 3.8 Lpm	905	44,477	2.9	28,566	2.8	0.3%	0.3%

Measure	Quantity Installed*	Reported Savings-Energy (kWh)	Reported Savings - Demand (kW)	Verified Savings-Energy (kWh)	Verified Saving-Demand (kW)	Percent of Program Savings - Energy (kWh)	Percent of Program Saving-Demand (kW)
Efficient Aerators (kitchen) < 5.7 Lpm	754	94,627	4.6	86,096	8.4	1.0%	0.9%
Efficient Showerhead (handheld) < 4.8 Lpm	686	160,318	8.1	89,758	8.8	1.0%	1.0%
Efficient Showerheads (standard) < 4.8 Lpm	424	99,089	5.2	80,478	7.8	0.9%	0.9%
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	2,093	111,348	56.1	92,289	6.2	1.1%	0.7%
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	488	51,191	5.4	133,437	19.0	1.5%	2.1%
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	422	43,466	4.9	77,671	10.5	0.9%	1.2%
Hot 2000 Output	18	48,427	-	62,327	-	0.7%	0.0%
Hot Water Tank Pipe Wrap - ½" (per foot)	537	154,209	8.7	22,025	2.2	0.3%	0.3%
Hot Water Tank Pipe Wrap - ¾ " (per foot)	97	33,937	1.7	6,995	0.7	0.1%	0.1%

Measure	Quantity Installed*	Reported Savings-Energy (kWh)	Reported Savings - Demand (kW)	Verified Savings-Energy (kWh)	Verified Saving-Demand (kW)	Percent of Program Savings - Energy (kWh)	Percent of Program Saving-Demand (kW)
Hot Water Tank Wrap - Fiberglass R10	27	2,778	0.2	2,554	0.3	0.0%	0.0%
Indoor Clothes Drying Rack	6,395	620,315	230.2	501,989	335.8	5.8%	37.5%
LED Downlight with Light Output >600 and <800 lumens	115	7,096	3.2	3,834	0.3	0.0%	0.0%
LED Downlight with Light Output >800 lumens	36	3,193	1.7	1,677	0.1	0.0%	0.0%
Power Bar with Integrated Timer	6,580	23,684	-	512,423	16.1	5.9%	1.8%
Programmable Thermostat – Line Voltage	855	104,481	-	121,020	-	1.4%	0.0%
Programmable Thermostat – Low Voltage	11	14,535	-	14,535	-	0.2%	0.0%
Refrigerator Replacement (10.0 - 12.5 cu ft)	299	53,820	6.3	55,653	7.3	0.6%	0.8%
Refrigerator Replacement (ENERGY STAR Qualified 15.5 - 16.9 cu ft)	400	82,000	10.1	81,179	10.7	0.9%	1.2%
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	1,059	230,862	31.2	202,038	26.6	2.3%	3.0%

Measure	Quantity Installed*	Reported Savings-Energy (kWh)	Reported Savings - Demand (kW)	Verified Savings-Energy (kWh)	Verified Saving-Demand (kW)	Percent of Program Savings - Energy (kWh)	Percent of Program Saving-Demand (kW)
Smart Power Bar	1,068	3,845	-	222,422	7.0	2.6%	0.8%
Wall Insulation	1	2,567	-	2,567	-	0.0%	0.0%
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	28	2,111	7.2	2,151	2.5	0.0%	0.3%
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	107	4,387	15.0	4,031	4.6	0.0%	0.5%
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	88	5,104	12.9	4,696	5.4	0.1%	0.6%
Program Total	**190,856**	**10,066,911**	**4,195.9**	**8,646,961**	**895.6**	**100.0%**	**100.0%**

* The quantity installed field represents the total amount of measures installed in PY2019. Note that some measures such as weatherization measures and hot water pipe wrap track area rather than measure quantity. To account for this difference the quantity for those measures is equal to the number of participants that received the measure.

Table B.2 displays the PY2019 HAP per-unit measure-level results for reported and verified energy savings (kWh). The per-unit verified energy savings values include the adjustments made during the tracking data review, TRM review, desk reviews, and ISR adjustments.

