2021-2024 CDM Framework Retrofit PY2022 Evaluation Results

Submitted to IESO

in partnership with NMR Group

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Acronyms and Abbreviations

CDM	Conservation and Demand Management
CDM-IS	Content data management information system
DCKV	Demand control kitchen ventilation
EM&V	Evaluation, measurement, and verification
EUL	Effective useful life
FR	Free-ridership
GTA	Greater Toronto Area
GW or GWh	Measurement of demand (GW) or energy (GWh) equivalent to 1,000,000,000 W or Whr
HVAC	Heating, ventilation, and air conditioning
IDI	In-depth interview
IESO	Independent Electricity System Operator
IF	Interim Framework
ISTC	In-Suite Temperature Controls
kW or kWh	Measurement of demand (kW) or energy (kWh) equivalent to 1,000 W or Whr
LED	Light emitting diode
MW or MWh	Measurement of demand (MW) or energy (MWh) equivalent to 1,000,000 W or Whr
NTG	Net-to-gross
PY	Program year
SO	Spillover
VFD	Variable frequency drive

1. Executive Summary

The Independent Electric System Operator (IESO) retained Resource Innovations, Inc. (formerly Nexant, Inc.) and its partner, NMR Group, Inc. (referenced throughout this report as 'the evaluation team'), for the evaluation of the 2021-2024 Conservation and Demand Management (CDM) Framework business programs. This report presents the results of the impact and process evaluations, cost-effectiveness assessment, and non-energy benefits (NEBs) analysis for the Program Year (PY) 2022 Retrofit program.

1.1. Program Description

The Retrofit program offers incentives to industrial, commercial, institutional, and multifamily residential facility customers that express interest in upgrading existing equipment with energy-efficient alternatives. As shown on the Save on Energy website, the Retrofit program requirements outline eligibility criteria for participants, facilities, and projects. The PY 2022 Retrofit program only offered prescriptive track measures. Prescriptive track applications provide a program-defined list of approved equipment and fixed incentives available for installation. The program requires limited documentation to ensure a simplified experience for participants.

1.2. Evaluation Objectives

For the PY2022 Retrofit program evaluation, the IESO outlined the following objectives:

- Conduct audits of completed projects to evaluate, measure, and verify completion and operating parameters through desk reviews, virtual site visits, and on-site inspections and metering.
- Annually verify gross energy and summer peak demand savings province-wide for the Retrofit program at 90% confidence level and 10% precision.
- Assess free-ridership and participant spillover to determine an appropriate net-to-gross (NTG) ratio.
- Research specific areas of interest to help the IESO improve the Retrofit program and prepare for future program designs and evaluations.
- Perform a cost-effectiveness assessment, greenhouse gas (GHG) reduction estimate, non-energy benefits (NEBs) analysis, and job impact quantification.
- Deliver annual reports, memos, impact result templates, and a final report that meets the IESO's requirements and timelines.
- Provide thoughtful recommendations for program improvements, based on feedback obtained through the evaluations.

1.3. Summary of Results

1.3.1. Impact Evaluation Results

This section summarizes the savings and cost-effectiveness results verified through the impact evaluation. The evaluation analyzed the program's impacts and quantified savings realized due to implementation of energy-efficiency retrofit projects in the province of Ontario during PY2022.

Table 1-1 presents overall impact results for the PY2022 Retrofit program. The first-year, net, verified energy and summer peak demand savings were 265,878 MWh and 29,471 kW, respectively. Gross verified savings for applicable lighting measures include Interactive effects and baseline shift-adjustment factors.

Table 1-1: Energy and Summer Peak Demand Impacts

Savings Type	Gross Reported Savings	Gross Verified Savings	Net Verified Savings
First Year Energy (MWh)*	306,783	287,561	265,878
First Year Summer Peak Demand (kW)*	29,322	31,249	29,471

*Includes Interim Framework carryover projects

These results include savings from the 2021-2024 CDM Framework projects as well as from Interim Framework (IF) carryover projects, described in Section 2.1. IF projects contributed 22,948 MWh (9%) of total, first-year, net verified energy savings and 3,190 kW (11%) of total, net summer peak demand savings.

Sampling for the PY2022 portion of the 2021-2024 CDM Framework program did not include IF carryover projects due to differences between programs. The IF Retrofit program was delivered differently, where the IF carryover population contained both Custom and Prescriptive track projects. The evaluation team took the realization rates and NTG ratios applied to the IF Retrofit carryover projects from the PY2022 IF Retrofit evaluations. To allow a presentation of the 2021-2024 CDM Retrofit program performance, the team bases information presented in the remainder of this report solely on projects completed among the 2021-2024 CDM Framework population.

Table 1-2 presents energy and summer peak demand sample realization rates for the PY2022 2021-2024 CDM Framework sample. The program achieved a 93.7% energy realization rate and a 106.57% summer peak demand realization rate. Program savings split into Lighting, Lighting—Greenhouses, and Non-Lighting measure tracks. To improve the evaluation results' precision, the team added rolling samples using previously evaluated projects (from PY2021) for the lighting and non-lighting strata to the current evaluation cycle.

The Lighting sample achieved a 14% precision at 85% confidence, and the non-lighting sample achieved just above the 10% target at the 90% confidence level. The Lighting Greenhouse sample, which achieved 4.8% precision at the 90% confidence level, consisted solely of PY2022 projects. Overall, the program achieved a 5.45% precision at the 90% confidence level.

Table 1-2: PY2022 2021-2024 CDM Framework Sample Realization Rates

Measure Type	Energy Realization Rate	Energy RR Relative Precision	Summer Peak Demand Realization Rate	Demand RR Relative Precision
Lighting*	106.77%	13.99%	106.81%	11.78%
Lighting - Greenhouses**	80.78%	4.88%	330.43%	46.29%
Non-Lighting**	97.23%	10.19%	92.35%	19.22%
TOTAL	93.73%	5.45%	106.57%	16.48%

*Reported precision is at 85% confidence interval.

** Reported precision is at 90% confidence interval.

Figure 1-1 and Figure 1-2 display PY2022 net verified first-year energy and summer peak demand savings percentages for the Prescriptive Lighting, Lighting—Greenhouses, and Non-Lighting tracks of the 2021-2024 CDM Retrofit program. The Prescriptive Lighting track represents 49% of total net verified first-year energy savings achieved by the program, with the Prescriptive Lighting—Greenhouse's track accounting for 44% and the Prescriptive Non-Lighting track accounting for 7%.

Figure 1-1: First-Year Net Verified Energy Savings % by Track

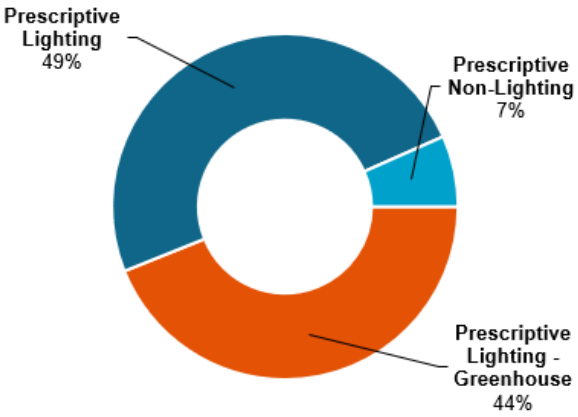
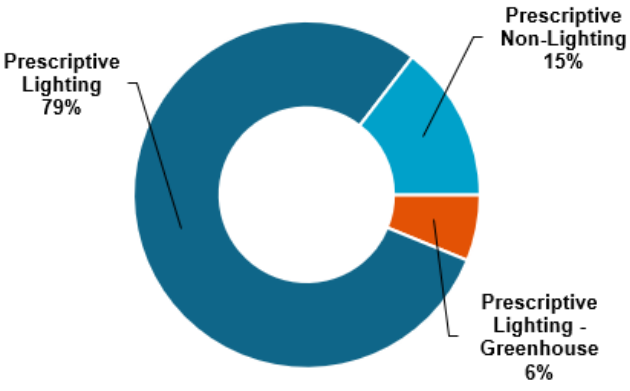


Figure 1-2: First-Year Net Verified Summer Peak Demand Savings % by Track & Type



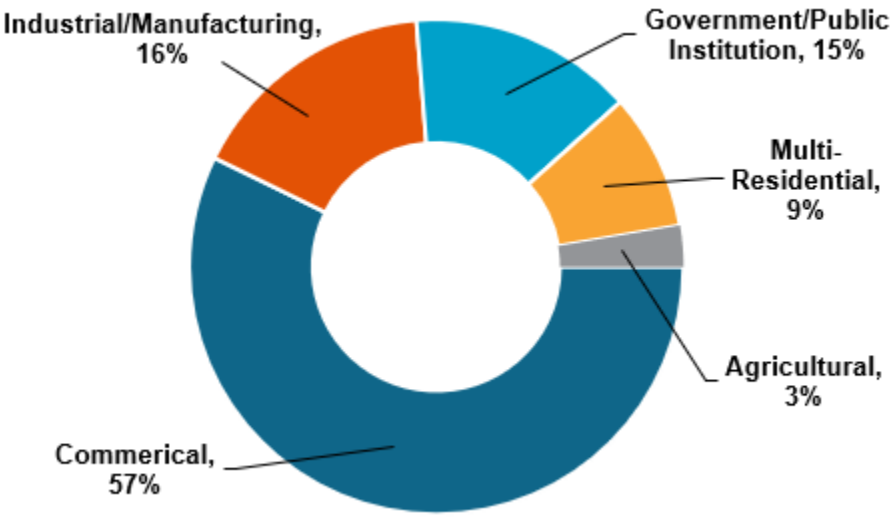
For the summer peak demand savings, however, the Prescriptive Lighting track represents 79% of total net verified first-year summer peak demand savings achieved by the program, with the Prescriptive Lighting—Greenhouses track accounting for 6% and the Prescriptive Non-Lighting accounting for 15%.

These trends remain consistent with PY2021 results, where prescriptive lighting projects represented 54% of the total net verified first-year energy savings achieved by the program, with the Prescriptive Lighting—Greenhouse's track accounting for 32% and the Prescriptive Non-Lighting accounting for 14%. In PY2021, the Prescriptive Lighting track represented 82% of total net verified first-year summer peak demand savings achieved by the program, with the Prescriptive Lighting—Greenhouse's track accounting for only 2% and the Prescriptive Non-lighting accounting for 16%.

The PY2022 2021-2024 CDM Retrofit program achieved a Program Administrator Cost (PAC) ratio of 3.66, exceeding the 1.00 target threshold. The PY2022 2021-2024 CDM Framework Retrofit CE results is close to two times the PY2021 CDM Framework Retrofit program which achieved a PAC ratio of 1.81. First-year avoided GHG emissions from electricity savings were reduced by the increase in GHG consumption due to the gas-heating penalty, resulting in 48,351.76 Tonnes of CO2 reduced in the first year. PY2022 CDM Framework Retrofit program projects are expected to achieve a total of 528,826.81 Tonnes of avoided GHG throughout the EUL of the installed measures.

A total of 2,310 Retrofit projects were completed in the province during PY2022 of the 2021-2024 CDM Framework. This is close to three times the number of projects (848) completed in the province during PY2021. The total number of IF carryover projects completed during PY2022 was 178 compared to 203 IF carryover projects completed during PY2021. Figure 1-3 displays the percentages of each facility type within the population during PY2022. The commercial facility portfolio represents 57% of the total program. On the other hand, agricultural facilities account for only 3% of the program.

Figure 1-3: Facility Type Count %



1.3.2. Process Evaluation

The evaluation team performed a process evaluation to better understand program design and delivery during 2022. The team collected primary data to support this evaluation through interviews with IESO staff and program delivery staff as well as surveys with applicant representatives, contractors, and participants. The executive summary summarizes key insights from the process evaluation, and Section 5 presents these insights in greater detail.

Program awareness. Applicant representatives and contractors most commonly reported that customers became aware of the program when their company contacted customers about it (59%). Similarly, close to two-thirds of participants (64%) reported hearing about the program through a contractor or equipment vendor. Other common ways participants reported hearing about the program included through previous participation in another Save on Energy program (29%), the IESO website (11%), and from colleagues or competitors (9%). Refer to Section 5.2.2 and Section 5.3.2 for additional details.

Program marketing and outreach. IESO staff said marketing and outreach efforts went well overall in PY2022. The program reinstated some in-person marketing and outreach activities and developed or updated other online and print resources as well. Program delivery vendors performed their own outreach and lead generation, noting that contractors and suppliers often promoted the program to their customers as well. The program aspect that applicant representatives and contractors provided the lowest satisfaction rating for was program marketing and outreach (50% with a rating of 4 or 5 on a scale of one to five, where one indicates “not satisfied at all” and five indicates “completely satisfied”). Refer to Section 5.1.3 and Section 5.2.6 for additional details.

Decision to Not Install Additional Energy-Efficient Equipment or Services. More than one-fourth of participants (26%) said they could not install equipment of interest due to insufficient program incentives. More than two-fifths (41%) reported not being able to install air conditioner replacements above code minimums. These participants estimated that the program incentive would need to cover an average of 52% of the cost for their company to install air conditioner replacements through the program. Participants also mentioned not being able to install fans (28%) and lighting (24%), estimating that the program incentive would need to cover an average of 54% and 43%, respectively, of the cost for their company to install the fans or lighting through the program. Refer to Section 5.3.4 for additional details.

Program barriers. When asked to identify barriers that prevented more customers from participating in the Retrofit Program, applicant representatives and contractors most commonly identified customers not perceiving upgrades as worth the trouble of participation (35%) and customers not knowing of the program (30%). IESO and delivery vendor staff identified limitations of the prescriptive-only offering, incentive levels being too low for some equipment, customers not thinking the program application worth their time, lack of awareness, staff turnover, lack of customer capital, supply chain issues, and paperwork requirements as common barriers. Refer to Section 5.1.5 and Section 5.2.6 for additional details.

Program improvement suggestions. The most common suggestions provided by participants to improve the program included improving the Save on Energy website and its online portal (21%), increasing the incentive amount (21%), and simplifying the overall process (19%). Applicant representatives and contractors most commonly suggested increasing the incentive amount (40%), expanding eligible measures (17%), and making the application process easier (13%). Refer to Section 5.2.6 and Section 5.3.5 for additional details.

1.4. Key Findings and Recommendations

This section includes a subset of the most important evaluation key findings and recommendations. Section 7 presents all the key findings and recommendations.

Finding 1: Incentive levels were generally considered too low. When asked if incentives for specific energy-efficient equipment or models offered through the program were appropriate, over one-half of applicant representatives and contractors (54%) reported they were too low. Nearly one-third of applicant representatives and contractors (31%) found incentives were too low generally; others listed a variety of equipment types where the incentives were too low, such as linear fixtures (14%), flat panels (10%), and LED troffers (10%). More than one-fourth of participants (26%) said they could not install equipment of interest due to insufficient program incentives. IESO and delivery vendor staff reported that incentives were generally considered too low to keep up with rising costs, with some staff providing recommendations for specific equipment that may require increased incentives (i.e., low-bay lighting, motors, rooftop units).

- **Recommendation 1:** Consider revisiting overall program incentive levels or key measures of interest, given concerns over incentives not keeping pace with

rising costs. Measures of interest could include those with high contribution to the Retrofit program and with the highest benefits to cost ratio, including lighting (LED medium/high bay fixture, T8 LED tube/u-bend replacement lamp, and T5 LED tube replacement lamp) and non-lighting (variable frequency drive, VSD compressed air, and ECMs for HVAC application (fam motor replacement)).

Finding 2: HOU and conservation case wattages for horticultural lighting measures. The differences between deemed and verified annual HOU and conservation case wattages are the main drivers of the low average realization rate (81%) for Lighting greenhouse measures. To obtain a comprehensive understanding, the combined results from PY2021 and PY2022 were utilized to verify the operating hours and conservation case wattages for each horticultural lighting measure. The average deemed and verified values for HOU and conservation case wattages in the PY2022 and PY2021-PY2022 rolling population with their respective precision values (at 90% confidence) are presented in Table 1-3 and Table 1-4 below. Analysis results do not include the LED grow lights - cannabis warehouses measure due to the limited sample size.

Table 1-3: Comparison of Hours of Use by Measure Type

Measure Type	Avg Deemed HOU	PY22 Avg Verified HOU	PY22 Sample Precision	PY 21 & 22 Avg Verified HOU	PY21 & 22 Sample Precision
HORTICULTURAL INTER-LIGHTING LED GROW LIGHT FIXTURE	5,327	4,863	1%	4,953	1%
LED GROW LIGHTS – VEGETABLE GREENHOUSES	2,400	2,893	8%	2,842	6%

Verified HOU from the combined PY2021 and PY2022 projects for Inter-lighting LED grow light fixtures were 7% lower than deemed hours. The deemed HOU fell outside of the error bounds of the verified HOU estimate. The error bounds of the verified estimate range from 4,899 to 5,008 hours. Conversely, HOU for LED grow lights—vegetable greenhouses were verified to be 18% higher than deemed hours for this measure. The error bounds of the verified estimate range from 2,672 to 3,013 hours and the deemed HOU fell outside of these error bounds.

Table 1-4: Comparison of Conservation Case Wattage by Measure Type

Measure Type	Avg Deemed Conservation kW	PY22 Avg Verified Conservation kW	PY22 Sample Precision	PY 21 & 22 Avg Verified Conservation kW	PY21 & 22 Sample Precision
HORTICULTURAL INTER-LIGHTING LED GROW LIGHT FIXTURE	0.096	0.114	2%	0.112	2%
LED GROW LIGHTS – VEGETABLE GREENHOUSES	0.540	0.689	7%	0.636	9%

Additionally, the verified conservation case wattage from the PY2021 and PY2022 projects for both Inter-lighting LED grow-light fixtures and LED grow lights—vegetable greenhouses exceeded the deemed values, with increases of 17% and 18, respectively. The deemed conservation wattage for both measures fell outside of the error bounds of the verified conservation wattage estimate. The error bounds of the verified estimate for horticultural Inter-lighting LED grow-light fixtures range from 0.11 kW to 0.114 kW and range from 0.581 kW to 0.691 kW for LED grow lights—vegetable greenhouses.

- **Recommendation 2:** Regularly review and consider updating the HOU and conservation case assumptions for horticultural lighting measures. The combined results of EM&V from multiple years can be utilized to determine the appropriate values, as they involve the collection and analysis of actual data during the evaluation of horticultural measures. While the evaluation results presented in Tables above present verified parameters with strong precision, they are based on relatively small samples and could change in the future.

Finding 3: Horticultural lighting measures deemed summer peak demand savings. The deemed summer peak demand savings for horticultural lighting measures are expected to be significantly low as it is assumed that during the summer peak demand period, the horticultural lighting measures are either non-operational or operating at a minimal capacity. For instance, the assumed coincidence factor for the Inter-lighting LED grow light fixtures, indicating their usage during the summer peak demand, is only two percent (2%). However, upon evaluating the Inter-lighting LED grow light fixtures using available hourly data, it was confirmed that they were used for extended periods during the summer peak demand period. After analyzing hourly data from ten projects, the average coincidence factor for summer peak demand savings was approximately 18%.

- **Recommendation 3:** Regularly review and consider updating horticultural lighting measures deemed summer peak demand savings. To increase confidence in verified peak demand savings, it is recommended to collect additional data in future evaluations until large enough sample is collected. This will help with future frameworks assumptions. Alternatively, a supplementary metering study on the horticultural lighting measures can be completed and integrate the obtained data into the current EM&V analyzed data. This can contribute to a more appropriate load shape development and coincidence factor selection for the summer peak demand period, aligning it better with the actual usage patterns of the horticultural lighting measures.

Finding 4 Lighting End-Uses MAL assumed HOU. The evaluation team compared the average verified HOU estimates from the impact sample projects to the Measure and Assumption List (MAL) deemed values. The evaluation team also compared the average verified HOU estimates incorporating a rolling population of PY2021 and PY2022 projects. During PY2021, the average verified HOU value for "Warehouse Wholesale" and "Large Non-Food Retail" were found to be 3,846 and 2,983 hours, respectively. The average deemed and verified values for HOU in the PY2022 and PY2021-PY2022 rolling population are presented in the Table 1-5 below. These categories had a high representation of measures in the 2021-2024 CDM Retrofit program so far. The deemed HOU for both the end uses fell outside of the error bounds of the verified HOU estimate in the PY2022 population as well as the rolling population of PY2021 and PY2022 projects. The error bounds of the verified estimate for PY2022 "Warehouse Wholesale" end-use range from 4,438 to 5,524 hours and for PY2021 and PY2022 range from 4,068 to 4,749 hours. The error bounds of the verified estimate for PY2022 "Large Non-Food Retail" end-use range from 2,668 to 3,823 hours and for PY2021 and PY2022 range from 2,826 to 3,415 hours.

Table 1-5: Comparison of Hours of Use by End-Use

END_USE	Avg Deemed HOU	PY22 Avg Verified HOU	PY22 Sample Precision	PY 21 & 22 Avg Verified HOU	PY21 & 22 Sample Precision
Warehouse Wholesale	3,759	4,981	11%	4,408	8%
Large Non-Food Retail	4,089	3,246	18%	3,121	9%

- **Recommendation 4:** Consider updating the HOU assumption for "Warehouse Wholesale" and "Large Non-Food Retail" after discussions with the program team regarding the makeup of the PY2021 and PY2022 population and sample and how representative that may be of the future program populations.

Finding 5: Increasing non-lighting applications is possible with additional program support. When asked how the program could increase the number of non-lighting applications, IESO staff said they are considering further outreach, education, and potential incentive increases. Similarly, delivery vendors suggested more funding and more engagement, with one delivery vendor noting the importance of bringing contractors on board and well-stocking with product. One delivery vendor noted that reintroduction of the custom path and introduction of midstream lighting program will substantially help increase the share of non-lighting projects for the Retrofit Program. Applicant representatives and contractors indicated that adding a wider variety of non-lighting measures (41%) and increasing the incentives for non-lighting measures (33%) would increase the number of non-lighting applications the program receives.

- **Recommendation 5a:** Support the submission of non-lighting applications by identifying sectors and businesses most likely to express interest in non-lighting projects. Further support these projects by providing appropriate incentives (see Recommendation 1 above) and by engaging contractors and encouraging stocking of efficient products.

- **Recommendation 5b:** Perform a jurisdictional scan to identify prescriptive measure offerings that are not currently offered under the Retrofit Program.

2. Introduction

This report summarizes the evaluation results for the PY2022 of the 2021-2024 CDM Framework Retrofit program and includes projects completed and reported to the IESO between January 1 and December 31, 2022.

2.1. Program Description

The Retrofit program offers incentives to industrial, commercial, institutional, and multifamily residential facility clients interested in upgrading existing equipment with energy-efficient alternatives. The Retrofit program requirements on the Save on Energy website outline eligibility criteria for participants, facilities, and projects. The 2021-2024 CDM Framework Retrofit program only offers a prescriptive track, which includes a program-defined list of approved equipment and fixed incentives available for installation. This track encourages lighting and non-lighting building improvements. It includes three streams: lighting, HVAC, and process. The program requires limited documentation to ensure a simplified experience for program participants.

This report presents savings results from the 2021-2024 CDM Framework Retrofit program as well as carryover projects from the PY2022 Interim Framework (IF) Retrofit program. PY2022's IF carryover projects received preapproval by April 30, 2021, and were submitted for post-approval by December 31, 2022. The IESO listed projects to be included in the 2021-2024 CDM Framework results. While the PY2022 of the 2021-2024 CDM Framework results included impacts from these projects, the appropriate regional realization rates from the PY2022 IF Retrofit evaluation were applied to the IF carryover projects.

2.2. Evaluation Objectives

The goals and objectives of the PY2022 2021-2024 CDM Framework Retrofit program evaluation included the following:

- Conduct audits of completed projects to evaluate, measure, and verify completion and operating parameters through desk reviews, virtual site visits, and on-site inspections and metering.
- Annually verify gross energy and summer peak demand savings province-wide for the Retrofit program at a 90% confidence level and 10% precision.
- Assess free-ridership and participant spillover to determine an appropriate net-to-gross (NTG) ratio.
- Research specific areas of interest to help the IESO improve the Retrofit Program and prepare for future program designs and evaluations.
- Perform a cost-effectiveness assessment, greenhouse gas (GHG) reduction estimate, Non-Energy Benefits (NEBs) analysis, and job impact quantification.
- Deliver annual reports, memos, an impact results template, and a final report that meets the IESO's requirements and timelines.