Table B.2 | PY2019 Reported and Verified Gross Energy Savings

Measure	Per-Unit Energy Savings - PY2019 Reported	Per-Unit Energy Savings - PY2019 Verified	Energy Realization Rate (kWh)
<=11W ENERGY STAR Qualified LED A Shape	47.7	35.3	74%
<=11W ENERGY STAR Qualified LED MR 16	35.7	30.6	86%
<=14W ENERGY STAR Qualified LED A Shape	47.4	35.0	74%
<=16W ENERGY STAR Qualified LED PAR 20	45.9	39.4	86%
<=16W ENERGY STAR Qualified LED PAR30 & PAR38	56.4	48.3	86%
<=23W ENERGY STAR Qualified LED A Shape	61.3	59.0	96%
<=23W ENERGY STAR Qualified LED PAR	52.8	45.2	86%
<=6W ENERGY STAR Qualified LED MR 16 / PAR 16	37.7	32.3	86%
Air Sealing	4.8	3.9	82%
Attic Insulation	2.3	2.4	103%
Audit Funding	-	-	N/A
Basement Insulation	1.4	1.6	115%
Block Heater Timer (just timer)	239.1	215.2	90%
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 - 21.2 l/day)	242.8	205.2	85%
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 - 25.4 l/day)	198.5	198.5	100%
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 - 35.5 l/day)	183.0	183.0	100%
Efficient Aerators (bathroom) < 3.8 Lpm	49.1	31.6	64%
Efficient Aerators (kitchen) < 5.7 Lpm	125.5	114.2	91%
Efficient Showerhead (handheld) < 4.8 Lpm	233.7	130.8	56%
Efficient Showerheads (standard) < 4.8 Lpm	233.7	189.8	81%
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	53.2	44.1	83%
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	104.9	273.4	261%
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	103.0	184.1	179%
Hot 2000 Output	2,690.4	3,462.6	129%
Hot Water Tank Pipe Wrap - ½" (per foot)	48.1	6.9	14%
Hot Water Tank Pipe Wrap - ¾ " (per foot)	71.9	14.8	21%
Hot Water Tank Wrap - Fiberglass R10	99.2	91.2	92%
Indoor Clothes Drying Rack	97.0	78.5	81%

Measure	Per-Unit Energy Savings - PY2019 Reported	Per-Unit Energy Savings - PY2019 Verified	Energy Realization Rate (kWh)
LED Downlight with Light Output >600 and <800 lumens	61.7	33.3	54%
LED Downlight with Light Output >800 lumens	88.7	46.6	53%
Power Bar With Integrated Timer	3.6	77.9	2164%
Programmable Thermostat – Line Voltage	122.2	141.5	116%
Programmable Thermostat – Low Voltage	1,321.4	1,321.4	100%
Refrigerator Replacement (10.0 - 12.5 cu ft)	180.0	186.1	103%
Refrigerator Replacement (ENERGY STAR Qualified 15.5 - 16.9 cu ft)	205.0	202.9	99%
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	218.0	190.8	88%
Smart Power Bar	3.6	208.3	5785%
Wall Insulation	2,567.0	2,567.0	100%
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	75.4	76.8	102%
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	41.0	37.7	92%
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	58.0	53.4	92%

Table B.3 displays the PY2019 HAP per-unit measure-level results for reported and verified demand savings (kW). The per-unit verified demand savings values include any adjustments made during the TRM review, desk reviews, and ISR adjustments.

Table B.3 | PY2019 Reported and Verified Gross Demand Savings

Measure	Per-Unit Energy Savings - PY2019 Reported	Per-Unit Energy Savings - PY2019 Verified	Demand Realization Rate (kW)
<=11W ENERGY STAR Qualified LED A Shape	0.0237	0.0024	10%
<=11W ENERGY STAR Qualified LED MR 16	0.0179	0.0021	11%
<=14W ENERGY STAR Qualified LED A Shape	0.0213	0.0023	11%
<=16W ENERGY STAR Qualified LED PAR 20	0.0176	0.0026	15%
<=16W ENERGY STAR Qualified LED PAR30 & PAR38	0.0264	0.0032	12%
<=23W ENERGY STAR Qualified LED A Shape	0.0327	0.0040	12%

Measure	Per-Unit Energy Savings - PY2019 Reported	Per-Unit Energy Savings - PY2019 Verified	Demand Realization Rate (kW)
<=23W ENERGY STAR Qualified LED PAR	0.0220	0.0030	14%
<=6W ENERGY STAR Qualified LED MR 16 / PAR 16	0.0203	0.0022	11%
Air Sealing	-	-	N/A
Attic Insulation	-	-	N/A
Audit Funding	-	-	N/A
Basement Insulation	-	-	N/A
Block Heater Timer (just timer)	-	-	N/A
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 - 21.2 l/day)	0.1069	0.0642	60%
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 - 25.4 l/day)	0.0995	0.0636	64%
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 - 35.5 l/day)	0.0770	0.0586	76%
Efficient Aerators (bathroom) < 3.8 Lpm	0.0032	0.0031	96%
Efficient Aerators (kitchen) < 5.7 Lpm	0.0062	0.0111	181%
Efficient Showerhead (handheld) < 4.8 Lpm	0.0118	0.0128	108%
Efficient Showerheads (standard) < 4.8 Lpm	0.0122	0.0185	152%
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	0.0268	0.0030	11%
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	0.0111	0.0388	349%
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	0.0115	0.0250	216%
Hot 2000 Output	-	-	N/A
Hot Water Tank Pipe Wrap - ½" (per foot)	0.0027	0.0007	26%
Hot Water Tank Pipe Wrap - ¾ " (per foot)	0.0037	0.0014	38%
Hot Water Tank Wrap - Fiberglass R10	0.0054	0.0096	180%
Indoor Clothes Drying Rack	0.0360	0.0525	146%
LED Downlight with Light Output >600 and <800 lumens	0.0279	0.0022	8%
LED Downlight with Light Output >800 lumens	0.0477	0.0031	7%
Power Bar With Integrated Timer	-	0.0025	No reported demand savings*
Programmable Thermostat – Line Voltage	-	-	N/A
Programmable Thermostat – Low Voltage	-	-	N/A
Refrigerator Replacement (10.0 - 12.5 cu ft)	0.0211	0.0245	116%

Measure	Per-Unit Energy Savings - PY2019 Reported	Per-Unit Energy Savings - PY2019 Verified	Demand Realization Rate (kW)
Refrigerator Replacement (ENERGY STAR Qualified 15.5 - 16.9 cu ft)	0.0252	0.0267	106%
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	0.0295	0.0251	85%
Smart Power Bar	-	0.0066	No reported demand savings*
Wall Insulation	-	-	N/A
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	0.2573	0.0909	35%
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	0.1402	0.0434	31%
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	0.1464	0.0614	42%

*No demand savings were reported in the program tracking data for these measures and the NMR team was not able to calculate a realization rate. The overall program realization rate for demand savings includes the verified demand values for these measures.

B.2 Substantiation Sheet Updates

Table B.4 provides a summary of the substantiation sheet updates that the NMR team implemented as a result of the impact evaluation TRM review. The table includes substantiation sheet prescribed savings values prior to and after the NMR team's TRM adjustments. The updated savings values displayed are calculated without ISRs or realization rate adjustments that the NMR team used to calculate gross verified savings. A brief summary that outlines the changes made to the substantiation sheet calculations are included in the table. The table only includes measures that the NMR team updated as a result of the TRM review. The changes to the measures are described in more detail in the subsections below.

Table B.4 | TRM Adjustment Measure Unit Savings Results Summary

Measure	PY2019 – Original Substantiation Sheet Values - kWh/yr	PY2019 – Original Substantiation Sheet Values - kW/yr	PY2019 – Adjusted Substantiation Sheet Values - kWh/yr	PY2019 – Adjusted Substantiation Sheet Values - kW/yr	Update
≤16W ENERGY STAR Qualified LED PAR 20	45.9	0.003	40.6	0.003	
≤16W ENERGY STAR Qualified LED PAR 30 & PAR 38	56.4	0.004	49.8	0.003	
≤23W ENERGY STAR Qualified LED PAR 38	52.8	0.004	46.6	0.003	
≤6W ENERGY STAR Qualified LED MR 16 / PAR 16	37.7	0.003	33.3	0.002	
≤11W ENERGY STAR Qualified LED MR 16	35.7	0.002	31.6	0.002	Updated base wattages for downlights and some general purpose lighting. Updated HOU for non-general purpose lighting measures
LED Downlight with Light Output >600 and <800 lumens	61.7	0.004	34.4	0.002	
LED Downlight with Light Output >800 lumens	88.7	0.006	48.0	0.003	
≤11W ENERGY STAR Qualified LED A Shape	47.7	0.003	36.5	0.002	
≤14W ENERGY STAR Qualified LED A Shape	47.4	0.003	36.1	0.002	
≤23W ENERGY STAR Qualified LED A Shape	61.3	0.004	60.8	0.004	

Measure	PY2019 – Original Substantiation Sheet Values - kWh/yr	PY2019 – Original Substantiation Sheet Values - kW/yr	PY2019 – Adjusted Substantiation Sheet Values - kWh/yr	PY2019 – Adjusted Substantiation Sheet Values - kW/yr	Update
ENERGY STAR LED Wet Location Rated PAR lamp ≤ 23W	53.2	0.004	47.0	0.003	
Kitchen Aerators <5.7 Lpm	125.5	0.012	SF: 137.9 MF: 113.1	SF: 0.013 MF: 0.011	
Bathroom Aerators <3.8 Lpm	49.2	0.005	SF: 33.8 MF: 52.4	SF: 0.003 MF: 0.005	Split out specific single-family and multifamily deemed savings values Adjusted people per household to reflect single-family and multifamily values
Efficient Showerheads (standard) <4.8 Lpm	233.7	0.023	SF: 208.1 MF: 235.1	SF: 0.020 MF: 0.023	Adjusted the number of faucets/showerheads to reflect single-family and multifamily values
Efficient Showerheads (handheld) <4.8 Lpm	233.7	0.023	SF: 138.8 MF: 156.7	SF: 0.014 MF: 0.015	
Hot Water Pipe Insulation (1/2" Diameter)	48.1	0.005	20.6	0.002	Updated to include circumference of both uninsulated and insulated pipe Updated from 3' of pipe length to 1' of pipe