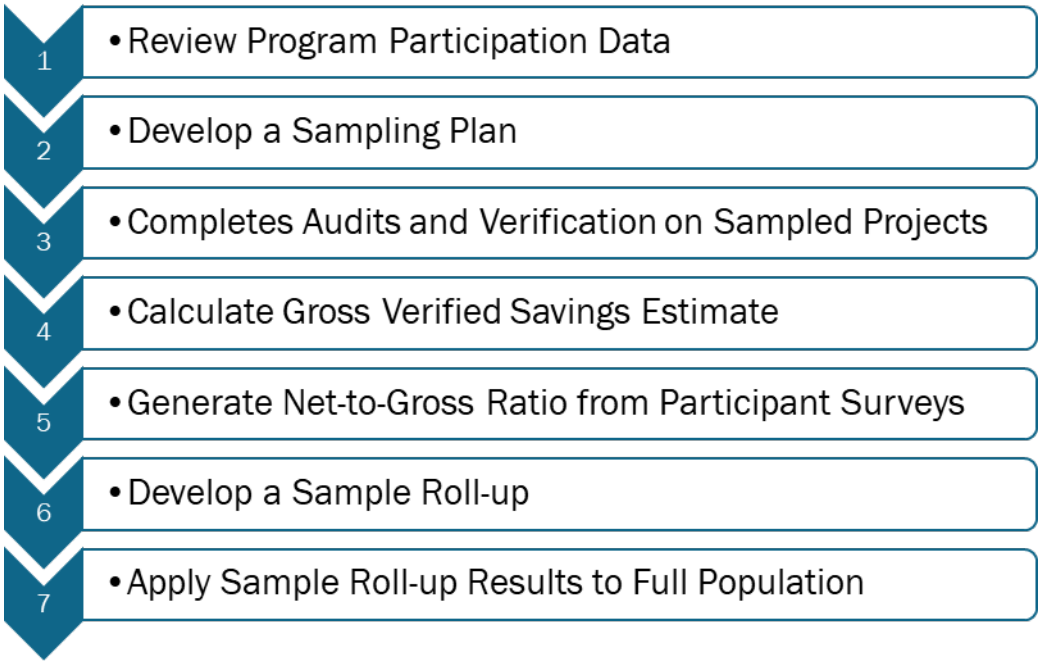
- Provide thoughtful recommendations on program improvements based on feedback obtained through the evaluations.

3. Methodology

3.1. Impact Evaluation Methodology

Figure 3-1 presents the impact evaluation methodology, comprised of the following distinct components.

Figure 3-1: Impact Evaluation Methodology



Appendix A and Appendix B, respectively, provide additional detail on the impact and NTG methodology.

3.1.1. Project Participation and Sampling

The evaluation team drew the impact evaluation sample solely from a list of PY2022 2021-2024 CDM Framework projects post-approved and paid between January 1 and December 31, 2022. The sampling did not include IF carryover projects for the 2021-2024 CDM Framework program due to program delivery differences between the frameworks. Impact sampling first involved stratifying the population into similar project types to minimize variability and improve the confidence and precision of the sample results. The team then stratified the population by measure type, followed by randomly sampling from each stratum. The number of projects selected from each stratum targeted results that achieved a 90% confidence level at a 10% precision level, assuming a coefficient of variation of 0.5. Lighting, Lighting—Greenhouses, and Non-Lighting tracks made up the impact evaluation sample, for a total of 166 random sample projects selected, as shown in Table 3-1.

Table 3-1: Impact Evaluation Sample

Measure Type	Population Project Count	Sample Project Count
Lighting	2,002	53
Lighting – Greenhouses	42	18
Non-Lighting	266	95
TOTAL	**2,310**	**166**

Each sampled project received a desk review, or a site visit as well as an independent project analysis using equipment-specific data collected from participants during the desk review phase or data collected on-site to verify gross savings. Using these individual sample project results, the team calculated realization rates applied to savings from projects in the PY2022 2021-2024 CDM Framework population. Sample results from the PY2022 IF Retrofit evaluation were applied to IF carryover projects attributed to the 2021-2024 CDM framework.

3.1.2. Net-to-Gross Evaluation Methodology

The evaluation team utilized the participant self-report survey results to estimate the NTG ratio. The survey's sample design was the same for both the NTG and process evaluations because the participant self-report survey was inclusive of both evaluation areas. The sample was developed at the province-wide level. The survey sought and achieved a NTG at 90% confidence and 10% precision in the results. The evaluation team will calculate net energy and summer peak demand savings that are attributable to the Retrofit Program by multiplying the gross verified energy and summer peak demand savings by the NTG. This equation and general methodology are used for estimating both the net energy and summer peak demand savings. The NTG ratio is based on measurement of free-ridership and spillover rates and is defined in Equation 3-1.

Equation 3-1: NTG Ratio

$$NTG = 1 - Free\ Ridership + Spillover$$

Appendix B provides additional detail on the NTG methodology.

3.2. Process Evaluation Methodology

The process evaluation focused on program design and delivery. The evaluation team assessed program processes through interviews and surveys with relevant program actors, including IESO staff, program delivery vendor staff, applicant representatives, contractors, and participants. The team developed customized interview guides or survey instruments for each respondent type to ensure responses produced comparable data and allowed for the inference of meaningful conclusions. Table 3-2 presents the survey methodology, the total

population invited to participate in the surveys or interviews, the total number of completed surveys, and the sampling error at the 90% confidence level for each respondent type. Appendix C provides additional detail regarding the process evaluation methodology.

Table 3-2: Process Evaluation Primary Data Sources

Respondent Type	Methodology	Population	Completed	Response Rate	90% CI Error Margin
IESO Staff	Phone In-depth Interviews (IDIs)	3	3	100%	0%
Program Delivery Vendor Staff	Phone IDIs	3	3	100%	0%
Applicant Representatives and Contractors	Web Survey	327	54	17%	10.3%
Participants	Web and Phone Survey	1,680	222[1]	13%	5.2%

3.3. Other Energy Efficiency Benefits Methodology

3.3.1. Non-Energy Benefits Methodology

The NEBs methodology for the PY2022 Retrofit program followed the same methodology as the two previous studies: *PY2021's 2021-2024 CDM Retrofit Evaluation Report;* and the *Non-Energy Benefits Study: Phase II*, which assessed NEBs from energy-efficiency projects funded by the IESO over the 2017-2021 period.[2]

The evaluation team calculated NEBs using two different techniques—the relative scaling approach and the willingness to pay approach—to determine the value of NEBs that program participants realized by installing program measures. All surveys required respondents to value all NEBs using both techniques. Data collected from these questions could then be used to quantify the NEBs. Appendix G provides additional detail regarding the NEB methodology.

3.3.2. Job Impacts Assessment Methodology

The evaluation team's analysis of job impacts utilized the Statistics Canada[3] (StatCan) Input-Output (IO) model to estimate direct, indirect, and induced job impacts. IO models are used to analyze the propagation of exogenous economic shocks throughout an economy. The models

[1] The NTG evaluation included more respondents (n=249) than the process evaluation (n=222) as 27 respondents did not fully answer the process evaluation survey questions.

[2] Dunsky. (July 2021). *Non-Energy Benefits: Phase II; Quantified Benefits and Qualitative Insights*. https://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation-reports/Non-Energy-Benefits-Study-Phase-II.ashx

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

represent relationships (or flows) of inputs and outputs between industries. Funding and implementing an energy efficiency program, such as the Retrofit program, creates a set of "exogenous shocks"—or events occurring outside of the system (e.g., demand for specific products and services, additional reinvestment by businesses from energy bill savings). These shocks propagate throughout the economy, and their impacts can be measured in terms of variables such as economic output and employment. Appendix E provides additional detail regarding the job impacts used in the evaluation methodology.

4. Impact Evaluation Results

The evaluation team performed an impact evaluation to assess energy and summer peak demand savings attributable to the program and to quantify savings generated by implementing Retrofit projects in the province of Ontario during PY2022.

4.1. Energy and Demand Savings

Table 4-1 presents overall impact savings for the PY2022 Retrofit Program. The program produced total first-year net verified energy and summer peak demand savings of 265,878 MWh and 29,471 kW, respectively. Gross verified savings include interactive effects and baseline shift adjustment factors for applicable lighting measures. The overall impact savings results significantly increased in comparison to the PY2021 Retrofit Program's projects, which produced total first-year net verified energy and summer peak demand savings of 63,794 MWh and 11,792 kW, respectively.

Table 4-1: Energy and Summer Peak Demand Savings

Savings Type	Gross Reported Savings	Gross Verified Savings	Net Verified Savings	Net Verified Savings at 2026
First-Year Energy (MWh)*	306,783	287,561	265,878	264,972
Summer Peak Demand (kW)*	29,322	31,249	29,471	29,398

*Includes IF carryover projects

Table 4-1's results include savings from PY2022's 2021-2024 CDM Framework projects as well as the IF carryover projects described in Section 2.1. These IF projects contributed 22,948 MWh (9%) of total first-year net verified energy savings and 3,190 kW (11%) of total, net summer peak demand savings. During the PY2021 Retrofit Program, IF carryover projects contributed 20,404 MWh (32%) of total first-year net verified PY2021 energy savings and 3,400 kW (29%) of total summer peak demand PY2021 savings.

Sampling for the 2021-2024 CDM Framework program did not include IF carryover projects due to differences between the two programs. The IF Retrofit program employed a differing delivery method and IF's carryover population contained both Custom and Prescriptive tracks projects. Realization rates and NTG ratios applied to the IF Retrofit carryover projects are derived from the PY2022 IF Retrofit evaluations. To allow a presentation discussion of the 2021-2024 CDM Framework Retrofit program's performance, information presented in the remainder of this report draws solely upon PY2022 projects in the 2021-2024 CDM Framework population.

Table 4-2 presents energy and summer peak demand sample realization rates for PY2022's 2021-2024 CDM Framework sample. The program achieved an energy realization rate of 93.73% and a summer peak demand realization rate of 106.57%. To improve the evaluation

results' precision, the team added rolling samples using previously evaluated projects (from PY2021) for the lighting and non-lighting strata to the current evaluation cycle.

The Lighting sample achieved 14% precision at 85% confidence, and the non-lighting sample came in just above the 10% target at the 90% confidence level. The team determined that the Lighting Greenhouse sample, which consisted solely of PY2022 projects, achieved a 4.8% precision at the 90% confidence level. Overall, the program achieved a 5.45% precision at the 90% confidence level.

Table 4-2 : PY2022 2021-2024 CDM Framework Sample Realization Rates

Measure Type	Energy Realization Rate	Energy RR Relative Precision	Summer Peak Demand Realization Rate	Demand RR Relative Precision
Lighting*	106.77%	13.99%	106.81%	11.78%
Lighting – Greenhouses**	80.78%	4.88%	330.43%	46.29%
Non-Lighting**	97.23%	10.19%	92.35%	19.22%
TOTAL	93.73%	5.45%	106.57%	16.48%

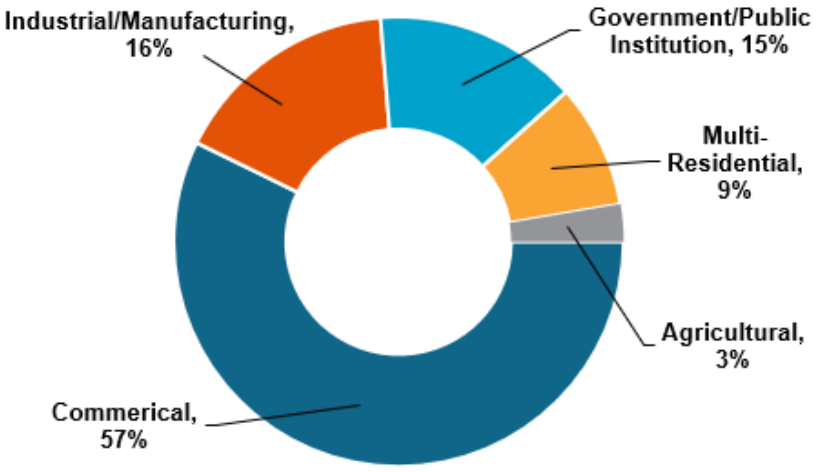
*Reported precision is at 85% confidence interval.

** Reported precision is at 90% confidence interval.

4.2. Participation and Net Savings by Facility Type

During PY2022 of the 2021-2024 CDM Framework, customers within the province completed a total of 2,310 Retrofit projects. This section describes the makeup of these projects in terms of measure counts and first- year net verified savings by facility and measure types. Figure 4-1: displays the percentage of total measures by facility type within the population.

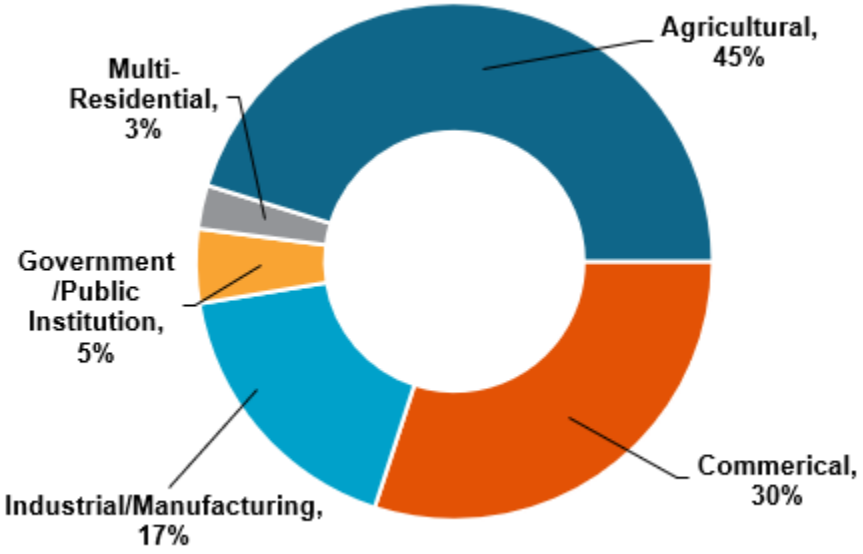
Figure 4-1: Measure Count Percentage by Facility Type



By measure count, commercial facility types made up 57% of all installed measures. The commercial facility type contained subcategories such as include Retail (15%), Office (13%), Warehouse/Wholesale (13%), Restaurant (1%), and "Other" commercial types (15%). These trends remain consistent with PY2021's results, where the commercial facility type was the most common by measure count, with 65% of all installed measures.

As shown in Figure 4-2, while agricultural facilities made up only 3% of installed measures, it accounted for 45% (109,916 MWh) of total net verified first-year energy savings in PY2022. These trends are consistent with the PY2021 results, where agricultural facilities made up only 2% of installed measures, but they accounted for 32% of total net verified first-year energy savings. The majority of PY2022 savings (99%) derived from Agricultural facilities with horticultural inter-lighting (53%) and horticultural grow lighting (46%) in vegetable greenhouses.

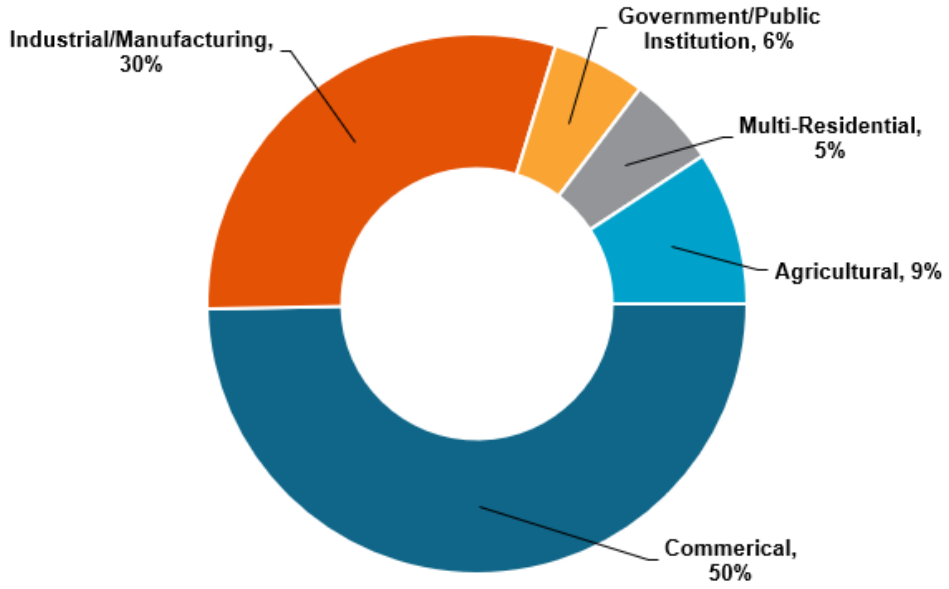
Figure 4-2: Net Verified First-Year Energy Savings Percentage by Facility Type



Despite Agricultural facilities achieving the greatest energy savings, they represented only 9% (2,428 kW) of summer peak demand savings for the program, as shown in Figure 4-3. These levels proved consistent with PY2021, where they represented 6% (529 kW) of summer peak demand savings. This mainly resulted from operation schedules that were not in use during summer months.

While participants installed 57% of measures in various commercial facilities, these only accounted for 30% (72,860 MWh) of total net verified first-year energy savings and 50% (13,062 kW) of total net verified first-year summer peak demand savings. Industrial/Manufacturing facilities accounted for 16% of measures, 17% (42,277 MWh) of net, verified, first-year energy savings and 30% (7,887 kW) of net first-year summer peak demand savings.

Figure 4-3: Net Verified First Year Summer Peak Demand Savings Percentage by Facility Type



4.3. Measure Categories

PY2022's 2021-2024 CDM Framework projects can be split into three main tracks: Prescriptive Lighting, Prescriptive Lighting—Greenhouse, and Prescriptive Non-Lighting measures. The Prescriptive Non-Lighting measure track further subdivides into Prescriptive HVAC and Prescriptive Process sub-tracks. Table 4-3 presents energy savings for each PY2022 2021-2024 CDM Framework project measure track.

Table 4-3: Energy Savings by Measure Track

Measure Track*	Gross Reported Savings	Gross Verified Savings	Net Verified Savings	Net Verified Energy Savings % Program Contribution
Lighting (MWh)	120,627	129,889	120,095	49%
Lighting – Greenhouse (MWh)	142,858	115,401	106,700	44%
Non – Lighting (MWh)	17,949	17,452	16,136	7%
TOTAL	281,434	262,742	242,931	100%

*Does not include IF carryover projects

The Lighting track represents 49% of total, net, verified, first-year energy savings achieved by the program, the Lighting—Greenhouse's track represents 44%, and the non-lighting represents 7%. Under non-lighting track, the process subtrack represents 5% and the HVAC subtrack represents only 2% of the total net verified first-year energy savings.

Table 4-4 presents summer peak demand savings for each measure track for PY2022's 2021-2024 CDM Framework projects.

Table 4-4: Summer Peak Demand Savings by Measure Category

Measure Category*	Gross Reported Summer Peak Demand Savings	Gross Verified Summer Peak Demand Savings	Net Verified Summer Peak Demand Savings	Net Verified Summer Peak Demand Savings Contribution
Lighting (kW)	20,534	22,088	20,831	79%
Lighting – Greenhouse (kW)	520	1,720	1,622	6%
Non – Lighting (kW)	4,396	4,059	3,828	15%
TOTAL	25,450	27,866	26,281	100%

*Does not include IF carryover projects.

The Lighting track represents 79% of the program's total net verified first-year summer peak demand savings, the Lighting—Greenhouse's track represents 6%, and the Non-Lighting track represents 15%. Within the Non-Lighting track, the process subtrack represents 6% of total, net, verified, first-year summer peak demand savings and the HVAC subtrack represents 9%.

4.3.1. Prescriptive Lighting Measure Track

The Prescriptive Lighting track contributed 49% and 79% of total net verified first-year energy and summer peak demand savings, respectively. This represents a slight decrease in comparison to PY2021 projects, where prescriptive lighting projects represented 54% and 82% of total net verified first-year energy and summer peak demand savings.

Figure 4-4 displays the measure count percentage of total lighting measures by category. Troffers were the most common lighting measures, accounting for 48% of installed lighting measures, followed by high-bays at 18% which remained consistent with PY2021 measure categories.

Figure 4-4: Lighting Measures Count Percentages

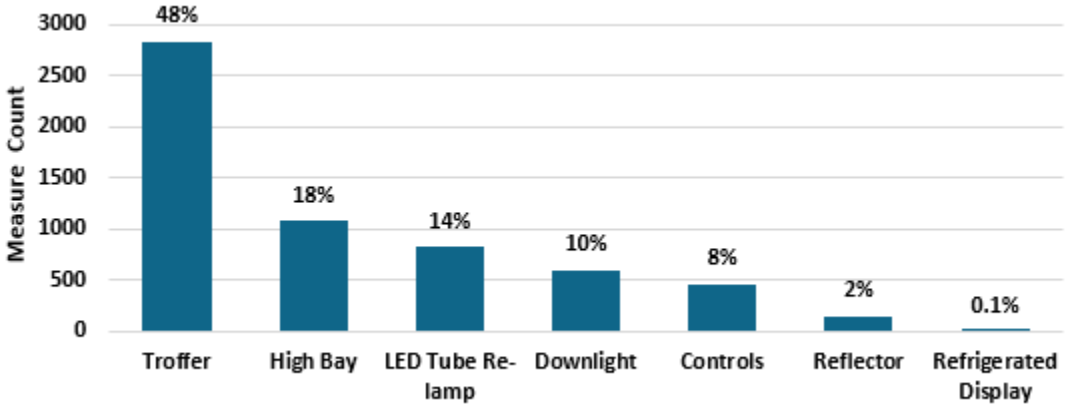


Figure 4-5 and Figure 4-6 display the percentage of net verified energy and summer peak demand savings by lighting measure category. While troffers were the most commonly installed program lighting measures, they ranked third for savings achieved. High-bay measures achieved the highest share of energy and summer peak demand savings at 65% and 68%, respectively. This trend remains consistent with PY2021 results, where high-bay lighting measures contributed 37% and 58% of energy and summer peak demand savings, respectively.

Figure 4-5: Lighting Net Verified Energy Savings Percentages

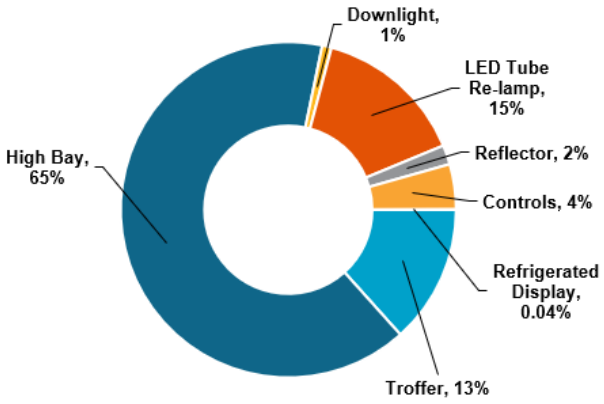
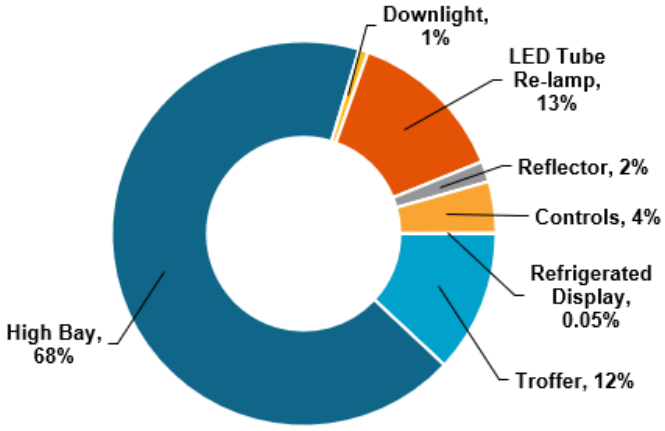


Figure 4-6: Lighting Net Verified Summer Peak Demand Savings Percentages



4.3.2. Prescriptive Lighting—Greenhouse Measure Track

The Prescriptive Lighting—Greenhouse measures contributed 44% and 6% of total net verified first-year energy and summer peak demand savings, respectively. The Prescriptive Lighting—Greenhouse projects' contribution increased in comparison to the PY2021 projects, where the same measures contributed 32% and 2% of total net verified first-year energy and summer peak demand savings, respectively.

Figure 4-7 displays the measure count percentage of total lighting—greenhouse measures by category. LED grow lights provided the most common lighting—greenhouse measures, accounting for 80% of lighting—greenhouse measures, followed by horticultural inter-lighting grow lights at 20%. The evaluation team observed an increase in horticultural inter-lighting measures compared to PY2021, where horticultural inter-lighting measures made up only 8% of lighting—greenhouse measures.

Figure 4-7: Lighting—Greenhouse Measures Count Percentages

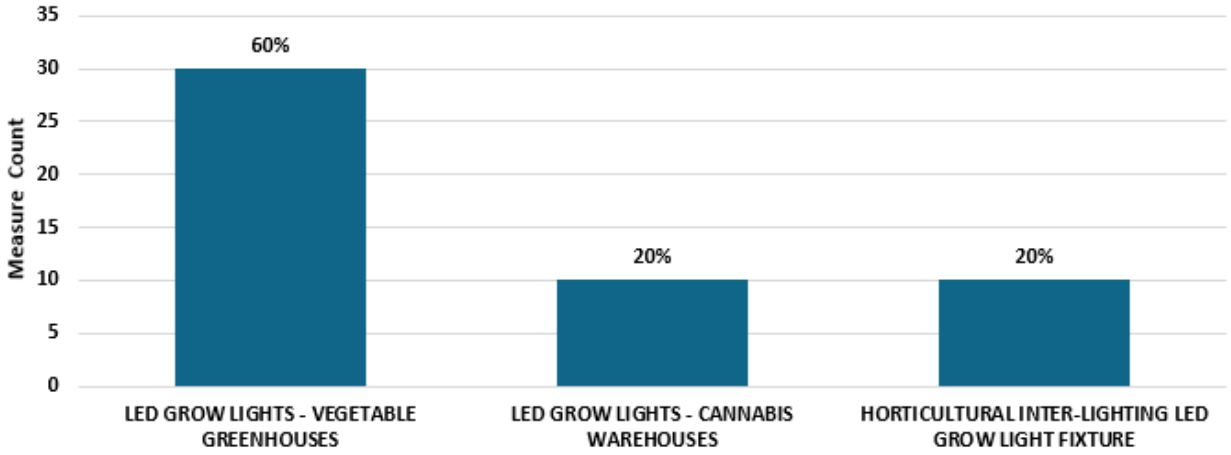


Figure 4-8 and Figure 4-9 display the percentage of net verified energy and summer peak demand savings by the lighting—greenhouse measure category. Although grow lights were the program's most common lighting measures, they ranked second (47%) for energy savings and demand (49.9%) achieved. Horticultural inter-lighting measures achieved the greatest energy (53%) and demand (50.4%) savings.

Though 42 projects implemented horticultural lighting measures, these achieved the largest portion of overall lighting measure savings, with average net verified energy savings of 2,134 MWh per project. High-bay fixtures provided the next-highest average energy savings per project for a lighting measure, at 72.2 MWh per project. Although troffer measures accounted for almost one-half of total lighting measures, they only had average savings of 5.7 net MWh per project.

Figure 4-8: Lighting—Greenhouse Net Verified Energy Savings Percentages

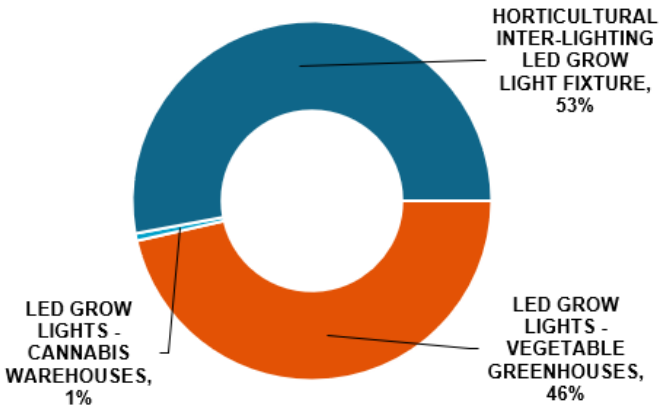
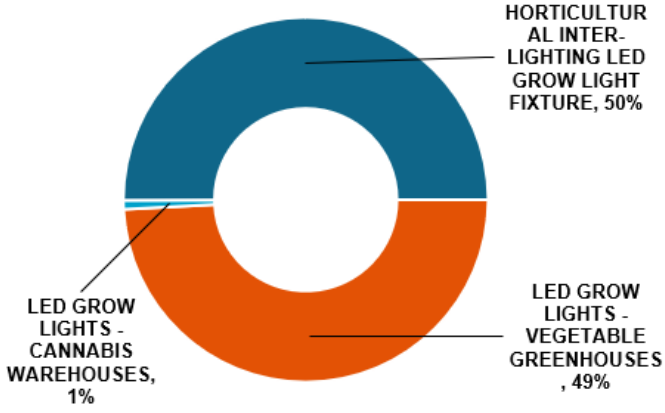


Figure 4-9: Lighting—Greenhouse Net Verified Summer Peak Demand Savings Percentages



4.3.3. Prescriptive Non-Lighting Measure Track

Process and HVAC projects make up the Prescriptive Non-Lighting measures. Together, the two strata contributed 7% and 15% of total program net verified first-year energy and summer peak demand savings, respectively. The non-lighting projects contribution decreased in comparison to the PY2021 projects, where the measures accounted for 14% and 16% of total program, net, verified, first-year energy and summer peak demand savings.

Table 4-5 presents energy savings for the Process and HVAC projects. The process subtrack represents 5% and the HVAC subtrack represents only 2% of the total net verified energy savings in PY2022.

Table 4-5: Energy Savings by Non-Lighting Measure Track

Non - Lighitng Measure Track*	Gross Reported Savings	Gross Verified Savings	Net Verified Savings	Net Verified Energy Savings % Program Contribution
HVAC (MWh)	5,144	5,001	4,624	2%
Process (MWh)	12,805	12,450	11,512	5%
TOTAL	17,949	17,451	16,136	7%

*Does not include IF carryover projects

Table 4-6 presents the summer peak demand savings for the Process and HVAC projects. The process subtrack represents 6% of total, net, verified, first-year summer peak demand savings and the HVAC subtrack represents 9%.

Table 4-6: Summer Peak Demand Savings by Measure Track

Non - Lighitng Measure Track*	Gross Reported Summer Peak Demand Savings	Gross Verified Summer Peak Demand Savings	Net Verified Summer Peak Demand Savings	Net Verified Summer Peak Demand Savings Contribution
HVAC (kW)	2,615	2,415	2,277	9%
Process (kW)	1,781	1,644	1,551	6%
TOTAL	4,396	4,059	3,828	15%

*Does not include IF carryover projects

4.3.3.1. Process Measures

Figure 4-10 displays the measure count percentage of total Process Non-Lighting measures by category. Variable frequency drives (VFD) were the most common non-lighting process measures, accounting for 45% of Process Non-Lighting measures installed for the program, which remained consistent with PY2021 percent (48%) of total Process Non-Lighting measures.

Figure 4-10: Process Non-Lighting Measures Count Percentages

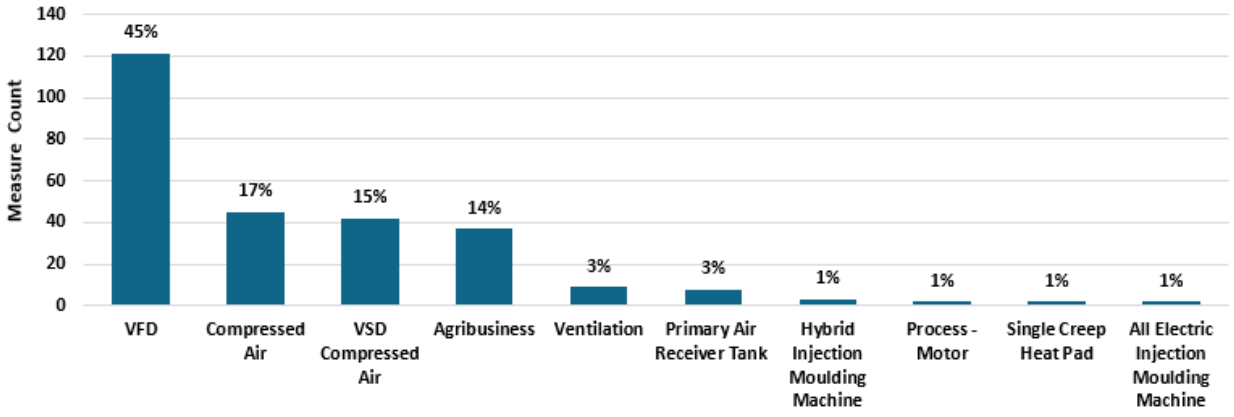


Figure 4-11 and Figure 4-12 display the percentage of net, verified energy and summer peak demand savings by the Process Non-Lighting measure category.

Figure 4-11: Process Non-Lighting Net Verified Energy Savings Percentages

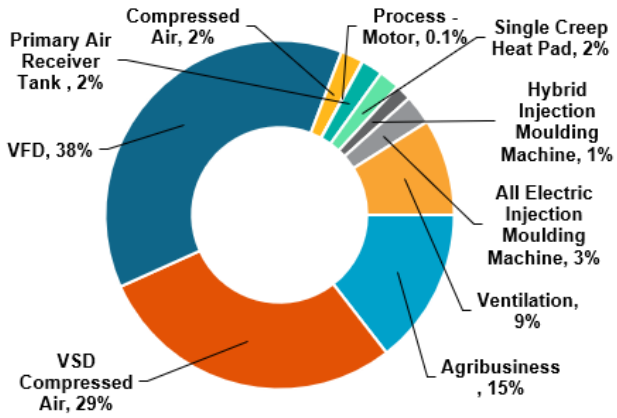
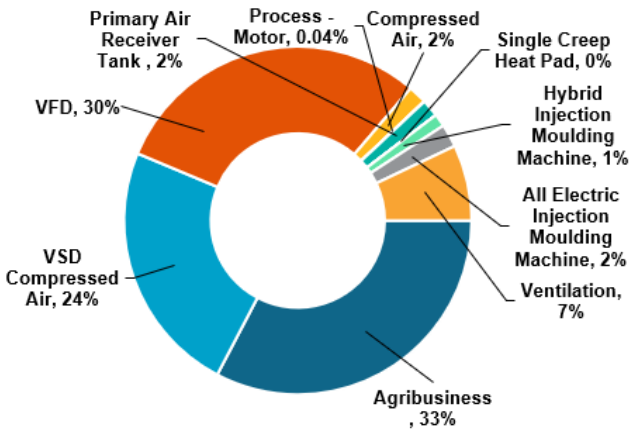


Figure 4-12: Process Non-Lighting Net Verified Summer Peak Demand Savings Percentages



The VFD measure accounted for 45% of measures installed and achieved the greatest energy savings (38%), followed by VSD compressed air measure savings, accounting for 27% of total, net verified energy savings for the Process category in PY2022. Alternatively, the PY2021 program, despite VFD measures accounting for 48% of measures installed and achieving 36% of the category's net verified energy savings, the VSD compressed air measure achieved the highest energy savings (48%) of all Process Non-Lighting net measures. Agribusiness process measures (primarily high-volume, low-speed fans), contributed to 33% of summer peak demand savings due to a high coincidence with peak demand periods. This remained consistent with PY2021 observations, where high-volume, low-speed fans primarily contributed to 34% of summer peak demand savings.

4.3.3.2. HVAC Measures

Figure 4-13 displays the measure count percentage of total, HVAC non-lighting measures by category. Demand Control Ventilation (DCV) were the most common non-lighting HVAC measures, accounting for 44% of HVAC non-lighting measures, which remained consistent with PY2021's percent (74%) of total HVAC non-lighting projects. The DCV measure's high contribution in PY2021 resulted from the lower number of measure categories that made up part of the PY2021 population. Demand Control Kitchen Ventilation accounts for 85% of the DCV measures while DCV in enclosed parking garages account for 13% and DCV in interior conditioned spaces account for just 1%. During PY2021, Demand Control Kitchen Ventilation accounted for 94% of the DCV measures and DCV in enclosed parking garages accounted for the remaining 6%.

Figure 4-13: HVAC Non-Lighting Measures Count and Percentages

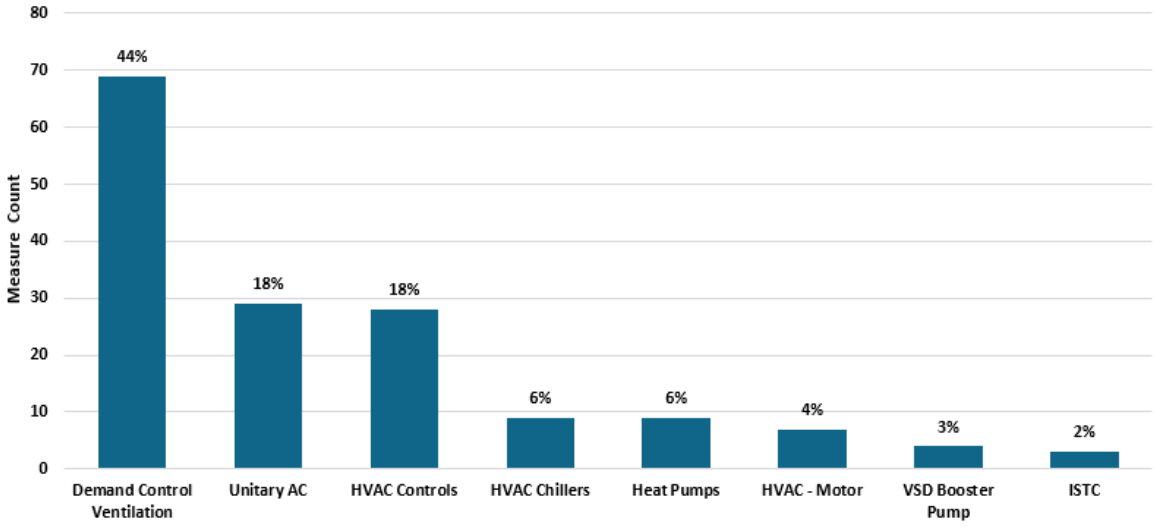


Figure 4-14 and Figure 4-15 display the percentage of net verified energy and summer peak demand savings in the HVAC non-lighting measure category.

Figure 4-14: HVAC Non-Lighting Net Verified Energy Savings Percentages

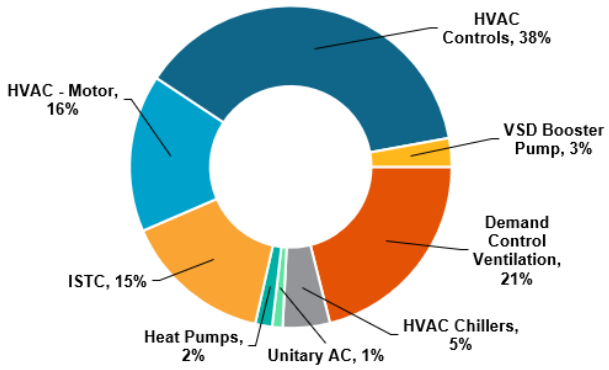
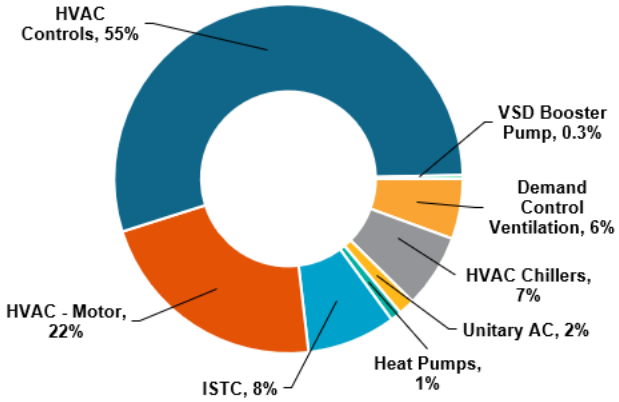


Figure 4-15: HVAC Non-Lighting Net Verified Summer Peak Demand Savings Percentages

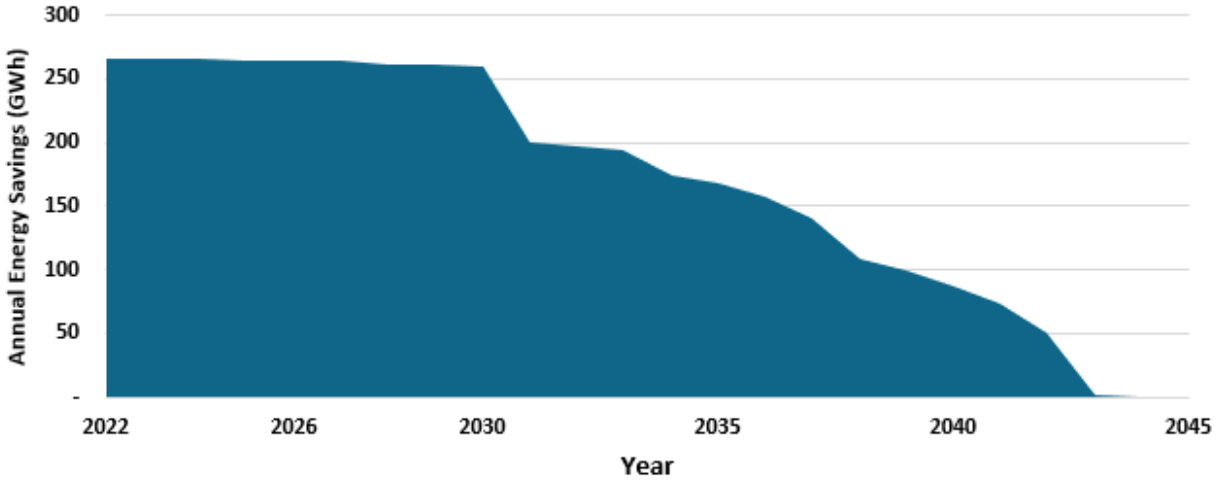


Though the DCV measure accounted for 44% of measures installed in PY2022, the HVAC Controls measure achieved greater energy savings due to higher average per-project savings of 62 MWh per project vs 14 net MWh per project for the DCV measures. This was inconsistent with PY2021 program metrics, where the DCV measure achieved the greatest energy savings (84%) for the HVAC category. Energy savings achieved by the HVAC Controls measure accounted for 38% and 55% of total net verified energy savings and net summer peak demand savings for the PY2022 HVAC category.

4.4. Savings Persistence

Figure 4-16 shows the persistence of total net energy savings.

Figure 4-16: Net Energy Savings Persistence



Nearly all (99.66%) of net savings will persist until 2026. Persisting annual savings begin to reduce past the first program year when certain measures reach the end of their effective useful life (EUL). The weighted average EUL for lighting and non-lighting measures is just over 14 years. By 2038, 60% of initial first-year savings will not persist.

For the 2022 program year, measures with EULs of four years or less contributed to a 0.34% decrease in net savings by 2026. These measures are usually related to occupancy controls and recommissioning projects which have EULs of less than 4 years. The 2021–2024 CDM Framework projects include prescriptive measures implemented during PY2021 and PY2022 (i.e., occupancy sensors and LED reflector flood/spot lamps with a pin or screw base).

4.5. Cost-Effectiveness

Cost-effectiveness (CE) for the Retrofit program was conducted using IESO's CE Tool V9.1. Table 4-7 presents the CE results. The PY2022 2021-2024 CDM Retrofit program achieved a PAC ratio of 3.66, exceeding the 1.00 target threshold (designed to determine if a program proves cost-effective).

Table 4-7: Cost-Effectiveness Results

PAC Test	PY2022	PY2021
PAC Costs ($)	$39,876,640	$15,590,964
PAC Benefits ($)	$145,967,491	$28,188,957
PAC Net Benefits ($)	$106,090,851	$12,597,993
PAC Net Benefit (Ratio)	3.66	1.81
Levelized Unit Energy Cost (LUEC)	**PY2022**	**PY2021**
$/kWh	$0.01	$0.02
$/kW	$129.99	$125.57

The PY2022 CDM Framework Retrofit program passed the Program Administrator Cost (PAC) test, with benefits exceeding their respective costs and a PAC ratio of 3.66 and a levelized unit energy cost of $0.01 per kWh and $129.99 per kW. The PY2022 CDM Framework Retrofit CE results are close to two times the PY2021 CDM Framework Retrofit CE results, where the PY2021 Retrofit Program achieved a PAC ratio of 1.81 and a levelized unit energy cost of $0.02 per kWh and $125.57 per kW. The increase in the PAC can be mainly attributed to higher admin costs in PY2021 as it was the program's startup year as part of the new 2021-2024 CDM Framework. In PY2022, the Commercial sector contributed to 52% of the PAC net benefits at a PAC ratio of 4.87 followed by the Agricultural sector at 29% with a PAC ratio of 2.81. The Commercial sector was found to be consistent with the PAC results of PY2021 where it contributed to 49%, whereas the Agricultural sector realized an increase in net benefits as it contributed to only 11% of the PY2021 PAC net benefits.

LED Grow Lights at vegetable greenhouses and Horticultural inter-lighting contributed the greatest PAC net benefits to 2021-2024 CDM Framework Retrofit program, at $21,769,739 and $11,556,904, respectively. These two measures produced high PAC ratios of 3.80 and 5.08, respectively, and contributed to nearly 43% of total Retrofit program net verified energy and 6% of the net summer peak demand savings. Inversely, Unitary Air-Conditioning produced a PAC net benefit of $6,899 and produced a low PAC ratio of 0.38. This measure contributed to only 0.02% of the total Retrofit program net verified energy and 0.13% of the net summer peak demand savings. Measure-level cost effectiveness analysis showed that Lighting measures such as Occupancy Sensors and LED Troffers had below that average PAC ratios of

2.73[4] and 2.80[4] respectively but had significantly high benefits and costs contributions to the Retrofit program. Unitary Air-Conditioning and Single Creep Heat Pad non-lighting measures also had below that average PAC ratios of 1.20[4] and 1.06[4] respectively and high benefits and costs contributions to the Retrofit program.

4.6. Key Impact Evaluation Findings

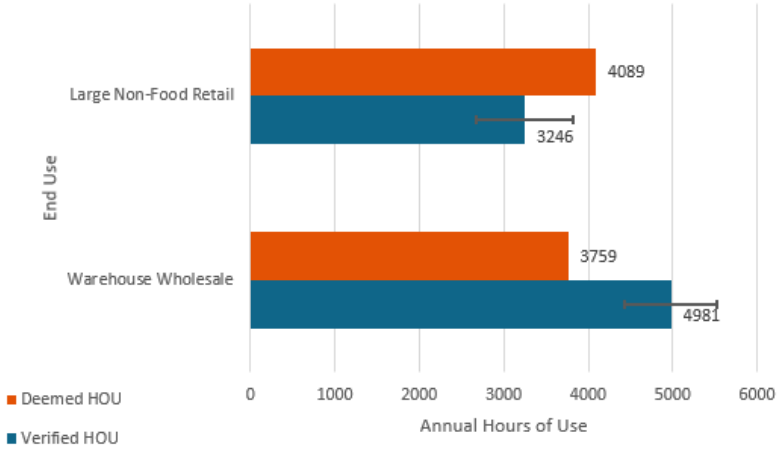
This section provides key impact findings.

4.6.1. Prescriptive Lighting Measures

4.6.1.1. Deemed Hours of Use

Hours of use (HOU) values were reviewed for all sampled lighting measures. Most end-uses (e.g., large offices, warehouses, hospitals) defined in the Measures and Assumptions List (MAL) had one HOU value for all measures associated with the end-use. The evaluation team compared average, verified HOU estimates from the impact sample projects to the MAL-deemed HOU values. Two end-uses provided sufficient sample and low precision to support findings: warehouse/wholesale and large non-food retail, two of the five most common end-uses in the population. As shown in Figure 4-17, the deemed HOU for both the end-uses fell outside of the error bounds of verified HOU estimates.

Figure 4-17: Deemed vs Verified HOU



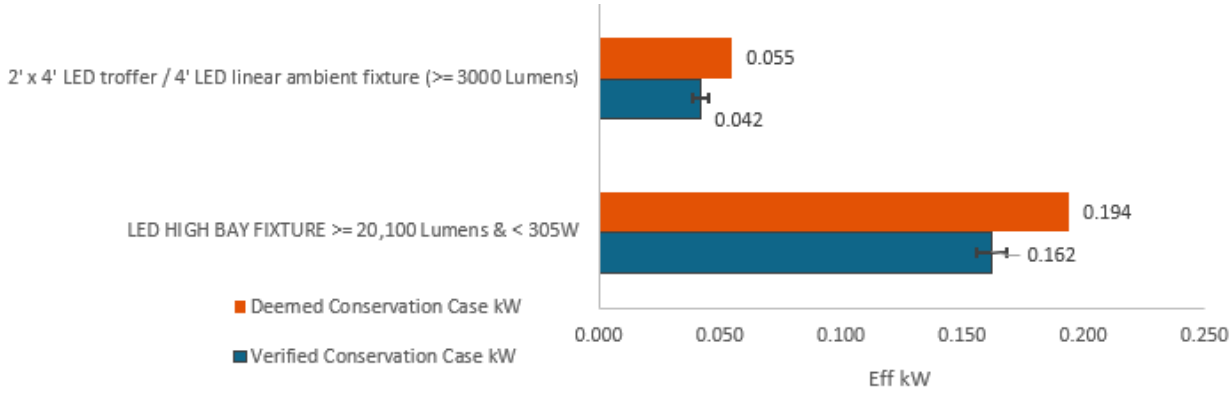
4.6.1.2. Deemed Conservation Case Wattages

The evaluation team reviewed deemed conservation case wattage values for all sampled lighting measures, comparing average verified conservation case wattage estimates from impact sample projects to MAL-deemed values. Two conservation cases provided sufficient

[4] Measure-level benefit to cost ratios do not include program admin costs. Admin costs are included in the program level CE results presented in Table 4-7 track-level CE results are directional in nature and to be used for comparison purposes.

samples and low precision to support a finding: LED HIGH-BAY FIXTURE >= 20,100 Lumens & < 305W and 2' x 4' LED troffer/4' LED linear ambient fixture (>= 3000 Lumens) fixtures— also the two most common conservation cases in the lighting measure population. The deemed wattage for both the conservation cases fell outside of the error bounds of average verified wattage estimates, as shown in Figure 4-18.

Figure 4-18: Deemed vs Verified Conservation Case kW



4.6.2. Prescriptive Lighting—Greenhouse Measures

In PY2022, 42 applications utilizing horticultural lighting measures were completed, resulting in a substantial 44% contribution towards the program's net verified first-year energy savings, representing a notable increase compared to the previous year (in which horticultural lighting measures accounted for 30% of net verified savings).