Measure	PY2019 – Original Substantiation Sheet Values - kWh/yr	PY2019 – Original Substantiation Sheet Values - kW/yr	PY2019 – Adjusted Substantiation Sheet Values - kWh/yr	PY2019 – Adjusted Substantiation Sheet Values - kW/yr	Update
Hot Water Pipe Insulation (3/4" Diameter)	71.9	0.007	44.5	0.004	length Updated HOU
Hot Water Tank Insulation	99.3	-	91.2	0.010	
Indoor Clothes Drying Rack	97.2	0.065	89.3	0.060	Updated base CEF Updated loads per year
Smart Power Bars - Tier 2 Advanced Power Strip	46.4	0.002	234.0	0.007	Updated deemed savings values to reflect an AV equipment type only for tier 2 advanced power bars
Window AC Replacement (6,000 - 7,999 Btu/hr)	41.0	0.049	41.6	0.049	
Window AC Replacement (8,000 - 9,999 Btu/hr)	58.0	0.069	58.9	0.070	Updated the existing equipment CEER
Window AC Replacement (10,000 - 12,000 Btu/hr)	75.4	0.089	76.7	0.091	

B.2.1 Lighting

The reviewed substantiation sheet for lighting relied upon a mix of primary and secondary research. The sheet cited the 2017 HAP lighting workbook for base measure wattages; the ENERGY STAR Qualified Product List for the conservation measure wattages; and, for HOU, the Northeast Residential Hours-of-Use Study that NMR conducted in 2014.[32]

In assessing whether wattage values needed updating for each measure, the NMR team compared deemed lumens per watt for the IESO measures with those cited in v8.0 of the IL TRM and v7 NY TRM. Based on these comparisons, the NMR team reduced the base measure wattage of the two downlight measures and the two lowest-wattage general purpose lighting measures.

In assessing whether HOU values needed updating, the NMR team compared HOU values across various TRMs, specifically for documents that have updated their savings calculations to reflect more recent findings in the Northeastern U.S. Three of four TRMs the NMR team reviewed—v8 IL, v7 NY, and 2019-2021 MA—differentiated between HOU for general purpose and non-general purpose lamps. The MA TRM specifically cited the Northeast HOU study from 2014, as well as more recent guidance accepted by the state's program administrators. As a result, the NMR team recommended that the IESO distinguish between HOU by lighting measure type and reduce HOU for non-general purpose lighting to 2.7 rather than 3.0.

B.2.2 Aerators and Showerheads

The NMR team adjusted the aerator and showerhead substantiation sheets in similar ways to each other. The previous version of these substantiation sheets derived deemed savings values based on a weighting scheme for single-family and multifamily homes. To increase accuracy of savings estimates, and since the home type is tracked in the data, the NMR team split these deemed savings values out into single-family and multifamily values specific to the building type of the project.

The NMR team also updated values for the average number of people per home and average number of faucets and showerheads per home based on V8.0 of the IL TRM, with separate values for single-family and multifamily.

As a part of the impact evaluation, the NMR team requested product specification sheets to verify the substantiation sheet values reflected the products the program distributes. The NMR team applied the verified flow rates for the installed aerators and showerheads to savings calculations. In the instance of handheld showerheads, the NMR team modified the flow rate in the substantiation sheet based on the actual product specification.

B.2.3 DHW Pipe Insulation and Tank Wrap

Upon review of the DHW pipe insulation and tank wrap substantiation sheets, the NMR team found that the algorithms and inputs were derived from the Illinois Technical Reference Manual V6.0, and so the focus was to update those to the most recent version – V8.0 – which was effective as of January 1, 2020. Most inputs remained the same, but the NMR team made four main updates.

[32] https://www.neep.org/sites/default/files/resources/Northeast-Residential-Lighting-Hours-of-Use-Study-Final-Report1.pdf

For both measures, the NMR team updated the HOU to 8,766 from 8,760. This simply reflects a change from 365 days/ year to 365.25 days/ year to account for leap years.

For DHW tank wrap, the NMR team changed the efficiency value used in the algorithm to the recovery efficiency of the water heater, as opposed to the energy factor.

For DHW pipe insulation, the NMR team separated the circumference variable into a baseline case circumference and an efficient case circumference to reflect the different surface area created by adding the insulation.