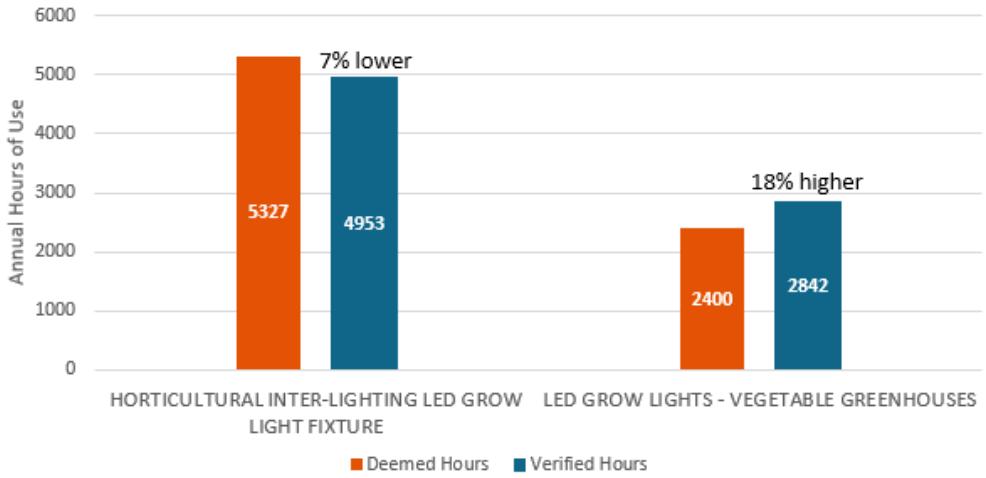
During the PY2022 evaluation cycle, 18 Lighting—Greenhouse projects were sampled and evaluated, with an average energy realization rate of 81% and an average summer demand realization rate of 330%.

Analysis of Operating Hours and Retrofit Case Wattages

The differences between deemed and verified annual HOU and conservation case wattages served as the main drivers of the low realization rates. To obtain a comprehensive understanding, the evaluation team combined results from PY2021 and PY2022 to verify operating hours and conservation case wattages for each specific horticultural measure type. Note that the analysis results do not include LED grow lights—cannabis warehouses measure due to the limited sample size.

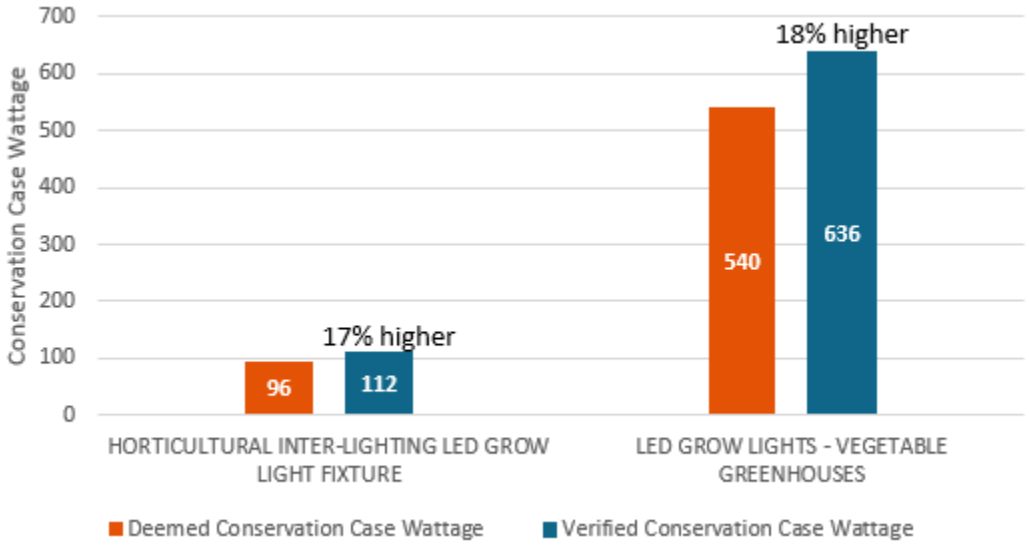
Verified HOU for Inter-lighting LED grow light fixtures were 7% lower than deemed hours. Conversely, HOU for LED grow lights—vegetable greenhouses were verified to be 18% higher than deemed hours for this measure, as shown in Figure 4-19.

Figure 4-19: Deemed vs Verified HOU for Horticultural Lighting Measures



Additionally, the verified conservation case wattage for both Inter-lighting LED grow-light fixtures and LED grow lights—vegetable greenhouses exceeded the deemed values, with increases of 17% and 18%, respectively, as shown in Figure 4-20.

Figure 4-20: Deemed vs Verified Retrofit Case Wattage for Horticultural Lighting Measures



Deemed Base Case Wattage Assumptions

Deemed base case wattages used in the horticultural lighting measures were based on specific assumptions. For example, the baseline wattage for Inter-lighting LED grow-light fixtures measures assumes that ten T8 fluorescents would provide equivalent brightness at the same distance from the vertical growing surface as one energy-efficient fixture. This assumption is difficult to verify and creates a large amount of savings per unit, which, in the near future, could be quickly adopted as the market baseline.

Summer Peak Demand Savings

Deemed summer peak demand savings for horticultural lighting measures were expected to be significantly low, assuming that, during the summer demand period, horticultural lighting measures would remain non-operational or operate at a minimal capacity. For example, the assumed coincidence factor for Inter-lighting LED grow light fixtures, indicating their usage during summer peak demand, was only 2%. However, upon evaluating Inter-lighting LED grow-light fixtures using available hourly data, the evaluation team confirmed that they were used for extended times during the summer peak demand period. After analyzing hourly data from ten projects, the average coincidence factor for summer peak demand savings was found to be approximately 18%.

4.6.3. Prescriptive Non-Lighting Measures

4.6.3.1. In-Suite Temperature Controls

In-Suite Temperature Controls (ISTC) contributes 15% of verified net energy savings for Prescriptive HVAC projects in the population, but, more importantly, had the highest verified net energy savings per project (231 MWh). All three projects implementing this measure were evaluated, supporting the finding. Verified net energy savings were generally lower than deemed savings as deemed savings for each temperature control installed were estimated based on heat pumps sized for a single-family home with electric space cooling and heating, whereas the evaluated ISTC projects included high-rise apartments with central electric space cooling and non-electric space heating.

4.6.3.2. Prescriptive Non-Lighting Measures Participation

The Prescriptive Non-lighting measures are made up of Process and HVAC measures. Process measures represent 5% and HVAC measures represent only 2% of the total net verified first-year energy savings when compared to Lighting measures which contribute 49% and Lighting - Greenhouse measures at 44%. Although there has been an increase in prescriptive non-lighting measure offerings during PY2022, the evaluation team found a low representation of non-lighting measure savings to the overall program. Amongst the new measure offerings, Advanced Rooftop Unit (RTU) Controls and Heat Pumps make up 38% and 6% respectively, of the installed Prescriptive HVAC measures in the population thus realizing the biggest increase in participation.

4.7. Net-to-Gross Evaluation

Table 4-8 presents the results of the PY2022 Retrofit Program NTG evaluation. The evaluation team targeted and achieved 90% confidence and 10% precision levels in the savings results. Appendix D.3 provides additional analyses performed to assist in interpreting these values,

Table 4-8: Retrofit NTG Results

Unique Participants	NTG Responses	Savings Weighted Free-ridership	Spillover – Energy	Spillover – Summer Demand	Weighted NTG – Energy	Weighted NTG – Summer Demand	Energy NTG Precision at 90% Confidence
1680	249	8.0%	0.4%	2.3%	92.5%	94.3%	± 6.0%

As presented in Table 4-8, participant feedback indicates moderately low FR levels at 8.0%.[5] Close to one-fifth of participants (18%) stated that they would have done the "exact same upgrade" in the program's absence, indicative of higher FR for these respondents. Nearly one-third of respondents (32%) showed no indication of FR since they stated they would have put off the upgrade for at least one year (19%) or would have cancelled their upgrade altogether (13%) had the program not been available to them. Other respondents were considered partial free riders if they reported that they would have scaled back on their project's size, efficiency, or scope (33%), if they did not know or what they would have done in the program's absence, or if they declined to answer (16%). The team combined these responses, with the results indicating moderately low FR levels for the surveyed participants. Program participation resulted in low SO at 0.4%, with the installation of new LED linear lighting measures primarily driving SO savings. Appendix D.3 provides additional analyses performed to assist in interpreting these values.

[5] Recent historical results include a FR value of 11.6% in PY2021.

5. Process Evaluation

The evaluation team performed a process evaluation to better understand the Retrofit program's design and delivery. The team used IESO and delivery vendor staff interviews as well as applicant representative, contractor, and participant surveys, to gather primary data for supporting this evaluation. In the following sections, if fewer than 20 respondents answered a question, counts are shown rather than percentages. These results should be considered as directional, given the small number of respondents.

5.1. IESO Staff and Program Delivery Vendor Staff Perspectives

The following subsections highlight feedback received from IESO staff and program delivery vendor staff IDIs. Appendix D.1 provides additional results.

5.1.1. Key Findings

Key findings from IESO staff and program delivery vendor staff IDIs include the following:

- Coordination between IESO staff and delivery vendor staff generally went well in PY2022, with both collaborating closely to address issues as they arose.
- More in-person marketing and outreach activities were re-instated, bringing with it a need to develop additional marketing collateral.
- IESO and delivery vendor staff reported that prescriptive offerings could meet some but not all customer needs (note that the custom offering was reinstated in PY2023).
- IESO and delivery vendor staff reported that incentives were generally seen as too low to keep up with rising costs, with some staff providing recommendations on specific equipment that might require increased incentives (i.e., low-bay lighting, motors, rooftop units).
- Additional equipment suggestions included distributed energy resources (DER), increased heat pump technologies (e.g., ground source), custom horticultural lighting, exterior lighting, HVAC measures, high-efficiency fans, and solar.
- Beyond the prescriptive offering and incentive levels, common barriers to program participation identified by IESO and delivery vendor staff included some customers not considering the program application worth their time, lack of awareness, staff turnover, increased costs, supply chain issues, lack of customer capital, paperwork requirements (e.g., disposal forms, invoices), lower engagement levels with the trade ally network, and lack of marketing materials from the IESO with which to engage contractors and customers.
- Delivery vendors encouraged the program to continue to look for opportunities that would make the Retrofit application portal simpler to use, revisit existing incentive levels, and further market the program (e.g., through in-person events, mass-marketing, co-branding with contractors).

5.1.2. Design and Delivery

As in prior years, the IESO was responsible for the program's administration and design in PY2022, and delivery vendors were responsible for the program's effective delivery. The program continued to be delivered as a prescriptive-only delivery model. It was provided to customers through three delivery vendors with geographically distinct territories in five geographic zones. IESO staff and delivery vendors noted working through some challenges related to program rules. Overall, however, IESO and delivery vendor staff reported that coordination between all parties went well. PY2022 also saw a transition to one new delivery vendor for one of the zones. Delivery vendors noted that this transition caused some initial customer confusion about the correct point of contact, though issues were resolved quickly.

5.1.3. Outreach and Marketing

IESO staff said marketing and outreach efforts went well overall in PY2022. The program reinstated some in-person marketing and outreach activities (e.g., in-person events to discuss program changes, participation in association events). IESO staff noted that reintroduction of in-person events and activities required additional marketing collateral (e.g., booth materials, brochures). The program relied on other tools (e.g., newsletters, the Save on Energy website, social media, LinkedIn posts) as well to raise awareness about the program and to share information about changes to equipment offerings, incentives, or processes.

IESO staff also reported updates to the Retrofit application portal, developing a how-to video for the portal, updating the portal's user guide pdf, and developing more marketing materials based on sectors or equipment types (e.g., a horticultural sell sheet). One delivery vendor reported finding that Save on Energy one-pagers specific to certain equipment types proved effective, especially for commercial and industrial facilities. They also found the program's FAQ guide, Retrofit guide, and website helpful.

Program delivery vendors performed their own outreach and lead generation, noting that contractors and suppliers often promoted the program to their customers as well. Additionally, the IESO's Retrofit Support Services Hotline fielded program leads. Delivery vendors also reported working closely with program contractors, with some hosting webinars or in-person "lunch and learns" to demonstrate ways to create and submit applications and provide information on available incentives. Additionally, some delivery vendors reported developing YouTube training videos and frequently e-mailing their contractor networks to keep them engaged.

5.1.4. Equipment and Services

When asked how well the current range of equipment and services offered through the program met eligible customer needs, IESO staff stated that the prescriptive offering was robust, but that it was not possible to meet all of their customers' needs, especially those with projects more suitable for a custom path (e.g., industrial customers). IESO staff noted customers and market actors provided nearly constant feedback that they would appreciate the custom path reintroduced to the program.

Delivery vendor staff generally believed the program offered a good mix of measures, though they too noted the lack of a custom track as a challenge. One delivery vendor reported that, while this posed an issue, the IESO effectively added new measures to the program when feasible (e.g., booster pumps).

When asked if incentives offered for specific measures were too low or too high, IESO staff said they had heard from customer and trade allies that incentives were generally too low. Delivery vendor staff reported that incentives were low, especially for larger projects. Both customers and contractors often told delivery vendor staff that the program was not worth the time required to provide participation documentation, given the low incentives. One delivery vendor said low-bay lighting should have higher incentives compared to troffers and that VFDs were well incentivized. Two delivery vendors said motor incentives were too low, noting that motors experienced low uptake due to very high efficiency requirements in comparison to the incentives. Delivery vendors also said incentives for rooftop units were low compared to their savings.

When asked if they had suggestions for offering additional equipment and services, delivery vendors reported that customers continued to express interest in exterior lighting, heat pumps, HVAC measures (e.g., high-efficiency fans), solar PV, and horticultural lighting. IESO staff stated that the market is looking towards pathways to decarbonization, electrification, and distribution of electricity resources. They also expressed interest in DER and more heat pump technologies (e.g., ground source). IESO staff continued to hear positive feedback on horticultural lighting measures, with many customers requesting custom opportunities for these measures. They noted that the IESO is looking further into horticultural offerings in 2023, including the introduction of lighting controls for the sector.

5.1.5. Barriers and Opportunities

IESO staff identified common participation barriers, including limitations of the prescriptive-only offering, incentive levels being too low for some equipment, customers not thinking the program application worth their time, lack of awareness, staff turnover, lack of customer capital, supply chain issues, and paperwork requirements (e.g., disposal forms, invoices).

Delivery vendor staff echoed many of these barriers, especially issues related to continued COVID-19 impacts (e.g., staff turnover, increased costs, supply chain issues). Additionally, delivery vendors commonly raised issues with lower-than-anticipated application volumes, insufficient incentives, lower engagement levels with the trade ally network, and a lack of IESO-provided marketing materials with which to engage customers. A delivery vendor also found the lack of a two-way Application Programming Interface for IESO's Retrofit application portal created additional labor burdens (e.g., manual entry, user errors due to typing in information).

Another delivery vendor reported that the shift in focus to peak demand savings prohibited them from achieving deeper savings. Delivery vendors encouraged the program to continue seeking opportunities to make the Retrofit application portal simpler to use, revisit existing

incentive levels, and further market the program (e.g., through in-person events, mass-marketing, co-branding with contractors).

5.2. Applicant Representative and Contractor Perspectives

The following subsections highlight feedback received from the applicant representative and contractor survey. Appendix D.3 provides additional results.

5.2.1. Key Findings

Key findings from the applicant representative and contractor survey included the following:

- Nearly all respondents (98%) were applicant representatives who provided application support for clients participating in the Program during 2022 and over one-half (54%) were contractors who completed projects for clients participating in the program in 2022.
- Close to three-fifths of respondents (59%) reported that customers learned of the Retrofit Program through respondents' companies contacting them directly.
- Respondents' most-requested training and education topics included covering offerings associated with the program (35%), marketing and outreach techniques (28%), and program rules and application processes (22%).
- Respondents indicated that adding a wider variety of non-lighting measures (41%) and increasing incentives for non-lighting measures (33%) would aid in increasing the number of non-lighting applications received by the program.
- Interactions with the Save on Energy representatives was the highest-rated program aspect (85% with a rating of 4 or 5 on a scale of one to five, where one indicates "not satisfied at all" and five indicates "completely satisfied"). The lowest-rated program aspect was program marketing and outreach (50% with a rating of 4 or 5).
- Respondents indicated that increasing incentive amounts (40%), expanding eligible measures (17%), and making the application process easier (13%) would help address the programs' customer participation barriers.
- Nearly three-fourths (73%) of respondents indicated that their customers could typically install all equipment they were interested in through the Retrofit Program. Among those indicating that they could not install the equipment they sought (19%), respondents identified exterior lighting as the most common equipment that could not be installed through the program.

5.2.2. Program Awareness

When asked for the primary way their customers learned of the Retrofit Program in PY2022, applicant representatives and contractors most commonly reported that their company contacted customers about the program (59%). Over one-tenth (11%) of respondents said customer awareness came from previous participation in other Save on Energy programs and from outreach from other contractors or equipment vendors (7%).Figure D-4 in Appendix D.3 presents a full list of the primary ways that customers heard about the program.

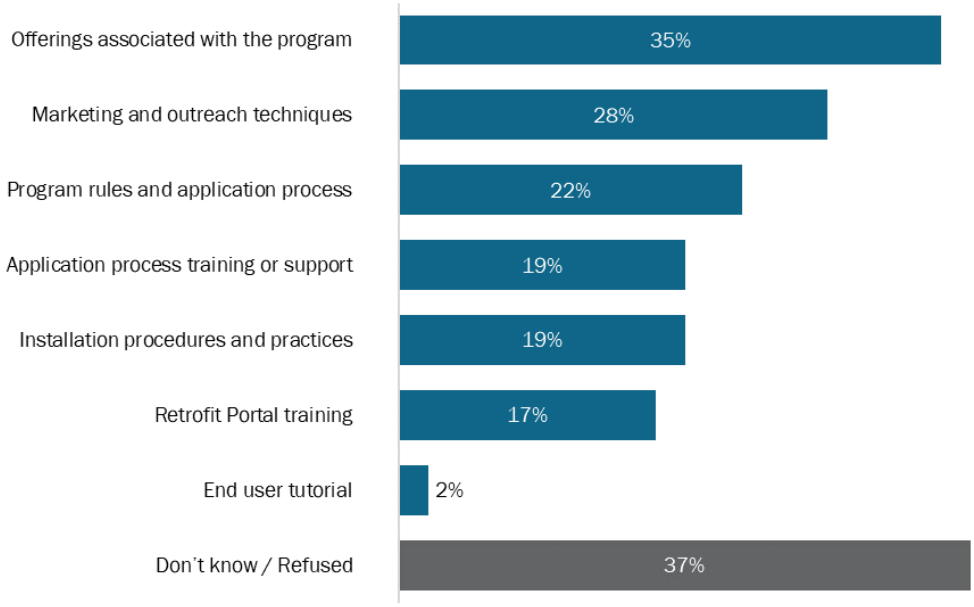
When asked about specific marketing or outreach activities that proved the most effective in terms of generating customer awareness of the program, applicant representatives and contractors most often reported outreach from contractors or equipment vendors (56%), followed by previous experience participating in other Save on Energy programs (30%) and outreach from Save on Energy representatives (26%). Figure D-5 in Appendix D.3 provides a full list of effective marketing and outreach activities.

5.2.3. Training and Education

As shown in Figure 5-1, when asked about additional training or education that would be helpful in supporting their future work with the Retrofit program, over three-fifths of applicant representatives and contractors (63%) responded, most often suggesting that training and education cover the offerings associated with the program (35%), marketing and outreach techniques (28%), and program rules and application process (22%). Figure D-6: Types of Training Received in Appendix D.3 provides details regarding training and education received.

Figure 5-1: Recommended Training and Education Topics

(Open-ended and multiple responses allowed; n=54)*



*Does not sum to 100% due to multiple responses.

Respondents rated their satisfaction with training on a scale of one to five, where one indicates "not satisfied at all" and five indicates "completely satisfied." Two-thirds (66%) were somewhat satisfied or completely satisfied with the training and education they received through the program. Additionally, they offered the following suggestions for improved training: training new applicant representatives before they start, more in-person training, increased training for application reviewers and program delivery vendors, and creation of video tutorials (mentioned by one respondent each).

5.2.4. Incentives

When asked whether they considered incentives for specific energy-efficient equipment or models offered through the program too high or too low, over one-half of respondents (54%) considered them too low. Nearly one-third (31%) found incentives were too low in general, and others reported them too low for a variety of equipment types, including linear fixtures (14%), flat panels (10%), and LED troffers (10%). Figure D-7 in Appendix D.3 provides a full list of incentives that respondents considered too low.

The evaluation team asked those who found an incentive too low to provide recommendations for adjusting the incentives. Most commonly, respondents recommended raising the incentives to ensure customers feel participation is worth the trouble (two respondents), that the program should increase incentives as they are too low compared to measure prices (two respondents), and they should be increased given increases in material costs (two respondents). Table D-3 in Appendix D.3 provides a full list of recommendations for adjusting incentives.

5.2.5. Non-Lighting Applications

When asked if anything could increase the number of non-lighting applications for the Retrofit program, applicant representatives and contractors most commonly suggested offering a wider variety of non-lighting measures (41%). One-third of respondents (33%) mentioned increasing incentives for non-lighting measures, with over one-fifth (22%) citing increases in program marketing and outreach focused on non-lighting equipment and services. Close to one-fifth (19%) suggested offering contractors additional training and support, focusing on non-lighting equipment and services.

Figure D-8 in Appendix D.3 provides a full list of suggestions offered for increasing non-lighting applications.

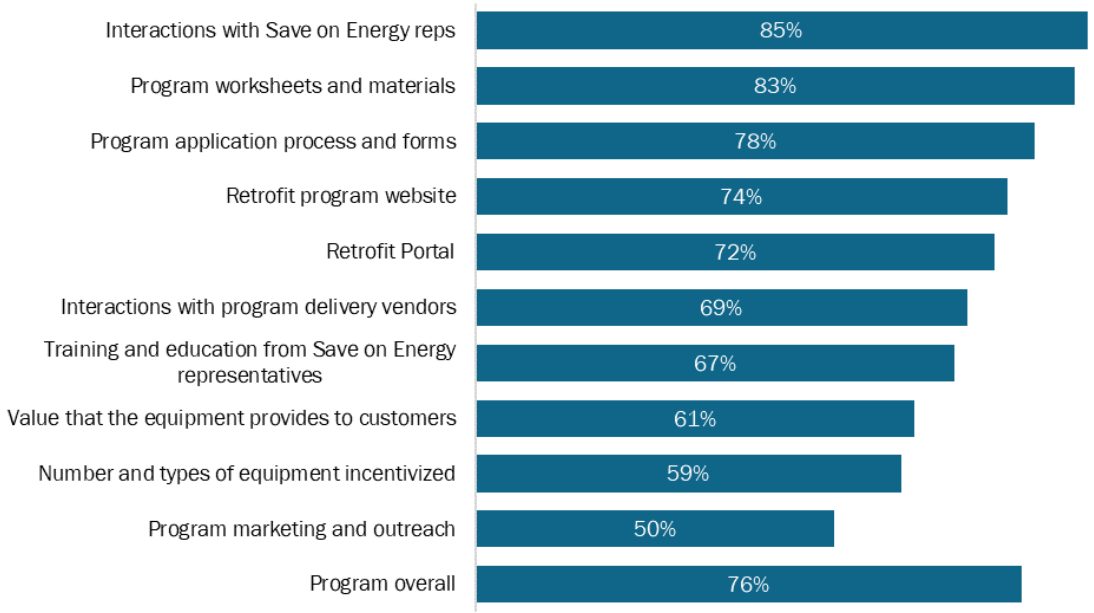
5.2.6. Program Experience and Improvement Suggestions

When asked to identify barriers that prevented more customers from participating in the Retrofit program, respondents most commonly identified customers not perceiving upgrades as worth the trouble of participation (35%) and customers not knowing of the program (30%). Appendix D.3 provides a full list of these barriers.

When were asked what the Retrofit program could do to overcome the barriers to customer participation, respondents most commonly suggested increasing the incentive amount (40%), expanding eligible measures (17%), and making the application process easier (13%). Appendix D.3 provides a full list of suggestions for overcoming customer participation barriers.

Respondents were asked to rate their satisfaction with different aspects of the Retrofit Program on a scale of one to five, where one indicates "not satisfied at all" and five indicates "completely satisfied" (Figure 5-2). The highest-rated aspect of the program was interactions with Save on Energy representatives (85% with a rating of 4 or 5). The lowest rated aspect was program marketing and outreach (50% with a rating of 4 or 5). A full breakdown of the satisfaction results can be found in Appendix D.3, and respondent improvement suggestions for key aspects of the program can be found in Table D-4.

Figure 5-2: Satisfaction with Aspects of Retrofit Program (n=54)*
(Ratings of 4 or 5 on a scale from 1 to 5)



*For "Training and education from Save on Energy representatives" n=45 since this was only asked of respondents indicating they had received training.

5.2.7. Equipment Offerings

When asked if participants were typically able to install the equipment they were interested in through the program, close to three-fourths of respondents (73%) indicated that they could do so. When asked what types of energy-efficient equipment or models participants were typically interested in but not able to install through the program, applicant representatives and contractors commonly mentioned exterior lighting (8 respondents). A full list of equipment mentioned by respondents can be found in Table D-5 in Appendix D.3

Respondents were also asked what additional energy-efficient equipment or services they would recommend for inclusion in the Retrofit Program. The most common recommendations were exterior lighting (21%) and battery storage (11%). A full list of recommended equipment can be found in Table D-6 in Appendix D.3

5.3. Retrofit Participant Perspectives

The following subsections highlight the feedback received from the participant survey. Additional results can be found in in Appendix D.5

5.3.1. Key Findings

Key findings from participants' responses include the following:

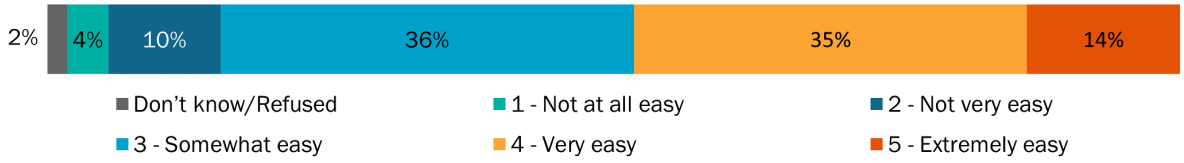
- Most respondents (85%) indicated that participation in the program was easy (ratings of 3.0 and above). Of these respondents, nearly three-fourths (72%) stated that a Save on Energy representative, contractor, vendor, or supplier made it easy to participate in the process.
- More than one-tenth of respondents (11%) indicated they knew about the change request form but only a small number (4 respondents) reported having used it.
- Close to three-fourths of respondents (74%) reported insufficient program incentives as the direct barrier to installing additional energy-efficient equipment and utilizing additional services of interest.
- Respondents' most frequent suggestions to bolster the Retrofit Program included improving the Save on Energy website (21%) and its online portal and raising incentive amounts (21%).
- Of the close to one-half (47%) of respondents that have not completed nor plan to complete electrification projects, more than one-third (35%) reported not proceeding with these projects due to insufficient capital or budget.
- More than one-fifth (21%) of respondents stated they have recently completed or plan to complete an electrification project in the future. Of these, more than one-third (36%) plan to complete their electrification projects within the next 6 months to a year.

5.3.2. Program Awareness

Close to two-thirds of respondents (64%) reported hearing about the program through a contractor or equipment vendor. Respondents also heard about the program through previous participation in another Save on Energy program (29%), the IESO website (11%), and from colleagues or competitors (9%). Figure D-33 in Appendix D.5 provides a full list of the ways respondents heard about the program.

When asked about the ease of participating in the Save on Energy Retrofit Program (shown in Figure 5-3), respondents used a scale of one to five, where one means "not at all easy" and five means "extremely easy"; close to one-half of respondents (49%) rated their program participation as a four or five.

Figure 5-3: Ease of Program Participation (n=222)*



*Does not sum to 100% due to rounding.

When asked which Save on Energy program aspects made participation easy, close to three-fourths of respondents (72%) said that a Save on Energy representative, contractor, vendor, or supplier facilitated the process. Respondents also named the Save on Energy website and online portal (16%) and the overall process (7%) as making easier. Figure D-34 in Appendix D.5 provides a full list of program aspects that made participation easier.

The evaluation team asked respondents to rate the ease of participating in the program. Respondents awarding a 1 or 2 (14%) were asked what aspects of the Save on Energy program impaired participation. More than one-third of these respondents (38%) reported that the overall process took a long time. Respondents also named the application process (27%) and the Save on Energy website and the online portal (27%) as aspects that made participation less easy. Figure D-35 in Appendix D.5 provides full list of aspects that made the program participation less easy.

5.3.3. Change Request Form

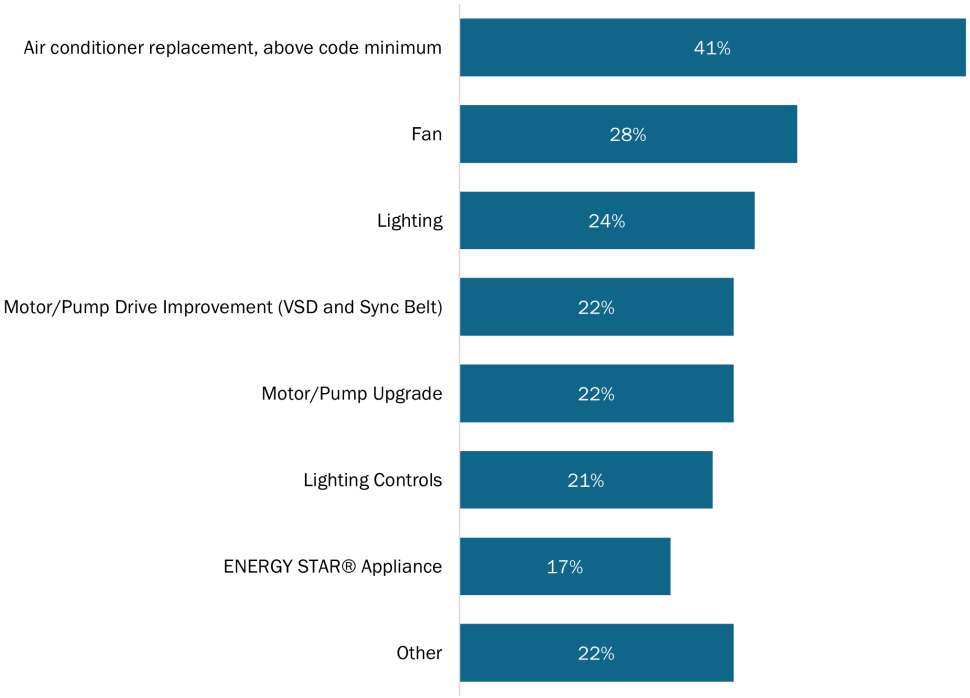
Respondents were asked if they were aware of the change request form, in which the public can submit a new equipment type or model for consideration as an addition to the Retrofit Program. More than three-fourths of respondents (77%) did not report knowing of the form. Respondents that said they knew of the form (11%) were asked if they had ever used it to submit a new equipment type or model for consideration. Less than one-fifth of these respondents (16% or four respondents) answered yes to using the change request form. These respondents then were asked about the ease of using the change request form. Using a

scale of one to five, where one means “not at all easy” and five means “extremely easy,” the respondents were asked how easy it was to use the change request form, respondents provided an average rating of 3.8, with one-half (two respondents) rating it as "somewhat easy” and the remainder (two respondents) rating it as “very easy” or “extremely easy.” Figure D-36 in Appendix D.5 summarizes these responses.

5.3.4. Decision to Not Install Additional Energy-Efficient Equipment or Services

More than one-fourth of respondents (26%) said they could not install equipment of interest due to insufficient program incentives. These respondents were then asked what, if any, additional energy-efficient equipment or services their company did not install due to insufficient program incentives, as shown in Figure 5-4. More than two-fifths of respondents (41%) reported not being able to install air conditioner replacements above code minimums. Respondents also mentioned not being able to install fans (28%), and lighting (24%).

Figure 5-4: Equipment Not Installed Because of Insufficient Incentives



(Open-ended and multiple responses allowed; n=58)*

*Does not sum to 100% due to multiple responses.

The team asked respondents unable to install equipment of interest what percentage of the cost the program would have had to cover for their company to have installed the equipment. Respondents unable to install air conditioner replacements above code minimums (19 out of

222) reported, on average, they would have had the program cover about one-half (52%) of the cost to permit equipment installation.

Similarly, respondents unable to install fans (12 out of 222) reported, on average, that the program would have needed to cover about one-half (54%) of the cost to permit equipment installation. Table D-18 in Appendix D.5 provides full list of equipment with average percent costs that respondents needed the program to cover for these installations to have been conducted.

5.3.5. Recommendations for Retrofit Program Improvement

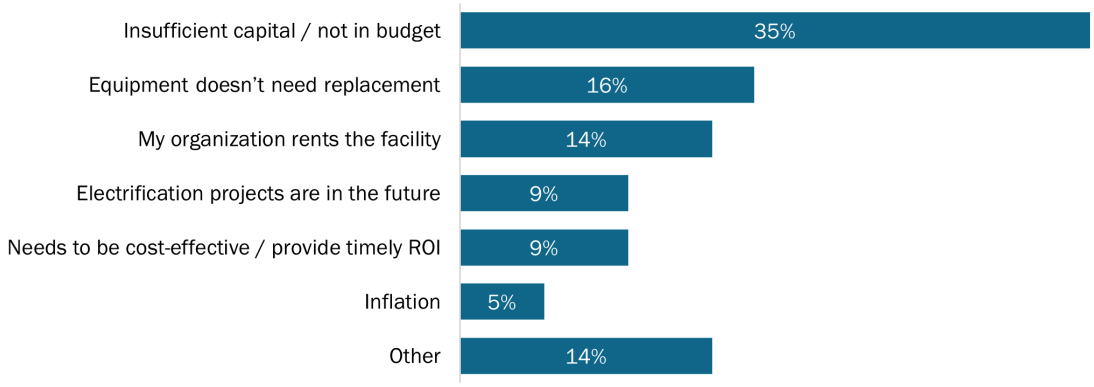
A total of 23% of respondents (52 out of 222) offered recommendations for additional energy-efficient equipment or services to consider for inclusion in the Retrofit Program. Most commonly, these recommendations included addressing additional HVAC equipment (17%), expanding lighting offerings (15%), and installing automation systems/controls (12%). Figure D-37 in Appendix D.5 provides a full list of recommended equipment.

A total of 19% of respondents (42 out of 222) provided recommendations to improve the Retrofit Program. The most common suggestions included improving the Save on Energy website and its online portal (21%), increasing the incentive amount (21%), and simplifying the overall process (19%). A full list of additional recommendations can be found in Figure D-38 in Appendix D.5.

5.3.6. Electrification Projects

The evaluation team asked respondents whether their company completed or planned to complete electrification projects at their facilities. Nearly one-half of respondents (47%) stated they had not completed nor planned to complete electrification projects. The team then asked these respondents why their organization was not yet considering electrifying its facilities, as shown in Figure 5-5. Respondents' most common reasons for not electrifying included insufficient capital or the expenditure was not in their company's budget (35%) and the equipment did not need replacement (16%).

Figure 5-5: Reasons for Not Considering Electrification Projects



(Open-ended and multiple responses allowed; n=43)*

*Does not sum to 100% due to multiple responses.

Of respondents who recently completed or planned to complete electrification projects (21%), most planned to complete their projects in the next six to nine months (19%) or within the next one to two years (32%). The team asked these respondents what assistance they found or would find helpful to complete their electrification projects. Respondents most commonly suggested higher incentives (four respondents), assistance from an electrification specialist (three respondents), and incentives for additional measures (three respondents). Figure D-39 in Appendix D.5 provides a full list of respondents' suggestions.

6. Other Energy Efficiency Benefits

6.1. Avoided Greenhouse Gas Emissions

Using the IESO CE Tool V9.1, the evaluation team calculated avoided GHG emissions for the first year along with the measures' lifetime savings for PY2022. Table 6-1 shows the results of these avoided GHG emissions calculations. First-year avoided GHG emissions from electricity savings were reduced by the increase in GHG consumption resulting from the gas-heating penalty, resulting in 48,351.76 Tonnes of CO_2 reduced in the first year. PY2022 CDM Framework Retrofit program projects are expected to achieve a total of 528,826.81 Tonnes of avoided GHG throughout the EUL of the installed measures. All GHG emissions shown are in Tonnes of CO_2 equivalent, unless otherwise noted.

Table 6-1: PY2022 Retrofit Program Avoided GHG Emissions

Electric First Year GHG Avoided	Gas* First Year GHG Avoided	Total First Year GHG Avoided	Electric Lifetime GHG Avoided	Gas Lifetime GHG Avoided	Total Lifetime GHG Avoided
61,664.89	(13,313.13)	48,351.76	740,701.14	(211,874.34)	528,826.81

*Interactive gas heating penalty.

6.2. Non-Energy Benefits

The following subsection discusses NEBs from the PY2022 Retrofit Program. Appendix G provides additional details regarding the NEB methodology and results. Note that the evaluation team presents these PY2022 NEBs results only for informational purposes. Per the IESO's request, the team used Phase II study NEBs values within the PY2022 cost-effectiveness calculator rather than the PY2022 NEBs participation evaluation survey values. This allows the IESO to collect additional NEB data in future evaluation years.[6]

6.2.1. Key Findings

The NEBs analysis included the following key findings:

[6] The team estimated the *PY2022 Cost-Effectiveness using the Phase II* study NEBs values ($/kWh), which were significantly higher than the equivalent adder used for the Interim Framework programs (15% adder). The effective IF $/kWh using the 15% adder was equal to $0.07/kWh, whereas the overall $/kWh NEB value for the PY2021 in the 2021-2024 CDM Framework was $0.16/kWh.

- Using the **hybrid, minimum approach**, PY2022 NEB values were $0.05/kWh for reduced building and equipment O&M, $0.02/kWh for thermal comfort, $0.01/kWh for improved air quality, and $0.0005/kWh for reduced spoilage.

6.2.2. Quantified NEBs Values

The PY2022 Retrofit participant survey included 123 participants that experienced at least one NEB from measures installed through the Retrofit program. The Retrofit participant survey asked about participant experiences with four NEBs:

- **Reduced building and equipment operations and** maintenance **(O&M):** Reduced labour or other costs associated with reduced operations and maintenance to maintain building systems.
- **Thermal comfort:** Improving the building's ability to maintain a comfortable temperature.
- **Improved indoor air quality:** Reduction in air pollutants in the indoor environment.
- **Reduced spoilage:** Reduced spoilage of perishable products due to improved refrigeration or ventilation.

More than nine-tenths of PY2022 participants (92%) experienced NEBs from reduced building and equipment operations and maintenance. One-fifth (20%) experienced NEBs from improved thermal comfort, more than one-tenth (11%) experienced NEBs from improved indoor air quality, and two participants (2%) experienced NEBs from reduced spoilage, as shown in Figure 6-1.

Figure 6-1: Participant Observation of NEBs, Phase II, PY2021, and PY2022

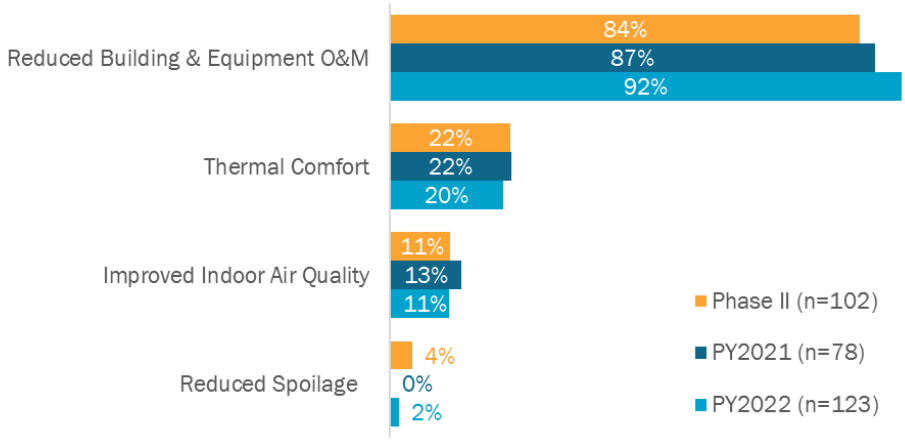


Table 6-2 presents quantified NEBs values for Phase II, PY2021, and PY2022, based on the hybrid, minimum ($/kWh) valuation—the approach recommended by the Phase II study.[7] Note that quantified NEBs from the Phase II study combined participants from the retrofit and small business lighting programs, but the PY2021 and PY2022 results only included Retrofit program participants.

As in the Phase II study, retrofit participants in PY2022 ($0.05/kWh) assigned the highest values to reduced building and equipment O&M NEB, followed by thermal comfort ($0.02/kWh), improved air quality ($0.01/kWh), and reduced spoilage ($0.0005/kWh).

This participant feedback is similar to NEBs that contractors reported their customers might have experienced due to participation in the Retrofit Program. Nearly one-half of contractors (48%) indicated that their customers experienced reduced building and equipment O&M, and that they ranked this as the most important NEB to their customers; more than one-fourth of contractors (28%) indicated their customers experienced increased improved indoor air quality. Figure G-1 in Appendix G.2 provides all contractor feedback associated with the NEBs.

Table 6-2: Quantified NEBs ($/kWh), Phase II, PY2021-P1, & PY2022

NEB	PY2022 (Retrofit Only)	PY2021 (Retrofit Only)	Phase II (Retrofit & SBL)
Reduced building and equipment O&M	$0.05	$0.20	$0.08
Thermal comfort	$0.02	$0.07	$0.05
Improved indoor air quality	$0.01	$0.02	$0.007
Reduced spoilage	$0.0005	-	$0.0002

The Phase II study found that program participants placed significant value on NEBs. In many cases, NEBs' value exceeded the value of participants' energy savings. This also took place in PY2022, with most respondents reporting NEBs having an equal or higher value on an annual basis than their electricity bill or savings. Furthermore, when asked if they would be willing to pay for a certain benefit independently from the energy savings, more than one-half (56%) were prepared to pay an equal or higher value per year than the amount of their electricity bill or savings. This highlights that factors beyond energy savings may motivate energy-efficiency participation or contribute to customers' positive experiences with such programs.

[7] Dunsky. (July 2021). *Non-Energy Benefits: Phase II; Quantified Benefits and Qualitative Insights*. https://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation-reports/Non-Energy-Benefits-Study-Phase-II.ashx

6.3. Job Impacts

6.3.1. Key Findings

The PY22 Jobs Impacts approach included the following key findings:

- The analysis used an input-output model, which estimated that the CF Retrofit will create 3,274 total jobs in Canada, 2,886 of which will be in Ontario.
- Some $1M in program investments resulted in creating 81.6 jobs, compared to 52.0 jobs in PY21.
- The observed increase in job creation per $1M of spending resulted from a combination of increased customer contribution to the demand shock as well as large overall increases in demand and reinvestment shocks.
- 216 out of 3,274 (6.5%) of jobs impacts were realized in the first year – 135 of the 216 first year jobs impacts were due to first year savings.

6.3.2. Input Values

The evaluation team used the model to estimate the impacts from three economic shocks:

- Demand shock, representing the demand for energy-efficient products and services from the Retrofit program.
- Business reinvestment shock, representing increased business reinvestment due to bill savings (and net of project funding).
- Household expenditure shock, representing decreases in household spending on goods and services due to increased program funding for the Residential function.

Table 6-3 displays input values for demand shock, representing products and services related to the Retrofit program. The team categorized each measure installed through the program to the StatCan IO Supply and Use Product Classifications (SUPCs).

Table 6-3: Summary of Input Values for Demand Shock

Category Description	Non-Labour	Labour	Total Demand Shock
	($ Thousands)		
Lighting fixtures	55,798	32,355	88,153
Switchgear, switchboards, relays and industrial control apparatus	9,487	5,196	14,683
Electric light bulbs and tubes	8,696	5,039	13,735
Heating and cooling equipment (except household refrigerators and freezers)	6,577	3,541	10,118
Industrial and commercial fans, blowers and air purification equipment	6,175	3,325	9,501
Metalworking machinery and industrial moulds	1,605	864	2,469
Pumps and compressors (except fluid power)	1,086	585	1,671

Category Description	Non-Labour	Labour	Total Demand Shock
	($ Thousands)		
Glass (including automotive), glass products and glass containers	457	246	703
Measuring, control and scientific instruments	329	178	506
Boilers, tanks and heavy gauge metal containers	90	48	138
Electric motors and generators	60	32	92
Agricultural, lawn and garden machinery and equipment	52	28	80
Subtotal	90,413	51,438	141,850
Office Administrative Services	-	-	11,220
Total			**153,070**

Business reinvestment shock was the second shock modelled using the IO Model. This shock represented the amount that businesses would reinvest and thus inject back into the economy. The amount was split over various industries to properly model the demand shock. Business reinvestment shock totaled $318.3 million over 29 different industries. Appendix F provides more detail on the business reinvestment shock, along with reinvestment values by industry.

Household expenditure shock provided the third model input.[8] This shock represented incremental increases in electricity bills to the residential sector due from funding the program. The approach assumed that IESO programs were funded by all customers in proportion to the overall consumption of electricity. Thus, the residential funding portion was 35% of the $28.9M program budget or $10.1M.

6.3.3. Model Results

Generally, StatCan I-O model impacts were generated separately for each shock and added together to calculate overall program job impacts. In the case of Retrofit, this meant three different sets of job impacts were combined into the overall jobs impacts. Table 6-4 shows total estimated job impacts by type, combining impacts from the demand, business reinvestment, and household expenditure shocks.

Table 6-4: Total Job Impacts by Type

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	Total Jobs per $1M Investment *(in person-years)*
Direct	1,317	1,374	1,528	1,590	39.7
Indirect	561	703	675	840	20.9

[8] Actually, the model was run with a normalized value of $1 million in extra household expenditures, and job results can be scaled by actual 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	Total Jobs per $1M Investment *(in person-years)*
Induced	504	626	683	844	21.1
Total*	**2,383**	**2,703**	**2,886**	**3,274**	**81.6**

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

The majority of estimated total jobs (2,886 out of the 3,274) occurred in Ontario, with 1,528 of 1,590 direct jobs created across Canada created in Ontario. A slightly smaller proportion of indirect and induced jobs occurred in Ontario, with 675 of 840 indirect jobs and 683 of 844 induced jobs estimated to be created within the province. FTE estimates were slightly lower overall than total jobs, with a total of 2,383 FTEs (of all types) created in Ontario and 2,703 FTEs added nationwide. Almost all direct FTEs (1,317 of 1,374) were added in Ontario, with this number representing approximately 55% of the total FTEs added in Ontario and 49% of all FTEs created across Canada. In 2022, each $1M of program spending resulted in creating 81.6 total jobs, compared to 52.0 jobs per $1M in 2021.

Appendix F provides a more detailed write up of model impacts, including a breakout of impacts by industry, impacts due to first-year savings, and verbatim responses from program contractors.

7. Key Findings and Recommendations

Finding 1: Incentive levels were generally considered too low. When asked if incentives for specific energy-efficient equipment or models offered through the program were appropriate, over one-half of applicant representatives and contractors (54%) reported they were too low. Nearly one-third of applicant representatives and contractors (31%) found incentives were too low generally; others listed a variety of equipment types where the incentives were too low, such as linear fixtures (14%), flat panels (10%), and LED troffers (10%). More than one-fourth of participants (26%) said they could not install equipment of interest due to insufficient program incentives. IESO and delivery vendor staff reported that incentives were generally considered too low to keep up with rising costs, with some staff providing recommendations for specific equipment that may require increased incentives (i.e., low-bay lighting, motors, rooftop units).

- **Recommendation 1:** Consider revisiting overall program incentive levels or key measures of interest, given concerns over incentives not keeping pace with rising costs. Measures of interest could include those with high contribution to the Retrofit program and with the highest benefits to cost ratio, including lighting (LED medium/high bay fixture, T8 LED tube/u-bend replacement lamp, and T5 LED tube replacement lamp) and non-lighting (variable frequency drive, VSD compressed air, and ECMs for HVAC application (fam motor replacement).

Finding 2: HOU and conservation case wattages for horticultural lighting measures. The differences between deemed and verified annual HOU and conservation case wattages are the main drivers of the low average realization rate (81%) for Lighting greenhouse measures. To obtain a comprehensive understanding, the combined results from PY2021 and PY2022 were utilized to verify the operating hours and conservation case wattages for each horticultural lighting measure. The average deemed and verified values for HOU and conservation case wattages in the PY2022 and PY2021-PY2022 rolling population with their respective precision values (at 90% confidence) are presented in Table 7-1 and Table 7-2 below. Analysis results do not include the LED grow lights - cannabis warehouses measure due to the limited sample size.

Table 7-1: Comparison of Hours of Use by Measure Type

Measure Type	Avg Deemed HOU	PY22 Avg Verified HOU	PY22 Sample Precision	PY 21 & 22 Avg Verified HOU	PY21 & 22 Sample Precision
HORTICULTURAL INTER-LIGHTING LED GROW LIGHT FIXTURE	5,327	4,863	1%	4,953	1%
LED GROW LIGHTS – VEGETABLE GREENHOUSES	2,400	2,893	8%	2,842	6%

Verified HOU from the combined PY2021 and PY2022 projects for Inter-lighting LED grow light fixtures were 7% lower than deemed hours. The deemed HOU fell outside of the error bounds of the verified HOU estimate. The error bounds of the verified estimate range from 4,899 to 5,008 hours. Conversely, HOU for LED grow lights—vegetable greenhouses were verified to be 18% higher than deemed hours for this measure. The error bounds of the verified estimate range from 2,672 to 3,013 hours and the deemed HOU fell outside of these error bounds.