The NMR team also discovered an error in the tracking database for the pipe insulation measure. The deemed savings value indicated in the substantiation sheet is for a 3' length of pipe insulation but is tracked as per foot in the field data collection form and in the tracking data itself. Therefore, the savings for this measure was overstated by a factor of 3. The NMR team updated the deemed savings values in the substantiation sheet to reflect a 1' length of pipe insulation to correct this.

B.2.4 Indoor Clothes Drying Rack

The substantiation sheet for indoor clothes racks cited the number of laundry loads per week referenced in the 2017 Clothesline Instant Savings Program Evaluation.[33] The NMR team updated this figure to 5.4, in accordance with three TRMs reviewed: v8 IL, v7 NY, and 2019-2021 MA. The NMR team also updated combined energy factor (CEF) values based on an average of the same three TRM documents. These updates increased the base CEF for all electric dryers; the base CEF for gas dryers remained the same.

B.2.5 Smart Power Bars – Tier 2

The substantiation sheet for Tier 2 smart power bars primarily references a study by the New York State Energy Research and Development Authority, which is also the basis of the New York State Technical Resource Manual, so the NMR team found that to be the best resource to update the input variables and savings values.[34]

The current substantiation sheet contains a deemed savings value by potential power bar locations (AV equipment or office equipment), which applies a weighting scheme to those values based on the presence of each obtained through a residential end use survey.

However, the NMR team discovered some issues with this approach. First, the deemed values being pulled from the New York TRM were for Tier 1 power bars, not Tier 2. Secondly, the Tier 2 smart power bars being distributed by the program are only intended to be used on AV equipment. The program delivery vendor confirmed the model of smart power bar that is distributed by the program and confirmed that they were only installed on AV equipment. Therefore, the NMR team updated the substantiation sheet to contain only one deemed value taken from the most recent NY TRM for Tier 2 power strips installed on AV equipment.

[33] Cadmus, October 2018. Evaluation of 2017 Clothesline Instant Savings Program Evaluation.
[34] https://energy.mo.gov/sites/energy/files/advanced-power-strip-research-report.pdf

B.2.6 Window Air Conditioner

Since this program assumes early replacement for window air conditioners, it uses a hybrid baseline to account for the remaining useful life of the existing equipment. The window AC measure applies a deemed value for the newly installed equipment as well. The value for the CEER of the existing room air conditioner (7.7) referenced the V6.0 of the IL TRM, but that same value appears as an EER in the IL TRM V8.0. Using the conversion factor of CEER= EER/1.01, the NMR team adjusted the CEER of the existing room air conditioner to 7.62, which resulted in a small increase in deemed savings.

B.2.7 Refrigerators/Freezers

The NMR team calculated verified savings for refrigerators and freezers using field collected annual energy consumption from model number lookups for the installed efficient refrigerators and freezers, while the reported savings used the minimum requirements for meeting the ENERGY STAR efficiency specifications. Using the actual annual energy consumption values provides a more accurate savings estimate and does not rely on using the minimum ENERGY STAR specifications. The NMR team updated substantiation sheets to include data collected on-site based on actual equipment specifications.

B.2.8 Dehumidifiers

Verified savings for dehumidifiers were calculated using field collected dehumidifier capacity values from model number lookups for the installed dehumidifier, while the reported savings applied capacity ranges. Using the actual existing and installed capacity provides a more accurate savings estimate. The substantiation sheets were updated to include data collected on-site based on actual equipment specifications.

B.3 Effective Useful Life and Incremental Cost Updates

Table B.5 displays the updates to the EUL by measure. The updated EULs are included in the lifetime savings calculations for PY2019 HAP net lifetime savings.

Table B.5 | PY2019 Effective Useful Life Updates

Measure	Current EUL	Updated EUL	Source
<=11W ENERGY STAR® Qualified LED A Shape (60W)	14	13.7	IESO Business Retrofit Assumption
<=11W ENERGY STAR® Qualified LED MR 16 (minimum 400 Lumen output)	14	13.7	IESO Business Retrofit Assumption
<=14W ENERGY STAR® Qualified LED A Shape (75W)	14	13.7	IESO Business Retrofit Assumption
<=16W ENERGY STAR® Qualified LED PAR 20 (minimum 600 Lumen output)	14	13.7	IESO Business Retrofit Assumption