Table 7-2: Comparison of Conservation Case Wattage by Measure Type

Measure Type	Avg Deemed Conservation kW	PY22 Avg Verified Conservation kW	PY22 Sample Precision	PY 21 & 22 Avg Verified Conservation kW	PY21 & 22 Sample Precision
HORTICULTURAL INTER-LIGHTING LED GROW LIGHT FIXTURE	0.096	0.114	2%	0.112	2%
LED GROW LIGHTS – VEGETABLE GREENHOUSES	0.540	0.689	7%	0.636	9%

Additionally, the verified conservation case wattage from the PY2021 and PY2022 projects for both Inter-lighting LED grow-light fixtures and LED grow lights—vegetable greenhouses exceeded the deemed values, with increases of 17% and 18, respectively. The deemed conservation wattage for both measures fell outside of the error bounds of the verified conservation wattage estimate. The error bounds of the verified estimate for horticultural Inter-lighting LED grow-light fixtures range from 0.11 kW to 0.114 kW and range from 0.581 kW to 0.691 kW for LED grow lights—vegetable greenhouses.

- **Recommendation 2:** Regularly review and consider updating the HOU and conservation case assumptions for horticultural lighting measures. The combined results of EM&V from multiple years can be utilized to determine the appropriate values, as they involve the collection and analysis of actual data during the evaluation of horticultural measures. While the evaluation results presented in the tables above present verified parameters with strong precision, they are based on relatively small samples and could change in the future.

Finding 3: Horticultural lighting measures deemed summer peak demand savings. The deemed summer peak demand savings for horticultural lighting measures are expected to be significantly low as it is assumed that during the summer peak demand period, the horticultural lighting measures are either non-operational or operating at a minimal capacity. For instance, the assumed coincidence factor for the Inter-lighting LED grow light fixtures, indicating their usage during the summer peak demand, is only two percent (2%). However, upon evaluating the Inter-lighting LED grow light fixtures using available hourly data, it was confirmed that they were used for extended periods during the summer peak demand period. After analyzing hourly data from ten projects, the average coincidence factor for summer peak demand savings was approximately 18%.

- **Recommendation 3:** Regularly review and consider updating horticultural lighting measures deemed summer peak demand savings. To increase confidence in verified peak demand savings, it is recommended to collect additional data in future evaluations until a large enough sample is collected. This will help with future frameworks assumptions. Alternatively, a supplementary metering study on the horticultural lighting measures can be completed and integrate the obtained data into the current EM&V analyzed data. This can contribute to a more appropriate load shape development and coincidence factor selection for the summer peak demand period, aligning it better with the actual usage patterns of the horticultural lighting measures.

Finding 4 Lighting End-Uses MAL assumed HOU. The evaluation team compared the average verified HOU estimates from the impact sample projects to the Measure and Assumption List (MAL) deemed values. The evaluation team also compared the average verified HOU estimates incorporating a rolling population of PY2021 and PY2022 projects. During PY2021, the average verified HOU value for "Warehouse Wholesale" and "Large Non-Food Retail" were found to be 3,846 and 2,983 hours, respectively. The average deemed and verified values for HOU in the PY2022 and PY2021-PY2022 rolling population are presented in the Table 7-3 below. These categories had a high representation of measures in the 2021-2024 CDM Retrofit program so far. The deemed HOU for both the end uses fell outside of the error bounds of the verified HOU estimate in the PY2022 population as well as the rolling population of PY2021 and PY2022 projects. The error bounds of the verified estimate for PY2022 "Warehouse Wholesale" end-use range from 4,438 to 5,524 hours and for PY2021 and PY2022 range from 4,068 to 4,749 hours. The error bounds of the verified estimate for PY2022 "Large Non-Food Retail" end-use range from 2,668 to 3,823 hours and for PY2021 and PY2022 range from 2,826 to 3,415 hours.

Table 7-3: Comparison of Hours of Use by End-Use

END_USE	Avg Deemed HOU	PY22 Avg Verified HOU	PY22 Sample Precision	PY 21 & 22 Avg Verified HOU	PY21 & 22 Sample Precision
Warehouse Wholesale	3,759	4,981	11%	4,408	8%
Large Non-Food Retail	4,089	3,246	18%	3,121	9%

- **Recommendation 4:** Consider updating the HOU assumption for "Warehouse Wholesale" and "Large Non-Food Retail" after discussions with the program team regarding the makeup of the PY2021 and PY2022 population and sample and how representative that may be of the future program populations.

Finding 5: Horticultural lighting measures deemed base case wattage. Deemed base case wattages used in the horticultural lighting measures were based on specific assumptions. For example, the baseline wattage for Inter-lighting LED grow-light fixture measures assumes that ten T8 fluorescents would provide equivalent brightness at the same distance from the vertical growing surface as one energy-efficient fixture. This assumption is difficult to verify and creates a large amount of savings per unit, which, soon, could be quickly adopted as the market baseline.

- **Recommendation 5:** Continue research into the horticulture lighting market to assess the need for additional measures and what the current market baselines are for existing measures. This is particularly relevant to the Inter-lighting LED grow light fixtures and LED grow lights – vegetable greenhouses as they gain popularity.

Finding 6: Lighting measures conservation case MAL assumed wattages. The evaluation team compared the average verified efficient case wattage estimates from the impact sample projects to the MAL deemed values. The evaluation team also compared the average verified efficient case wattage estimates incorporating a rolling population of PY2021 and PY2022 projects. During PY2021, the average verified conservation case wattage value for "LED HIGH BAY FIXTURE >= 20,100 Lumens & < 305W" and "2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)" were found to be 0.151 kW and 0.044 kW respectively. The average deemed and verified values for efficient case wattages in the PY2022 and PY2021-PY2022 rolling population are presented in Table 7-4 below. These categories had a high representation of measures in the 2021-2024 CDM Retrofit program so far. The deemed efficient case wattage for both the fixtures fell outside of the error bounds of the verified efficient case wattage estimates. The error bounds of the verified estimate for PY2021 and PY2022 "LED HIGH BAY FIXTURE >= 20,100 Lumens & < 305W" end-use range from 0.156 kW to 0.167 kW. The error bounds of the verified estimate for PY2021 and PY2022 "2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)" end-use range from 0.042 kW to 0.045 kW.

Table 7-4: Comparison of Conservation Case Wattages by Measure Type

CONSERVATION_MEASURE	PY22 Avg Deemed Conservation kW	PY22 Avg Verified Conservation kW	PY22 Sample Precision	PY 21 & 22 Avg Verified Conservation kW	PY21 & 22 Sample Precision
LED HIGH BAY FIXTURE >= 20,100 Lumens & < 305W	0.194	0.162	4%	0.161	3%
2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)	0.055	0.042	7%	0.043	4%

- **Recommendation 6:** Consider updating the efficient case wattage assumption for the "LED HIGH BAY FIXTURE >= 20,100 Lumens & < 305W" and "2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)" fixtures after discussions with the program team regarding the makeup of the PY2021 and PY2022 population and sample and how representative that may be of the future program populations.

Please note, a recommendation to consider updating the MAL conservation case wattage for the "2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)" was included in the PY2021 evaluation. In response to the recommendation in PY2021, the IESO indicated that conservation case wattages would be reviewed during the next round of MAL updates based on the non-weighted average of all DLC troffers meeting the measure category requirements. Given that similar findings with improved precision through a rolling sample were determined as a part of the PY2022 evaluation, a similar recommendation for "2' x 4' LED troffer / 4' LED linear ambient fixture (>= 3000 Lumens)" has been provided to ensure MAL assumptions are carefully monitored for future program years.

Finding 7: Possible misprint for MAL measures wattages. The deemed base and conservation case wattages in MAL for the "Measure mix of T8s and T12s" were found to be extremely high. After further review and comparison with verified parameters, measure IDs 305611, 305608 and 305616 seem to have deemed wattages that are 1000 times higher than actual values.

- 305611 – Deemed base case (6,122 W) and deemed efficient case (6,093 W)
- 305608 – Deemed base case (3,122 W) and deemed efficient case (3,093 W)
- 305616 – Deemed base case (11,122 W) and deemed efficient case (11,093 W)

- **Recommendation 7:** Although this finding did not have a huge impact on the verified net energy savings due to the difference between the overstated wattages being consistent, it is recommended to update the MAL to accurately reflect the base case and efficient case wattages for these measures.

Finding 8: In-Suite Temperature Controls (ISTC) deemed assumptions and delivery. In-Suite Temperature Controls contribute 15% of the verified net energy savings for Prescriptive HVAC projects in the population, but importantly has the highest verified net energy savings per

project (231 MWh). This measure was implemented in three projects and all three projects were evaluated. The verified net energy savings were generally lower than the deemed savings because the deemed savings for each temperature control installed is estimated based on air source heat pumps sized with electric space cooling and heating, whereas the ISTC projects evaluated were verified to be high rise apartments with central electric space cooling and non-electric space heating.

- **Recommendation 8:** Reassess the assumptions and delivery of the ISTC:
    - Ensure the delivery agent and technical reviewers are aware of measure eligibility criteria and program rules. The ISTC measure worksheet published on the IESO Save on Energy website indicates that the measure is eligible for electric spaces heating and cooling only.
    - Consider reviewing the deemed savings of the ISTC to develop sub-measure categories depending on the system specification (for example, electric vs non-electric heating, or systems with electric heating and no cooling).

Finding 9: Increasing non-lighting applications is possible with additional program support. When asked how the program could increase the number of non-lighting applications, IESO staff said they are considering further outreach, education, and potential incentive increases. Similarly, delivery vendors suggested more funding and more engagement, with one delivery vendor noting the importance of bringing contractors on board and well-stocking with product. One delivery vendor noted that reintroduction of the custom path and introduction of midstream lighting program will substantially help increase the share of non-lighting projects for the Retrofit Program. Applicant representatives and contractors indicated that adding a wider variety of non-lighting measures (41%) and increasing the incentives for non-lighting measures (33%) would increase the number of non-lighting applications the program receives.

- **Recommendation 9a:** Support the submission of non-lighting applications by identifying sectors and businesses most likely to express interest in non-lighting projects. Further support these projects by providing appropriate incentives (see **Recommendation 1**) and by engaging contractors and encouraging stocking of efficient products.
- **Recommendation 9b:** Perform a jurisdictional scan to identify prescriptive measure offerings that are not currently offered under the Retrofit Program.

Finding 10: Expanding the scope of equipment offerings was a common improvement suggestion. Nearly three-fourths of applicant representatives and contractors (73%) indicated their customers could typically install all equipment in which they displayed interest. Applicant representatives and contractors, however, provided numerous suggestions for additional equipment for consideration in the program, including exterior lighting (21%), battery storage (11%), EV batteries/chargers (11%), and solar PV (11%). A total of 23% of participants provided equipment suggestions that included additional HVAC equipment (17%), expanded lighting offerings (15%), and automation systems/controls (12%). IESO and delivery vendor staff suggested including DER, more heat pump technologies (e.g., ground source), custom horticultural lighting offerings, exterior lighting, HVAC measures (e.g., high-efficiency fans), and solar.

- **Recommendation 10:** Explore the feasibility of additional equipment that aligns with program goals and cost-effectiveness targets (see **Recommendation 9** for measure-related recommendations).

Please note that a similar recommendation was included in the PY2021 evaluation as well. In response to the recommendation in PY2021, the IESO indicated it would continue to refine the process for submitting measure recommendations online, that it would explore options to further promote this process, and that it would explore additional ways to address the needs of impacted customer segments and support complex projects through program enhancements planned for 2023. The IESO later noted that that this recommendation was of low relevance given that the custom track would be returning. Given that similar feedback was shared as part of the PY2022 evaluation, and given that a prescriptive track option will still be available to customers, a similar recommendation has been provided again to ensure that it continues to be carefully considered in future program years.

Finding 11: The bi-annual change process continued to work well. IESO staff said the bi-annual program change process that occurs in spring and fall worked well in PY2022. As part of this process, new equipment types may be added to the program or incentive levels adjusted. IESO staff recommended continuing to include this process once the custom track is reintroduced as the consistency it provides to the market in terms of knowing when program changes will occur. Delivery vendor staff said spring and fall updates were well communicated, customers were interested, and they typically received an influx of new submissions in the Retrofit application portal at those times. Participants reported low awareness (11%) and usage (four respondents) of the change request form on the Save on Energy website, which allows the public to submit new equipment suggestions that the IESO considers during the bi-annual change process.

- **Recommendation 11a:** Continue to offer the bi-annual program change process in spring and fall as delivery vendors, applicant representatives, contractors, and customers found this helpful in knowing when to anticipate program changes.
- **Recommendation 11b:** Consider better ways to promote the change request form on the program website (e.g., posting about it on social media, describing how to use it at in-person events or on customer calls).

Finding 12: Opportunities exist to better support under-subscribed areas. When asked if any measure categories or building types were under-represented in the program, IESO staff reported more opportunities may be available in the multi-unit residential building category, though program incentives are currently limited to common areas. One delivery vendor reported Save on Energy one-pagers specific to certain equipment types have proven effective, especially for commercial and industrial facilities. Delivery vendors also suggested greater outreach to hotels and chains and reported the industrial sector is generally underserved.

- **Recommendation 12a:** Consider performing targeted outreach to under-subscribed sectors, such as multi-unit residential buildings, hotels, chains, or the industrial sector. Developing additional sector-specific case studies and relevant equipment sell sheets

may help delivery vendors and contractors better upsell the program in these customer categories.

- **Recommendation 12b:** Explore the feasibility of extending the program to cover in-unit equipment upgrades in multi-unit residential buildings.

Finding 13: Some customers would be interested in receiving guidance and financial support to further electrify their facilities. Close to one-half of participants (47%) had not completed or had no plans to complete electrification projects at their facilities to address GHG emissions. They most commonly did not complete electrification projects due to insufficient capital (35%) or the equipment did not need replacement (16%). Participants suggested higher incentives, assistance from an electrification specialist, and incentives for additional measures would aid in completing electrification projects, were they to consider completing such projects in the future.

- **Recommendation 13:** Explore the feasibility of supporting customers interested in completing electrification projects with financial incentives and information on upgrades and costs of electrification projects.

8. Progress Updates on Process Topics

This section provides progress updates on common process evaluation research topics. These topics have typically been included as Key Findings and Recommendations in previous year's evaluation reports. Because these topics may be of continued interest to monitor, they are included here for additional consideration.

Process Progress Update 1. Further opportunities exist to expand program marketing and outreach. IESO staff indicated that more in-person marketing and outreach activities were reinstated in PY2022. IESO staff reported this shift brought on a push to develop additional marketing collateral. Delivery vendors encouraged the IESO to further market the program through providing more in-person events and mass-marketing, developing more customer-facing print pieces, and further co-branding with contractors on marketing materials they could use to sell the program to their customers. Close to three-fifths of applicant representatives and contractors (59%) reported that customers learned of the program through their companies contacting them directly, which may suggest additional opportunities exist to market the program through other channels. Applicant representatives and contractors provided the lowest satisfaction ratings for program marketing and outreach (50% with a rating of 4 or 5 on a scale of one to five, where one indicates "not satisfied at all" and five indicates "completely satisfied"). To address this, they recommended outreach from contractors and equipment vendors (56%) and from Save on Energy representatives (26%).

- **Improvement Opportunity 1:** Consider increasing the variety and frequency of marketing efforts across different mediums (e.g., social media; paid digital advertisements; mass media tactics [radio, TV, billboards]; additional in-person events; outreach to business associations and local community organizations).

Process Progress Update 2: Further opportunities exist to improve applicant representative and contractor training and education. Delivery vendors reporting working closely with program contractors, with some hosting webinars or in-person "lunch and learns" to demonstrate how to create and submit applications and to provide information on available incentives. Some delivery vendors mentioned developing training YouTube videos and e-mailing their contractor networks frequently to keep them engaged. Most applicant representatives and contractors (76%) reported receiving some training and education about the program, though over one-fifth did not (22%). Over three-fifths of applicant representatives and contractors (63%) provided suggestions regarding additional topics about which they would find more training helpful. These included offerings associated with the program (35%), marketing and outreach techniques (28%), and rules and application process for the program (22%).

- **Improvement Opportunity 2:** Ensure that training covers topics of the most interest to applicant representatives and contractors and that provide them with knowledge they need to effectively support the program. Key training topics for consideration include program offerings, marketing and outreach techniques, and rules and application processes for the program.

Appendix A Impact Evaluation Methodology

A.1 Sample Plan

Independently verifying energy and demand savings and attributing these savings first requires selecting sample projects representing the program's population. A representative sample ensures results can be applied to the population's reported savings to verify gross and net impacts with minimal uncertainty. A random sampling of projects was completed by studying the population and developing a sampling plan based on the following factors:

- Participation levels provided in the program database extract.
- Overall confidence/precision targets of 90/10 for the program, assuming a 0.5 coefficient of variation (C_V).

A.2 Project Counts

Due to the broad range of measures incentivized through the Retrofit program, several variables were considered when defining a unique project:

- Application identification (ID)
- Measure type (lighting/non-lighting)

As a result, a number of IESO-defined projects were split into various evaluation projects, often due to measure types within the same application. This sorting process resulted in a greater count of evaluation projects, thus exceeding the count of projects reported by the IESO.

A.3 Project Audits

Subsequent to the sampling process, the evaluation team completed project audits representing the entire Retrofit population. Sampled projects received Level 1 audits, consisting of desk reviews of project documentation from the program delivery vendor. These documents included project applications, equipment specification sheets, notes on equipment installed, invoices for equipment, and any other documentation submitted to the program.

Evaluation of the Retrofit program often included Level 2 audits with on-site visits and metering to estimate equipment HOU and operational loads. A subset of sampled projects received Level 2 audits, where a Resource Innovations engineer visited the facility to confirm equipment installation, gathered metering/trend data, and interviewed participants to confirm key details of the project, operating patterns, and schedules.

A.4 Reported Savings

Gross reported savings were energy and summer peak demand savings derived from information submitted on participant applications. They reflected equipment installed

throughout the program. This information was provided to the evaluation team through the program participation data extract provided by the IESO.

A.5 Verified Savings

Energy and demand savings were verified for all sampled projects and relied on data collected and verified during the project audit. This information was evaluated utilizing analytical tools to determine savings attributable to each project. For a specific stratum, verified savings were compared to reported savings to define the stratum realization rate. This realization rate was then applied to all projects' gross reported savings in a stratum's population to estimate the verified savings. Equation A-1 displays the formula for calculating a stratum's realization rate.

Equation A-1: Realization Rate

$$\text{Realization Rate} = \frac{\sum_i^n Savings_{\text{verified}}}{\sum_i^n Savings_{\text{reported}}}$$

Where:

$Savings_{verified}$ = Energy (kWh) or demand (kW) savings verified for each project in the sample

$Savings_{reported}$ = Energy (kWh) or demand (kW) savings reported by the program for each project in the sample

Total verified savings reflected the program's operations' direct energy and demand impacts. However, these savings did not account for customer or market behaviour impacts that may have been added to or subtracted from the program's direct results. These market effects were accounted for through the net impact analysis.

A.6 Interactive Effects for Lighting Equipment

The Retrofit program incentivizes installing lighting equipment with higher-efficiency levels (compared to commonly installed lamps and fixtures). Ideally, this high-efficiency equipment consumed less energy. It was understood, however, that the equipment's energy consumption in an enclosed space could not be viewed in isolation. Building systems interact with one another, and a change in one system can affect a separate system's energy consumption.

This interaction should be considered when calculating benefits provided by the program. Examining cross-system interactions provides a comprehensive view of building-level energy changes, rather than limiting analysis to the energy change that directly relates to the modified equipment. The IESO EM&V Protocols state that interactive energy changes should be quantified and accounted for, whenever possible. Based on this guidance, interactive effects were calculated for all energy-efficient lighting measures installed through the program to capture changes in the operation of HVAC equipment due to the lower heat loss from energy-efficient lighting equipment.

A.7 Lifetime Savings

When performing the impact evaluation, one had to consider total savings over the retrofitted equipment's lifetime. This consideration was necessary given that energy savings, demand savings, avoided energy costs, and other benefits continued to accrue each year the equipment remained in service. Equation A-2 presents the method of calculating lifetime energy savings of a measure level.

Equation A-2: Lifetime Energy Savings

$$Lifetime\ Energy\ Savings = EUL \times Annual\ Energy\ Savings$$

Where:

EUL = Estimated useful life of the retrofitted equipment

Appendix B Net-to-Gross Methodology

This appendix provides detail on the sampling plans for collecting NTG data, the instruments used to assess FR and SO, the implementation of the data collection, and the analysis methods.

The evaluation team developed an effective questionnaire to assess FR and SO, an approach used successfully in many previous evaluations. The NTG ratio presented in Equation B-1: Net-to-gross Ratio is defined as follows:

Equation B-1: Net-to-gross Ratio

$$NTG = 100\% - FR + SO$$

Where FR is free-ridership and SO is spillover.

B.1 Free-ridership Methodology

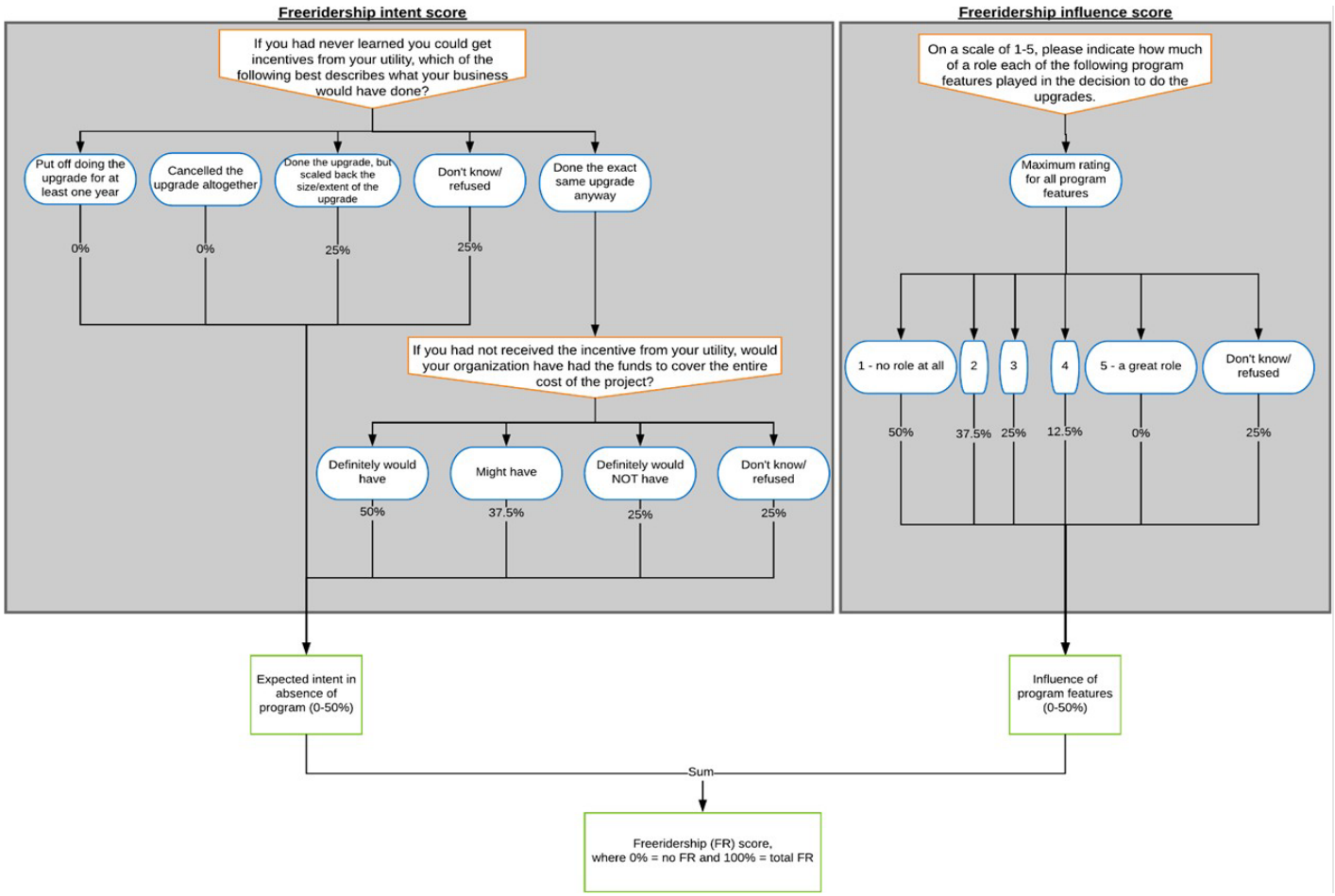
The survey addressed the attribution of savings for each sampled project or type of equipment through two main components:

- Intention of the expected behaviour in the program's absence; and
- Influence of various program features, such as the incentive, program marketing and outreach, and any technical assistance received.

Each component produced scores ranging from 0 to 50. The two components were summed to produce a total FR score ranging from 0 (not a free-rider) to 100 (complete free-rider). The total score was interpreted as a percentage (0% to 100%) to calculate the mean FR level for a given program.