Measure	Current EUL	Updated EUL	Source
<=16W ENERGY STAR® Qualified LED PAR30 & PAR38 (minimum 600 Lumen output)	14	13.7	IESO Business Retrofit Assumption
<=23W ENERGY STAR® Qualified LED A Shape (100W) (minimum 1600 Lumen output)	14	13.7	IESO Business Retrofit Assumption
<=23W ENERGY STAR® Qualified LED PAR (minimum 1100 Lumen output)	14	13.7	IESO Business Retrofit Assumption
<=6W ENERGY STAR® Qualified LED MR 16 / PAR 16 (minimum 250 Lumen output)	14	13.7	IESO Business Retrofit Assumption
Air Sealing	15	20	Illinois TRM
Attic Insulation	25	20	Illinois TRM
Basement Insulation	25	20	Illinois TRM
Block Heater Timer (just timer)	15	15	No Update
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 - 21.2 l/day)	12	12	No Update
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 - 25.4 l/day)	12	12	No Update
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 - 35.5 l/day)	12	12	No Update
Efficient Aerators (bathroom) < 3.8 Lpm	10	10	No Update
Efficient Aerators (kitchen) < 5.7 Lpm	10	10	No Update
Efficient Showerhead (handheld) < 4.8 Lpm	10	10	No Update
Efficient Showerheads (standard) < 4.8 Lpm	10	10	No Update
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	14	13.7	IESO Business Retrofit Assumption
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	11	12	MA TRM
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	11	12	MA TRM
Hot Water Tank Pipe Wrap - ½" (per foot)	15	15	No Update
Hot Water Tank Pipe Wrap - ¾ " (per foot)	15	15	No Update
Hot Water Tank Wrap - Fiberglass R10	7	7	No Update
Indoor Clothes Drying Rack	10	12	MA TRM

Measure	Current EUL	Updated EUL	Source
LED Downlight with Light Output >600 and <800 lumens	14	13.7	IESO Business Retrofit Assumption
LED Downlight with Light Output >800 lumens	14	13.7	IESO Business Retrofit Assumption
Power Bar with Integrated Timer	10	7	Illinois TRM
Programmable Thermostat – Line Voltage	11	11	No Update
Programmable Thermostat – Low Voltage	11	11	No Update
Refrigerator Replacement (10.0 - 12.5 cu ft)	12	12	No Update
Refrigerator Replacement (ENERGY STAR Qualified 15.5 - 16.9 cu ft)	12	12	No Update
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	12	12	No Update
Smart Power Bar	10	7	Illinois TRM
Wall Insulation	25	20	Illinois TRM
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	12	12	No Update
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	12	12	No Update
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	12	12	No Update

Table B.6 provides updates to the incremental cost for the installation of each measure. Nexant conducted the incremental cost research. This research is used for the PY2019 cost-effectiveness testing documented as a part of the substantiation sheet updates.

Table B.6 | PY2019 Incremental Cost Updates

Measure	Unit	Current Inc. Cost	Updated Inc. Cost	Source
<=11W ENERGY STAR® Qualified LED A Shape (60W)	$/unit	$10.00	$1.00	Market Research
<=11W ENERGY STAR® Qualified LED MR 16 (minimum 400 Lumen output)	$/unit	$25.00	$7.00	Market Research
<=14W ENERGY STAR® Qualified LED A Shape (75W)	$/unit	$14.00	$6.00	Market Research
<=16W ENERGY STAR® Qualified LED PAR 20 (minimum 600 Lumen output)	$/unit	$28.00	$10.00	Market Research
<=16W ENERGY STAR® Qualified LED PAR30 & PAR38 (minimum 600 Lumen output)	$/unit	$35.00	$6.00	Market Research
<=23W ENERGY STAR® Qualified LED A Shape (100W) (minimum 1600 Lumen output)	$/unit	$25.00	$5.00	Market Research
<=23W ENERGY STAR® Qualified LED PAR (minimum 1100 Lumen output)	$/unit	$38.00	$15.00	Market Research
<=6W ENERGY STAR® Qualified LED MR 16 / PAR 16 (minimum 250 Lumen output)	$/unit	$25.00	$9.00	Market Research
Air Sealing	$/sq ft	N/A	$0.71	Minnesota TRM
Attic Insulation	$/sq ft	N/A	$1.92	Wisconsin TRM
Basement Insulation	$/sq ft	N/A	$1.94	Market Research
Block Heater Timer (just timer)	$/unit	$15.00	$24.00	Market Research
Dehumidifier Replacement (ENERGY STAR Qualified 14.2 - 21.2 l/day)	$/unit	$224.00	$266.00	Market Research
Dehumidifier Replacement (ENERGY STAR Qualified 21.3 - 25.4 l/day)	$/unit	$286.00	$281.00	Market Research
Dehumidifier Replacement (ENERGY STAR Qualified 25.5 - 35.5 l/day)	$/unit	$261.00	$386.00	Market Research
Efficient Aerators (bathroom) < 3.8 Lpm	$/unit	$11.00	$11.00	No Update