Figure B-1 illustrates the FR methodology.

Figure B-1: Free-ridership Methodology



Intention Component

The FR score's intention component asked participants how the evaluated project would have differed in the program's absence. Two key questions determined the intention score:

> Question 1: If you had never learned you could get incentives/upgrades at no cost through the program, which of the following best describes what your business would have done? Your business would have…

1. Put off doing the upgrade for at least one year.
2. Cancelled the upgrade altogether.
3. Done the upgrade but scaled back the size or extent of the upgrade.
4. Done the exact same upgrade anyway ☐ Ask Question 2

98. Don't know
99. Refused

[ASK ONLY IF RESPONSE TO QUESTION 1=4: Done the exact same upgrade anyway] Question 2: If you had not received the incentive/upgrades at no cost from the program, would you say your organization definitely would have, might have, or definitely would not have had the funds to cover the entire cost of the project?

1. Definitely would have
2. Might have
3. Definitely would NOT have
98. Don't know
99. Refused

Table B-1 indicates possible intention scores a respondent could have received, depending on their responses to these two questions.

Table B-1 : Key to Free-ridership Intention Score

Question 1 Response	Question 2 Response	Intention Score (%)
1 or 2	Not asked	0 (no FR for intention score)
3, 98 (Don't Know), or 99 (Refused)	Not asked	25
4	3, 98 (Don't Know), or 99 (Refused)	25
4	2	37.5
4	1	50 (high FR for intention score)

If a respondent provided an answer of 1 or 2 (would postpone or cancel the upgrade) to the first question, the respondent received an FR intention score of 0% (on a scale from 0% to 50%, where 0% is associated with no FR and 50% is associated with high FR). If the respondent answered 3 (would have done the project but scaled back the size or extent) or stated did not know or refused the question, the respondent received an FR intention score of 25% (associated with moderate FR). If the respondent answered 4 (would have done the exact same project anyway), they were asked the second question before an FR intention score could be assigned.

The second question asked participants whether they would have done the exact same project, regardless of whether their organization would have had the funds available to cover the entire project cost. If the respondent answered 1 (definitely would have had the funds), the respondent received a score of 50% (associated with high FR). If the respondent answered 2 (might have had the funds), they received a slightly lower FR score of 37.5%. If the respondent answered 3 (definitely would not have had the funds) or did not know or refused the question, the respondent received an FR intention score of 25% (associated with moderate FR).

The bullet points below display the same FR intention scoring approach as a list. As noted, an intention score was calculated for each respondent, ranging from 0% to 50%, based on the respondent's report of how the project would have changed in the program's absence:

- Project postponement or cancellation = 0%
- Reduction in size or scope or use of less energy-efficient equipment = 25%
- Respondent does not know what they would have done in the absence of the program = 25%
- No change and respondent states firm would not have made funds available = 25%
- No change, but respondent is not sure whether firm would have made funds available = 37.5%
- No change, and respondent confirms firm would have made funds available = 50%

Influence Component

The influence component of the FR score asked each respondent to rate how much of a role various potential program-related influence factors had on their decision to do the upgrades in question. Influence was reported using a scale from one to five, where one indicates "it played no role at all" and five indicates "it played a great role." The potential influence included the following:

- Availability of the incentives
- Information or recommendations provided to you by an IESO representative (if applicable)
- The results of any audits or technical studies done through this or another program provided by the IESO (if applicable)
- Information or recommendations provided from contractors, vendors, or suppliers associated with the program
- Information from Enbridge Gas
- Information from another government entity
- Marketing materials or information provided by the IESO about the program (e.g., email, direct mail)
- Information or resources from the IESO's website
- Information or resources from social media
- Previous experience with any energy-saving program
- Others (identified by the respondent)

Table B-2 indicates the possible influence scores a respondent could receive depending on how they rated the influence factors above. For each respondent, the program influence was set equal to the maximum influence rating a respondent reports across the various influence factors. For example, suppose the respondent provided a score of 5 (great role) to at least one of the influence factors. In that case, the program was considered to have had a great role in their decisions to do upgrades, and the influence component of FR was set to 0% (not a free rider).

Table B-2 : Key to Free-ridership Influence Score

Maximum Influence Rating	Influence Score (%)
5 - program factor(s) highly influential	0
4	12.5
3	25
2	37.5
1 - program factor(s) not influential	50
98 – Don't know	25
99 - Refused	25

The following bullet points display the same FR Influence scoring approach in a list form. As discussed, for each project, a program influence score was calculated, ranging from 0% to 50%, based on the highest influence rating given among potential influence factors:

- Maximum rating of 1 (no influencing factor had a role in the decision to do the project) = 50%
- Maximum rating of 2 = 37.5%
- Maximum rating of 3 = 25%
- Maximum rating of 4 = 12.5%
- Maximum rating of 5 (at least one influence factor had a great role) = 0%
- Respondent does not know how much influence any factor had = 25%

Intention and program influence scores were summed for each project to generate an FR score ranging from 0 to 100. The scores were interpreted as % FR: a score of 0 indicates 0% FR (the participant was not at all a free rider), a score of 100 indicates 100% FR (the participant was a complete free rider), and a score between 0 and 100 indicates the participant was a partial free rider.

B.2 Spillover Methodology

To assess the SO, respondents were asked about installing energy-efficient equipment or services performed without a program incentive following their participation in the program. Equipment-specific details assessed follow:

- ENERGY STAR Appliance: type and quantity
- Fan: type, size, quantity
- HVAC: air conditioner replacement, above code minimum: tonnage and quantity
- Lighting: type, quantity, wattage, HOU, location, and fixture length
- Lighting—controls: type of control, type and quantity of lights connected to control, HOU, and percentage of time the timer turned off lights
- Motor/Pump Upgrade: type, end-use, horsepower, and efficiency quantity

- Motor/Pump Drive Improvement (VSD and Sync Belt): type, end-use, horsepower, and quantity
- Others (identified by the respondent): description of upgrades, sizes, quantities, HOU

For each equipment type the respondent reported installing without a program incentive, the survey instrument asked about the extent of influence that earlier involvement in the program had on their decisions to carry out upgrades. Influence was reported using a scale from one to five, where one indicated "it played no role at all" and five indicated "it played a great role." If the influence score was between 3 and 5 for a particular equipment type, the survey instrument solicited details about upgrades to estimate the quantity of energy savings that the upgrade produced.

For each upgrade, the program influence rating was converted to an influence score ranging from 0% to 100%, as follows:

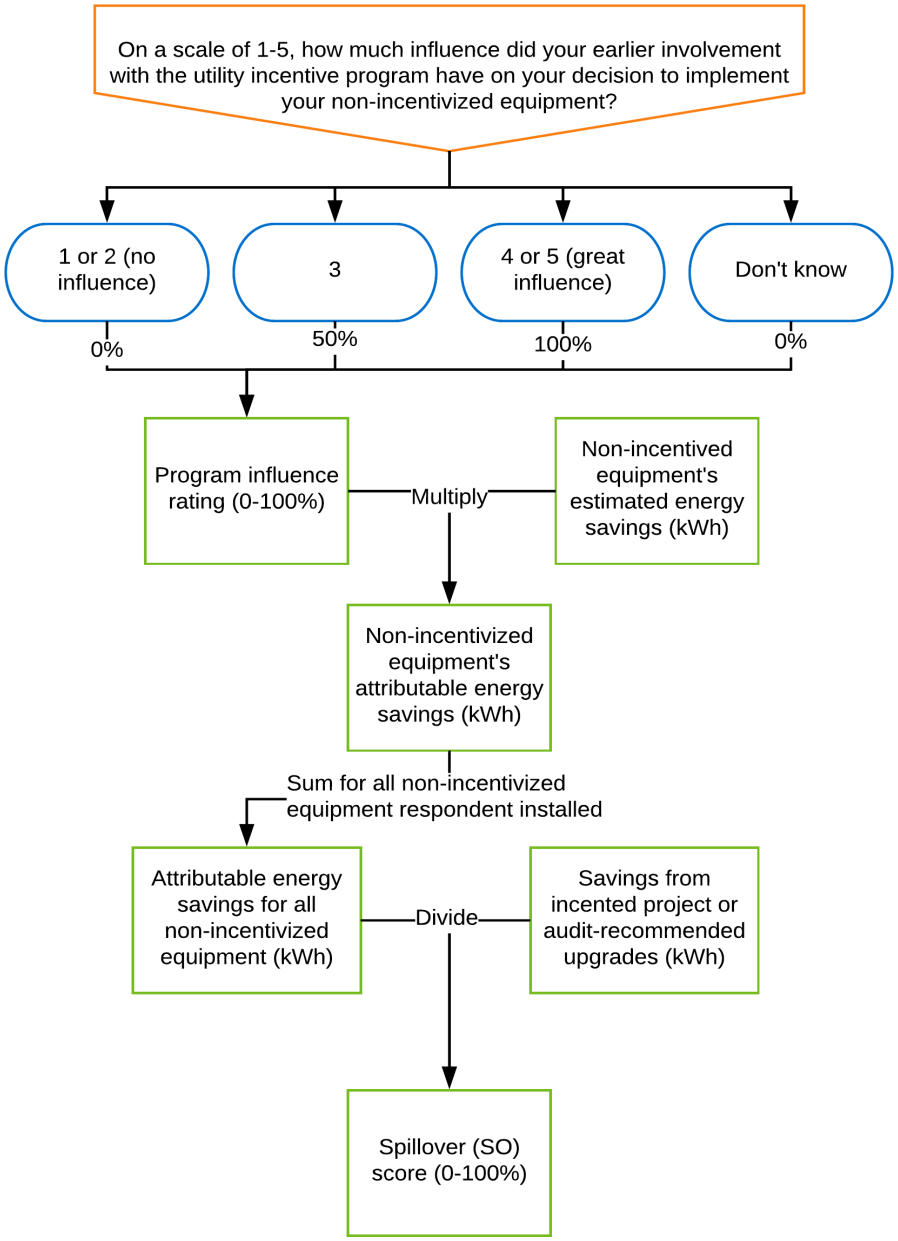
- Maximum rating of 1 or 2 (no influence) = 0%
- Maximum rating of 3 = 50%
- Maximum rating of 4 or 5 (great influence) = 100%
- Respondent does not know how much influence any factor had = 0%

The following procedure was used to calculate an SO percentage for each respondent:

- Multiplying the estimated energy savings for each upgrade by the influence percentage to calculate the upgrade's program-attributable energy savings.
- Summing program-attributable energy savings from all identified upgrades for each respondent to calculate the respondent's total SO savings.
- Dividing each respondent's total SO savings by the savings from the incented project.

Figure B-2 illustrates the SO methodology.

Figure B-2: Free-ridership Methodology



B.3 Identification of Project or Upgrade for NTG Assessment

Participants were asked to consider all their projects completed through the Retrofit Program during the program year. This approach allowed for applying the respondent's NTG value across all the projects they completed during the program year rather than a single one.

B.4 Other Survey Questions

In addition to the questions addressing FR and SO, the survey included the following topics to provide additional context.

- Whether the respondent was an employee of the company. If the person was not an employee of the company, they were asked to forward the survey web link to someone at the company who is able to respond.
- Whether the respondent had primary or shared responsibility for the budget or expenditure decisions for program-incentivized work completed at their company.
- The respondent's job title.
- When the respondent first learned about program incentives relative to the upgrade in question (i.e., before planning, after planning but before implementation, after implementation began but before project completion, or after project completion).
- When the respondent submitted their application to the program and their reasons for submitting it after work was started or completed, if applicable.
- How the respondent learned about the program.

Responses to these questions were not included in the algorithms for calculating FR or SO, but they provided additional context. The first question ensured that the appropriate person responded to the survey. The other questions provided feedback about the responsibility for budget and expenditure decisions, the respondent's job title, application submission process details, and how and when program influence occurs.

B.5 Net-to-Gross Survey Implementation

The survey was implemented over the web and by phone. The survey lab was instructed to avoid collecting duplicate responses by no longer calling on respondents if they responded to the web survey or deactivating the respondent's survey web link if they responded to the phone survey.

For each phone survey, the survey lab called participants in a randomized order. After reaching the identified contact for a given participant, the interviewer explained the survey's purpose and identified the IESO as the sponsor. The interviewer asked if the contact was involved in decisions about upgrading equipment at their organizations. If the contact was not involved in decisions about upgrading equipment, the interviewer asked to be transferred to or to receive the contact information of the appropriate decision-maker. The interviewer then attempted to reach the identified decision-maker to complete the survey.

It was assumed that all contacts who responded to the web version of the survey were the appropriate contacts to answer the questions. The introductory text in the survey asked the respondent to forward the survey web link to the appropriate contact to fill it out if they were not the appropriate contact to do so.

Appendix C Detailed Process Evaluation Methodology

This appendix provides additional detail about the process evaluation methodology. Section 3.2 summarizes the methodology.

C.1 Research Question Development

Table C-1 provides a list of the key research questions and the data sources used to investigate each of these. The research questions were developed at the beginning of the PY2022 evaluation period in January and February 2023. They were written in consultation with the IESO program and the IESO EM&V staff and were finalized after reviewing the timing of related survey instruments to ensure respondent fatigue would be minimized. After the research questions were finalized, they were adapted for inclusion in the interview guides and survey instruments, which were, in turn, reviewed and approved by the IESO EM&V and program staff (refer to Appendix C.2 for more information on the interview and survey methodology).

Table C-1 : Retrofit Program Process Evaluation Research Questions and Data Sources

Research Questions	Document and Program Records Review	IESO & Delivery Vendor Staff Interviews	Participant Surveys	Applicant Representative & Contractor Surveys
Are sufficient data being captured to effectively verify recommendations and savings?	✓	✓		
What are the goals and objectives of the program, and how well is the program doing in terms of meeting them?		✓		
What program processes are followed by the IESO and program vendors? What areas of process improvement may exist?		✓		✓
What strategies implemented by the IESO were effective in terms of driving participation, increasing program awareness, and avoiding free-ridership?		✓	✓	✓
What program marketing and outreach occurred in support of the program? How did participants become aware of the program? What specific marketing or outreach activities show the most opportunity?		✓	✓	✓
Can non-energy benefits (environmental, social) be better leveraged by program messaging?		✓		

Research Questions	Document and Program Records Review	IESO & Delivery Vendor Staff Interviews	Participant Surveys	Applicant Representative & Contractor Surveys
What were the experiences of applicant representatives and contractors in participating in the program?				✓
What are the program strengths, barriers, and areas of improvement?		✓	✓	✓
Do the current range of program equipment/services meet customer needs? Were participants able to install all equipment models of interest to them? What suggestions exist for additional equipment/services?			✓	✓
How can we increase the number of non-lighting applications in the program?		✓		✓
Are incentives for specific measures too low or too high?		✓	✓	✓
Would lowering the minimum incentive threshold materially increase the energy/demand savings potential?		✓		
How can we improve the conversion of applications from pre to post?		✓		
How has the biannual (spring and fall) change process been working?		✓		
Are people aware of the change request form?		✓	✓	✓
How might the biannual (spring and fall) change process be adapted for 2023 (knowing that Custom will be returning in 2023)?		✓		✓
How well are the IESO training and webinars working for the service providers, especially the new providers?		✓		
Are there measure categories or building types that are undersubscribed through the program?	✓	✓		
Which additional horticultural measures and incentives could be added to the program in the future?	✓	✓		✓

Research Questions	Document and Program Records Review	IESO & Delivery Vendor Staff Interviews	Participant Surveys	Applicant Representative & Contractor Surveys
How do baselines observed in the sample of participant projects deviate from the IESO's assumed baselines for the existing horticultural measures? Does this warrant a change to assumptions?	✓			
What were the direct impacts of horticultural measures on local peak demand in the areas these projects took place?	✓			

C.2 In-Depth Interview and Survey Methodology

The process evaluation collected primary data from key program actors, including IESO staff, program delivery vendor staff, applicant representatives, contractors, and participants, as shown in Table C-2. Data were collected using different methods, including web surveys, telephone surveys, or telephone based IDIs, depending on that most suitable for a particular respondent group. When collected and synthesized, these data provide a comprehensive understanding of the program.

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

Table C-2 : Process Evaluation Primary Data Sources

Respondent Type	Methodology	Population	Completed	Response Rate	90% CI Error Margin
IESO Staff	Phone In-depth Interviews (IDIs)	3	3	100%	0%
Program Delivery Vendor Staff	Phone IDIs	3	3	100%	0%
Applicant Representatives and Contractors	Web Survey	327	54	17%	10.3%
Participants	Web and Phone Survey	1680	222[9]	13%	5.2%

[9] The NTG evaluation included more respondents (n=249) than the process evaluation (n=222) as 27 respondents did not fully answer the process evaluation survey questions.

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

IESO Staff and Program Delivery Vendor Staff Interviews

IDIs were completed with three members of IESO's staff and three staff from the program delivery vendor, as shown in Table C-3. The interviews sought to better understand the perspectives of the IESO program and of program delivery vendor staff related to the program design and delivery.

Table C-3 : IESO Program Staff and Program Delivery Vendor Staff IDI Disposition

Disposition Report	IESO Staff	Program Delivery Vendor Staff	Total
Completes	3	3	6
No Response	0	0	0
Unsubscribed	0	0	0
Partial Complete	0	0	0
Bad Contact Info (No Replacement Found)	0	0	0
Total Invited to Participate	3	3	6

Interview topics included program roles and responsibilities, program design and delivery, applicant representative and contractor engagement, marketing and outreach, customer participation, market impact, program strengths and weaknesses, and improvement suggestions.

The appropriate staff to interview were identified in consultation with IESO EM&V staff. Telephone IDIs were conducted with IESO staff and program delivery vendor staff using in-house staff (rather than a survey lab). The interviews were completed between April 13 to 25, 2023. Each interview took approximately one hour to complete.

Applicant Representative and Contractor Survey

A total of 54 application representatives and contractors were surveyed from a sample of 327 unique applicant representatives and contractors, as shown in Table C-4. The survey's purpose was to better understand the applicant representatives' and contractors' perspectives on program delivery.

Table C-4 : Applicant Representative and Contractor Survey Disposition

Disposition Report	Total
Completes	54
Emails bounced	10
Bad Contact Info (No Replacement Found)	0
Unsubscribed	0
Partial Complete	2

Disposition Report	Total
Screened Out	21
No Response	240
Total Invited to Participate	327

Survey topics included firmographics, program roles and responsibilities, how customers learned about the program, effective marketing and outreach activities, training and education, participation barriers, equipment customers expressed interest in but could not install, incentives, increasing non-lighting equipment installations, satisfaction with various program aspects, equipment offering feedback, program improvement suggestions, biannual change process feedback, FR and SO, job impacts, and NEBs perspectives.

The sample was developed from program records provided by the IESO EM&V staff. A census-based approach was employed to reach the largest number of respondents possible, given the small number of unique contacts.

NMR staff delivered the survey over the web, using Qualtrics survey software. Survey implementation was conducted between March 14 and April 11, 2023. The survey took an average of 13 minutes to complete after removing outliers.[10] Weekly e-mail reminders were sent to non-responsive contacts through web survey fielding.

Participant Survey

A total of 222 participants were surveyed from a sample of 1,680 unique contacts, as shown in Table C-5. The survey's purpose was to better understand the participants' perspectives related to the program experience.

Table C-5 : Participant Survey Disposition

Disposition Report	Web	Phone
Completes	222	0
Emails bounced	42	-
Partial Complete	79	-
Screened Out	78	-
Callback	-	2
Hard Refusal	-	2
Non-working #	-	2

[10] The survey was designed to allow a respondent to complete at a later time 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.

Disposition Report	Web	Phone
Left message with operator	-	1
Voicemail	-	12
Agreed to Complete Online	-	9
Wrong Number	-	1
No longer with company	-	1
No Response	1.259	4
Total Invited to Participate	1.680	34

Survey topics included firmographics, how customers heard about the program, ease of participation, the change request form, equipment not installed due to insufficient incentives, equipment recommendations, program improvement recommendations, electrification projects, FR and SO, and NEBs perspectives.

The sample was developed from program records provided by IESO EM&V staff. A census-based approach was employed to reach the largest number of respondents possible, given the small number of unique contacts.

The survey was delivered over the phone and the web in partnership with Resource Innovations' survey lab, using Qualtrics survey software. NMR staff worked closely with Resource Innovations' survey lab to test the survey's programming and to perform quality checks on all data collected.

Survey implementation was conducted between March 14 and April 21, 2023. The survey took an average of 17 minutes to complete after removing outliers.[11] Weekly e-mail reminders were sent to non-responsive contacts through web survey fielding.

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

Appendix D Additional Net-to-Gross and Process Evaluation Results

This appendix provides additional results in support of the NTG and process evaluations.

D.1 Additional IESO Staff and Program Delivery Vendor Staff Results

This appendix provides additional detail regarding process evaluation results collected as part of IESO staff and program delivery vendor staff IDIs.

Biannual Program Change Process

IESO staff said the biannual program change process that occurs in the spring and fall worked well in PY2022. As part of this process, new equipment types can be added to the program or incentive levels can be adjusted. IESO staff recommended continuing to include this process once the custom track is reintroduced to the program. Delivery vendor staff said that the spring and fall updates were well communicated, that customers were interested to learn about the changes, and that they typically received an influx of new submissions in the Retrofit application portal during those times.

Minimum Incentive Threshold

When asked if lowering the minimum incentive threshold could materially increase the energy or demand savings potential, most IESO staff agreed that doing so might not be helpful. IESO staff members noted that the threshold is already quite low at $500. Delivery vendors generally agreed, stating that smaller applications would lead to increases in delivery costs without much savings to be gained.

Underrepresented Measure Categories or Building Types

When asked if any measure categories or building types were underrepresented in the program, IESO staff mentioned challenges with increasing the share of non-lighting projects through the program. IESO staff also indicated more opportunities might exist in the multi-unit residential building category, though program incentives are currently limited to common areas. Delivery vendors suggested more outreach to hotels and chains and said the industrial sector is generally underserved.

Increase the Number of Non-lighting Applications

When asked how the program could increase the number of non-lighting applications, IESO staff said they were considering further outreach, education, and potential incentive increases. Similarly, delivery vendors suggested more funding and more engagement, with one delivery vendor noting the importance of having the contractors on board and well-stocked with product. One delivery vendor noted that reintroduction of the custom path and the introduction of the midstream lighting program will substantially help increase the share of non-lighting projects for the Retrofit Program.

Conversion of Applications from Pre to Post

When asked how the program could improve the conversion of applications from pre to post, IESO staff suggested an opportunity might exist to better structure the closing of projects, ensuring they are completed more quickly. IESO staff also recommended additional outreach, education, further follow-up with customers, and ensuring projects will be legitimate during pre-approval. One delivery vendor suggested automating the Retrofit application portal further (such as programming a message to be sent through the portal one month after the project's completion or setting up the portal to delete an application or its documents if it is idle for too long to encourage customers to revisit it with greater frequency). Another delivery vendor said that conversion rates are relatively good from their perspective.

D.2 Contractor Net-to-Gross Results

This appendix provides a summary of the FR and SO results collected through the Retrofit applicant representative and contractor survey. FR and SO feedback were only collected from contractors. Given that a small number of contractors responded to these survey questions, these results were not used to calculate the Retrofit Program's NTG. Only the FR and SO results collected as part of the participant survey were used to calculate NTG.

Contractor FR. The survey collected feedback from respondents to better understand contractors' perspectives on the extent of FR within the Retrofit Program. Contractors were asked to estimate the percentage of various equipment types that would have been installed at the same efficiency level had there been no incentives available through the program. A total of 22 contractors responded to the FR and SO questions in the survey.

Over three-fifths of surveyed contractors (14 of 22, or 64%) stated that at least some of their projects would have installed the same equipment with the same efficiency level in the Retrofit program's absence. Of 932 total projects reported among these contractors, they indicated about one-tenth (12%, or a total of 114 projects) would have installed the same equipment.

Contractors were asked to estimate the percentage of various equipment types that would have been installed with the same efficiency level had no incentive been available through the program. The average percentage among the ten contractors who provided an estimate for lighting was 50%.

Contractor SO. To estimate SO, contractors were asked if they installed any energy-efficient equipment that did not receive incentives. The 12 contractors responding to this question reported that, of 250 projects that did not go through the program, 107 (42%) installed equipment that would have been eligible for an incentive but did not receive one.

One contractor largely drove this, stating that 60 of their 100 non-program projects had efficient equipment that would have been eligible for an incentive. The respondents rated the program's influence on the decision to install such equipment as an average of 2.5 out of 5 on a scale from one

to five, where one indicates the program was “not at all influential” and five indicates the program was “extremely influential.”