Measure	Unit	Current Inc. Cost	Updated Inc. Cost	Source
Efficient Aerators (kitchen) < 5.7 Lpm	$/unit	$15.00	$11.00	Illinois TRM
Efficient Showerhead (handheld) < 4.8 Lpm	$/unit	$15.00	$15.00	No Update
Efficient Showerheads (standard) < 4.8 Lpm	$/unit	$15.00	$15.00	No Update
ENERGY STAR® LED Wet Location Rated PAR lamp ≤ 23 Watt (minimum 1100 Lumen output)	$/unit	$45.00	$5.00	Market Research
Freezer Replacement (ENERGY STAR Qualified 12-14.4 cu ft)	$/unit	$261.00	$747.00	Market Research
Freezer Replacement (ENERGY STAR Qualified 14.5 – 16.0 cu ft)	$/unit	$286.00	$1,015.00	Market Research
Hot Water Tank Pipe Wrap - ½" (per foot)	$/ft	$3.73	$3.73	
Hot Water Tank Pipe Wrap - ¾ " (per foot)	$/ft	$3.73	$3.73	
Hot Water Tank Wrap - Fiberglass R10	$/unit	$44.00	$138.00	Market Research
Indoor Clothes Drying Rack	$/unit	$21.00	$39.00	Market Research
LED Downlight with Light Output >600 and <800 lumens	$/unit	$75.00	$14.00	Market Research
LED Downlight with Light Output >800 lumens	$/unit	$98.00	$21.00	Market Research
Power Bar With Integrated Timer	$/unit	$10.00	$16.00	Market Research
Programmable Thermostat – Line Voltage	$/unit	$85.00	$197.00	Market Research
Programmable Thermostat – Low Voltage	$/unit	$85.00	$197.00	Market Research
Refrigerator Replacement (10.0 - 12.5 cu ft)	$/unit	$650.00	$548.00	Market Research
Refrigerator Replacement (ENERGY STAR Qualified 15.5 - 16.9 cu ft)	$/unit	$650.00	$900.00	Market Research
Refrigerator Replacement (ENERGY STAR Qualified 17.0 – 18.4 cu ft)	$/unit	$650.00	$1,052	Market Research

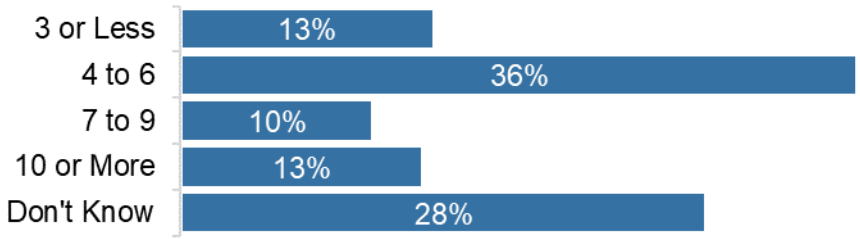
Measure	Unit	Current Inc. Cost	Updated Inc. Cost	Source
Smart Power Bar	$/unit	$72.00	$91.00	Market Research
Wall Insulation	$/sq ft	N/A	$2.62	Wisconsin TRM
Window Air Conditioner Replacement (ENERGY STAR Qualified 10,000 – 12,000 BTU/hr)	$/unit	$320.00	$583.00	Market Research
Window Air Conditioner Replacement (ENERGY STAR Qualified 6,000 – 7,999 BTU/hr)	$/unit	$195.00	$373.00	Market Research
Window Air Conditioner Replacement (ENERGY STAR Qualified 8,000 – 9,999 BTU/hr)	$/unit	$245.00	$470.00	Market Research

B.4 Hours of Use

The participant survey collected HOU information for several upgrades that homeowners received through the program. Please note that the NMR team will collect more detailed information about HOU as part of the PY2020 participant survey to further support this analysis.

Figure B.1 displays the hours per day respondents used their LEDs. Over one-third (36%) of respondents used there LEDs from four to six hours per day. Over one-fifth (23%) of respondents used there LEDs for more than six hours per day. On average, respondents used their LEDs for 6.3 hours per day.

Figure B.1 | Hours per Day LEDs in Use (n=714)



On average, respondents took 4.4 showers per week. The average duration of each shower was 12.2 minutes. ***Figure B.2*** and ***Figure B.3*** display the distribution of shower frequency and duration among respondents.

Figure B.2 | Showers per Week per Person (n=74)

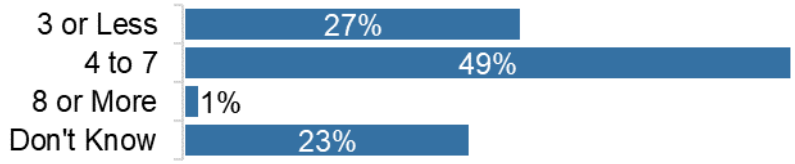


Figure B.3 | Minutes per Shower (n=57)

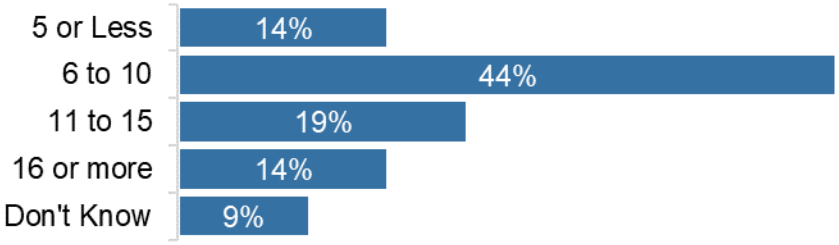
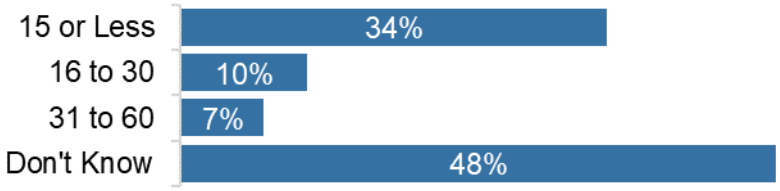


Figure B.4 displays the minutes per day respondents used their aerators. Around one-third (34%) of respondents used their aerators for 15 minutes per day or less. On average, respondents used their aerators for 16.4 minutes per day.

Figure B.4 | Minutes per Day Aerator in Use (n=29)



On average, respondents used their dehumidifiers for 16.4 hours per day, 165 days per year. ***Figure B.5*** and ***Figure B.6*** display the distribution of days per year and hours per day respondents used their dehumidifiers.

Figure B.5 | Days per Year Dehumidifier in Use (n=52)

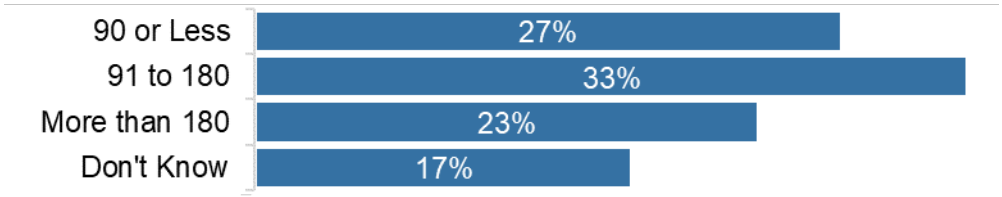
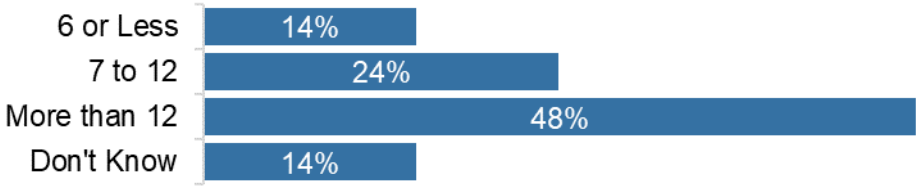
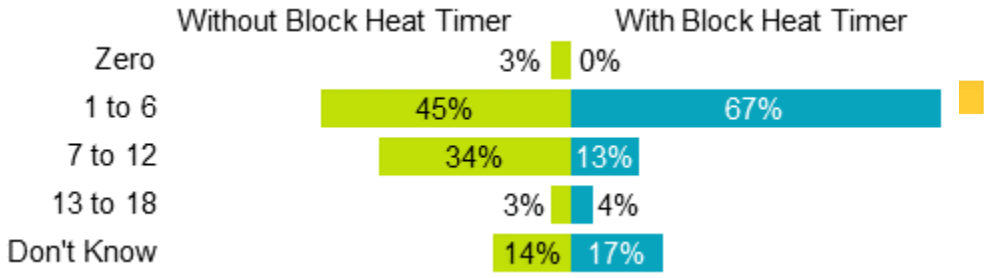


Figure B.6 | Hours per Day Dehumidifier in Use (n=42)



Before receiving the block heater timers provided by the program, respondents used their block heaters for 6.4 hours per day on average. After installing the block heat timers, respondents used their block heaters for an average of 4.8 hours per day. ***Figure B.7*** displays the distribution of hours per day that respondents used their block heaters before and after receiving the block heat timers.

Figure B.7 | Hours per Day Block Heater in Use (n=29)



Appendix C – Program Logic Model

This appendix includes a Logic Model for the Home Assistance Program. Logic models are graphic depictions that present the relationship between activities, outputs, and short, mid-, and long-term outcomes for a given energy efficiency program. ***Figure C.1*** demonstrates these relationships for the Home Assistance Program.

Figure C.1 | Home Assistance Program Logic Model