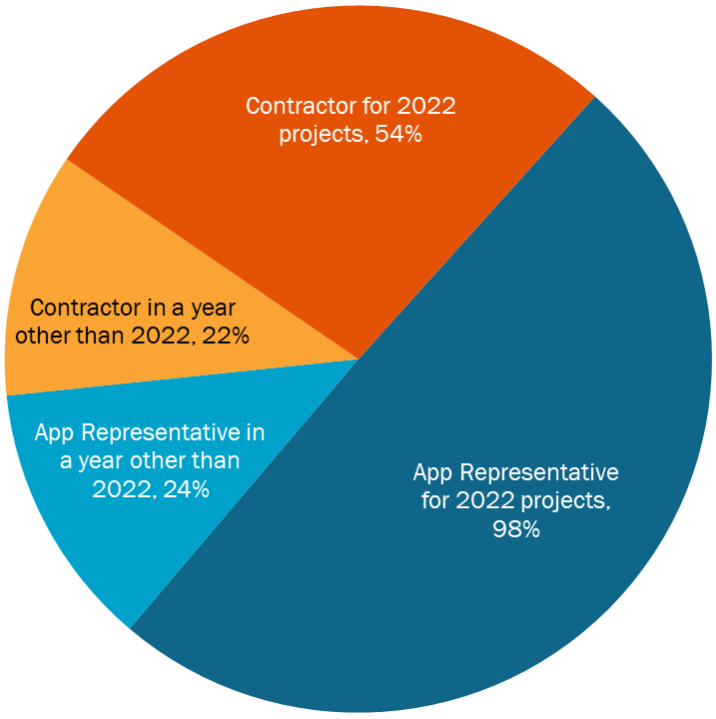
D.3 Additional Applicant Representative and Contractor Process Results

This appendix provides additional detail regarding the process evaluation results collected as part of the Retrofit applicant representative and contractor surveys.

Firmographics

As presented in Figure D-1, nearly all respondents (98%) were applicant representatives who assisted clients participate in the program in 2022. Over one-half (54%) were contractors that completed projects for clients participating in the program in 2022, just under one-fourth (24%) were applicant representatives who assisted clients participate in the program in a year other than 2022, and more than one-fifth (22%) were contractors who completed projects for clients participating in a year other than 2022.

Figure D-1: Respondents' Role in Retrofit Program (n=54)*



*Does not sum to 100% due to multiple responses.

Table D-1 displays the number of full- and part-time employees at the respondents’ companies. Nearly one-fourth (24%) were affiliated with companies with five or fewer full-time positions. Over

one-fourth (28%) were affiliated with companies that had over 20 full-time positions. Nearly one-third (32%) reported having part-time positions.

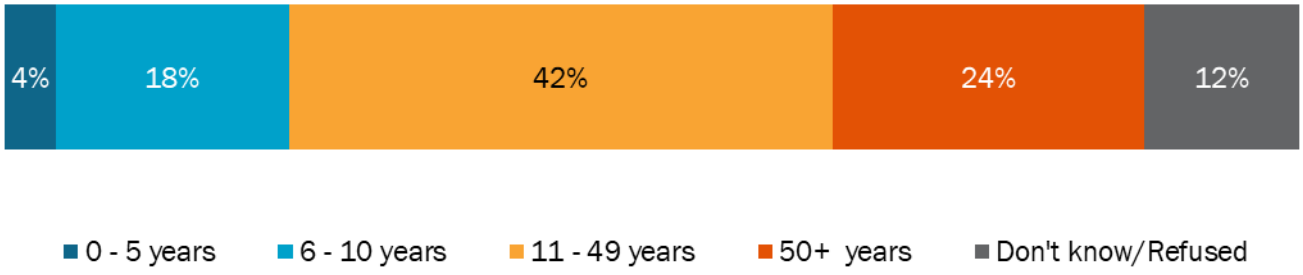
Table D-1 : Respondents' Full- and Part-time Employees (n=50)*

Number of Employees	Full-Time*	Part-Time
1-5	24%	22%
6-10	6%	0%
11-20	6%	6%
20+	28%	8%
Don't know/Refused	34%	34%
None	2%	34%

*Does not sum to 100% due to rounding.

The breakdown of the respondents' company age is presented in Figure D-2. Less than one-tenth of respondents (4%) were affiliated with companies that had been in business for less than five years. Over two-fifths (42%) were affiliated with companies that had been in business between 11 and 49 years. Nearly than one-fourth (24%) were affiliated with older businesses in operation for more than 50 years.

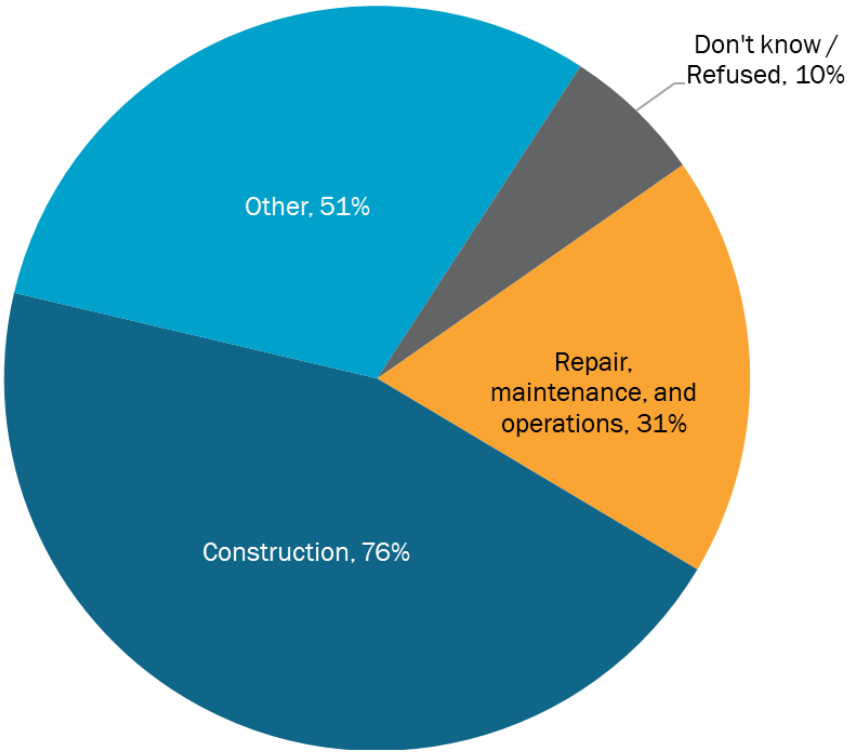
Figure D-2: Respondents' Company Age (n=50)*



*Does not sum to 100% due to rounding.

Respondent business categories varied, as presented in Figure D-3. Over three-fourths (76%) worked in construction. Nearly one-third (31%) worked in repair maintenance and operations.

Figure D-3: Respondents' Business Category
(Open-ended and multiple responses allowed; n=49)*



*Does not sum to 100% due to multiple responses.

Respondents reported other business categories that best represented their company, including electric wholesale and distribution, lighting retrofits, sales and manufacturing, and renewable energy and conservation.

Project Background

Applicant representatives and contractors were asked to provide background information about the projects they completed through the Retrofit program.

Applicant Representatives

Of 53 responding applicant representatives, 45 provided estimates on the number of clients they assisted with applications. In total, applicant representatives reported representing 861 clients, with an average of 19 clients per respondent.

Contractors

Of 33 responding contractors, 29 provided detail on the total number of projects their company completed through the program in 2022. In aggregate, respondents reported a total of

1,786 projects, over one-half (a total of 932, or 56%) of which were completed through the Retrofit program. On average, 19% of total sales went through the Retrofit program.

Respondents were asked to provide total sales estimates by equipment type for program-eligible measures, regardless of whether the equipment received an incentive through the program. They were then asked what percentage of those sales (by equipment type) went through the Retrofit program. Table D-2 presents average estimates of the percentage of sales by equipment type and the percentage of those sales that went through the Retrofit program. Lighting represents the largest percentage of sales (48%). EMS represent a small portion of sales (<1%) that went through the Retrofit program.

Table D-2 : Percent of Sales by Equipment Type
(Open-ended and multiple responses allowed; n=22)

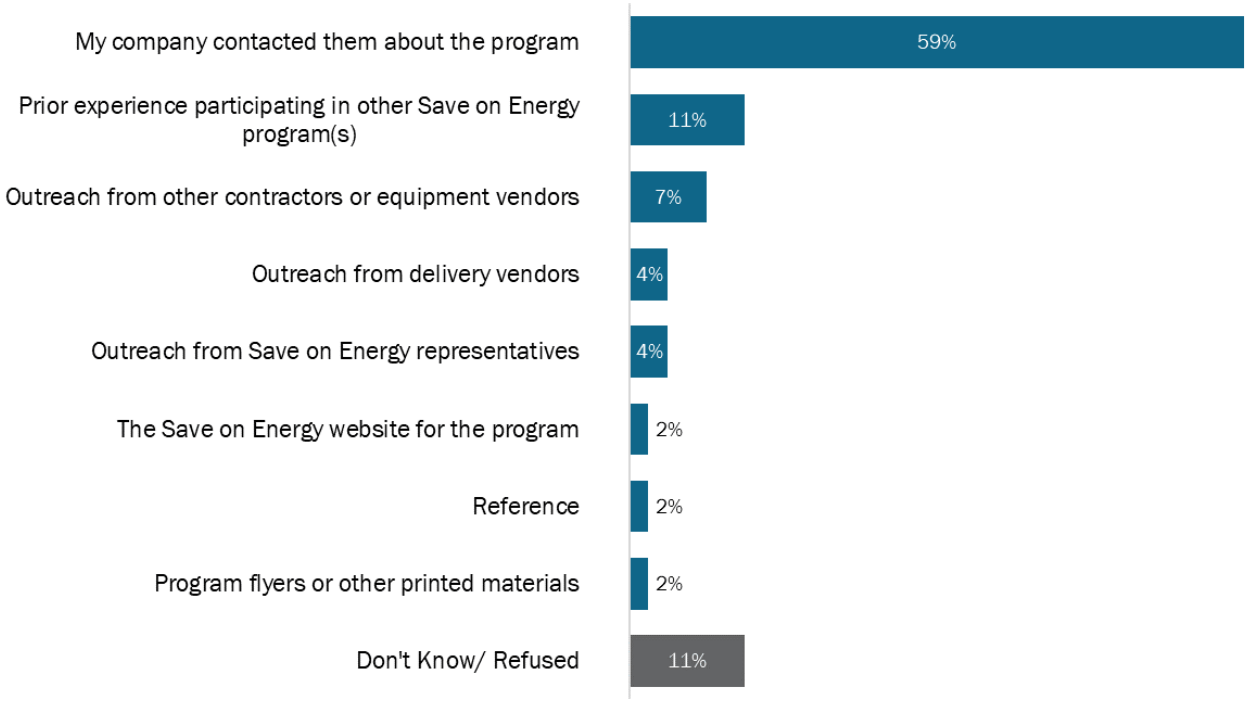
Equipment Type	% of Total Sales
Lighting	48%
HVAC	8%
Refrigeration	5%
Lighting, controls	2%
HVAC, controls	1%
Motor VSD	1%
Pump VSD	<1%
EMS	<1%
Other program eligible measures	<1%

Program Awareness

Respondents reported the primary ways that their customers heard about the Retrofit program (Figure D-4). Over one-half of respondents (59%) reported their companies contacted customers about the program. Section 5.2.2 includes an additional discussion regarding program awareness.

Figure D-4: Customer Awareness of the Program

(Open-ended and multiple responses allowed; n=54)*

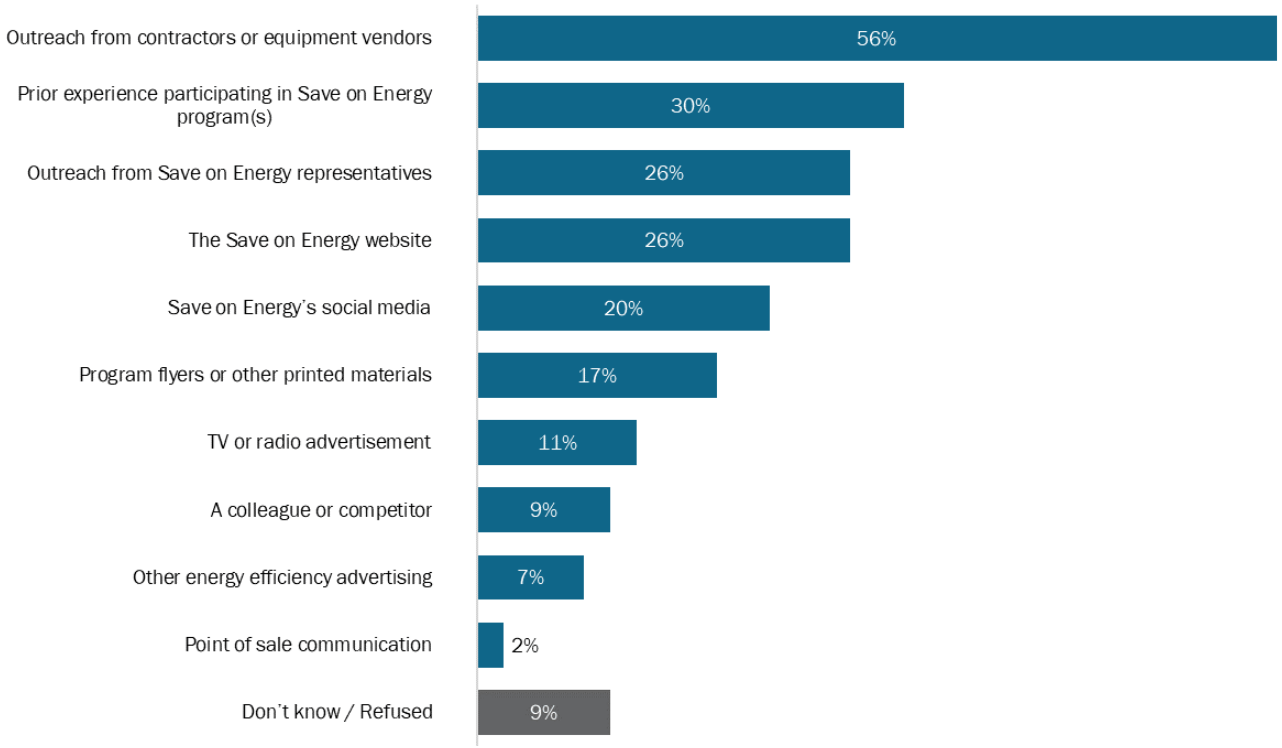


*Does not sum to 100% due to multiple responses.

Respondents were asked which marketing or outreach activities had most effectively generated customer awareness of the Retrofit Program. As shown in Figure D-5, over one-half of respondents (56%) suggested outreach from contractors or equipment vendors proved most effective. Section 5.2.2 includes an additional discussion regarding marketing and outreach effectiveness.

Figure D-5: Marketing and Outreach Effectiveness

(Open-ended and multiple responses allowed; n=54)*



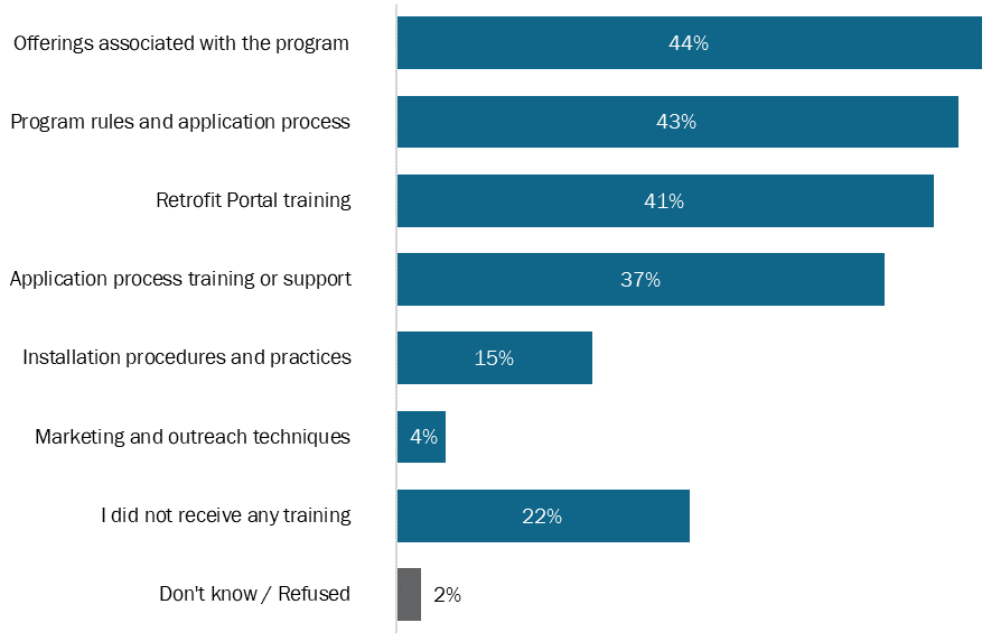
*Does not sum to 100% due to multiple responses.

Training and Education

Most respondents (76%) reported receiving some type of training and education in support of the Retrofit Program. Nearly one-half of respondents received training on offerings associated with the program (44%) and the program rules and application process (43%), as shown in Figure D-6. Over one-fifth of respondents (22%) indicated that they had not received any training at all. Section 5.2.3 includes an additional discussion regarding training and education.

Figure D-6: Types of Training Received

(Open-ended and multiple responses allowed; n=54)*



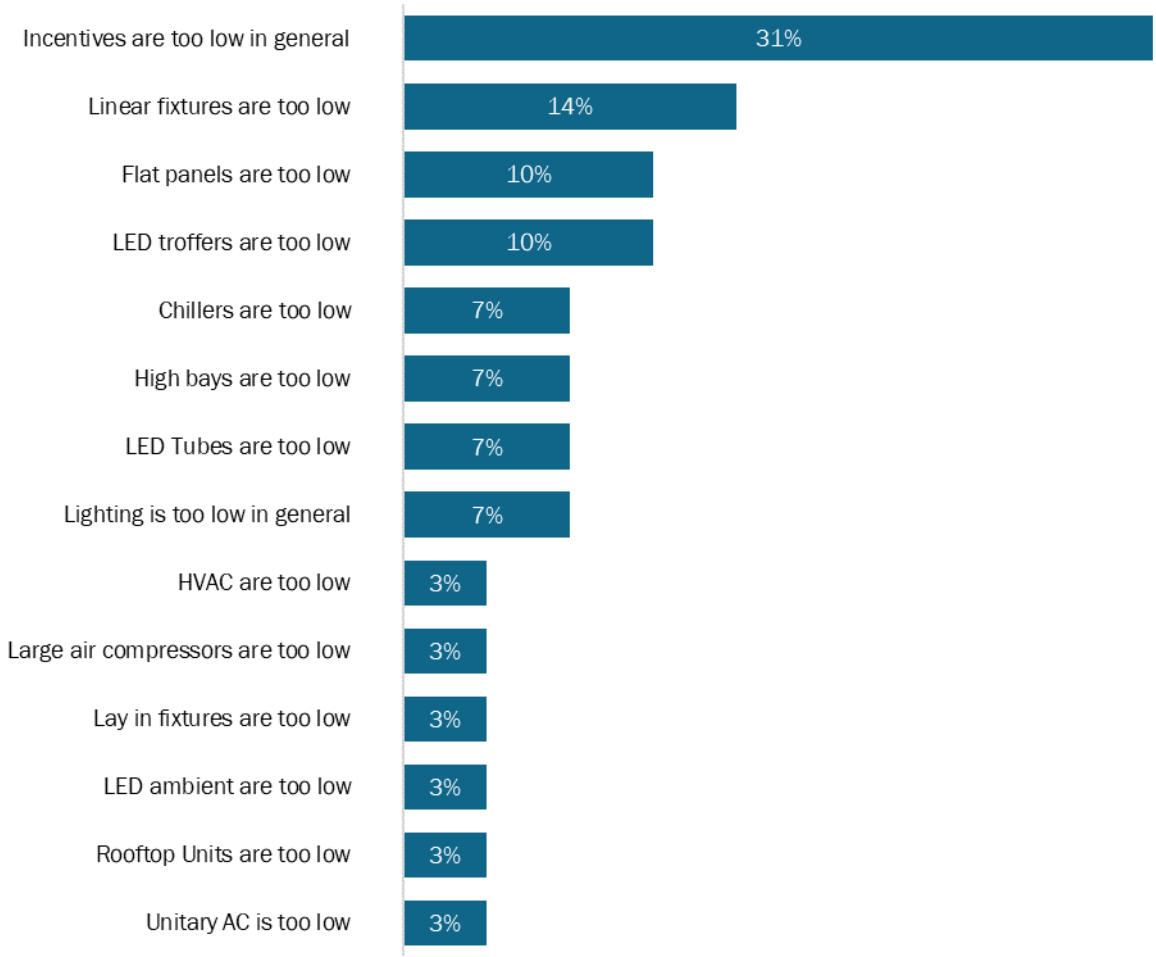
*Does not sum to 100% due to multiple responses.

Incentives

As shown in Figure D-7, respondents were asked to specify if incentives for any energy-efficient equipment or models offered through the program were too high or low. More than one-half of respondents that answered (54%) indicated the incentives were too low. Of these, nearly one-third (31%) reported incentives were too low in general; others recommended a variety of equipment types with incentives that they considered too low. Section 5.2.4 includes additional discussion regarding incentives that respondents identified as too low.

Figure D-7: Equipment for Which Incentives are Too Low*

(Open ended and multiple responses allowed; n=29)



*Does not sum to 100% due to multiple responses.

Respondents recommended adjusting the incentive pricing, as shown in Table D-3. One of the most common recommendations was that incentives should be higher to ensure customers feel it is worth the trouble of participating (two respondents). Section 5.2.4 includes additional discussion regarding suggestions for incentive adjustments.

Table D-3 : Suggestions for Incentive Adjustments

(Open-ended and multiple responses allowed; n=11) *

Suggestions for Incentives	Respondents
Should be higher to ensure customers feel it is worth the trouble to participate	2
Should increase incentives because they are too low compared to the measure price	2
Should be increased given increases in material costs	2
Should be increased because prices have increased	1
Should be increased given the increase in installation costs	1
Should be increased for most popular measures	1
Should be increased to meet inflation	1
Should be increased given economic environment	1
Should increase incentives for measures that offer strong alternatives to commonly installed but less-efficient measures	1
Should increase incentives to lower the cost barrier	1

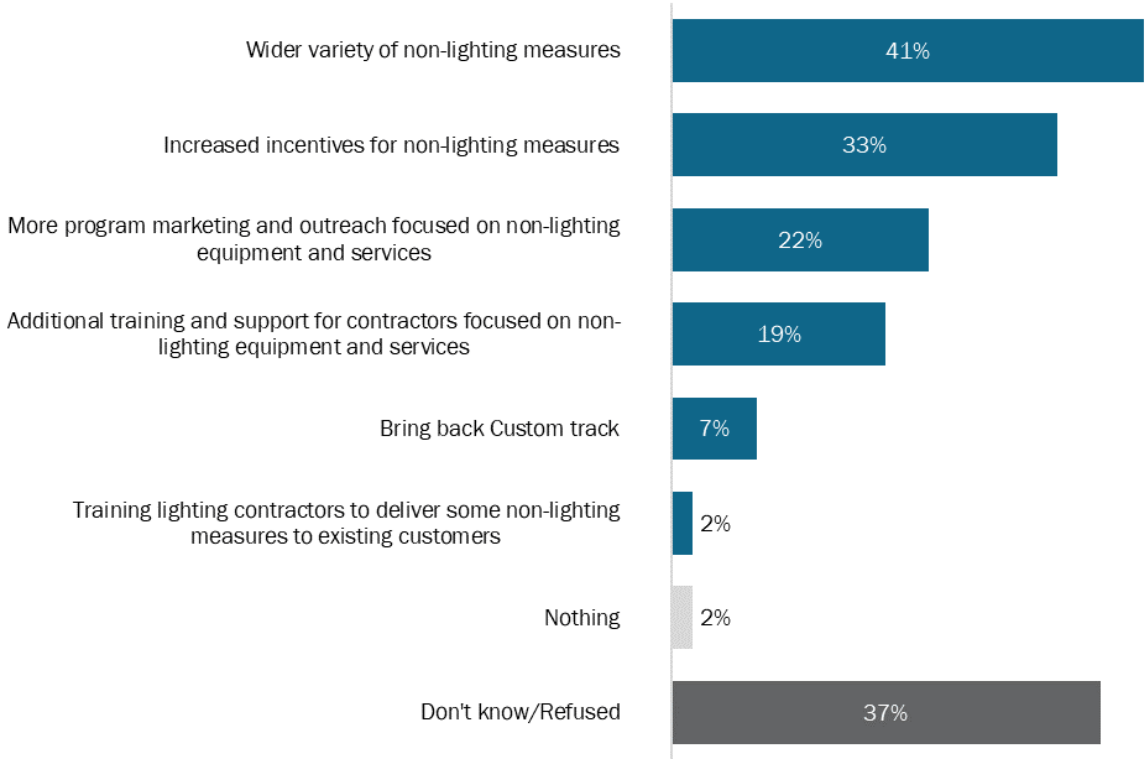
*Does not sum to 11 due to multiple responses.

Non-lighting Applications

Respondents indicated ways to increase the number of non-lighting applications to the Retrofit program, as shown in Figure D-8. Over two-fifths (41%) suggested offering a wider variety of non-lighting measures. Section 5.2.5 includes additional discussion regarding suggestions for increasing non-lighting applications.

Figure D-8: Non-lighting Application Suggestions

(Open-ended and multiple responses allowed; n=54)*



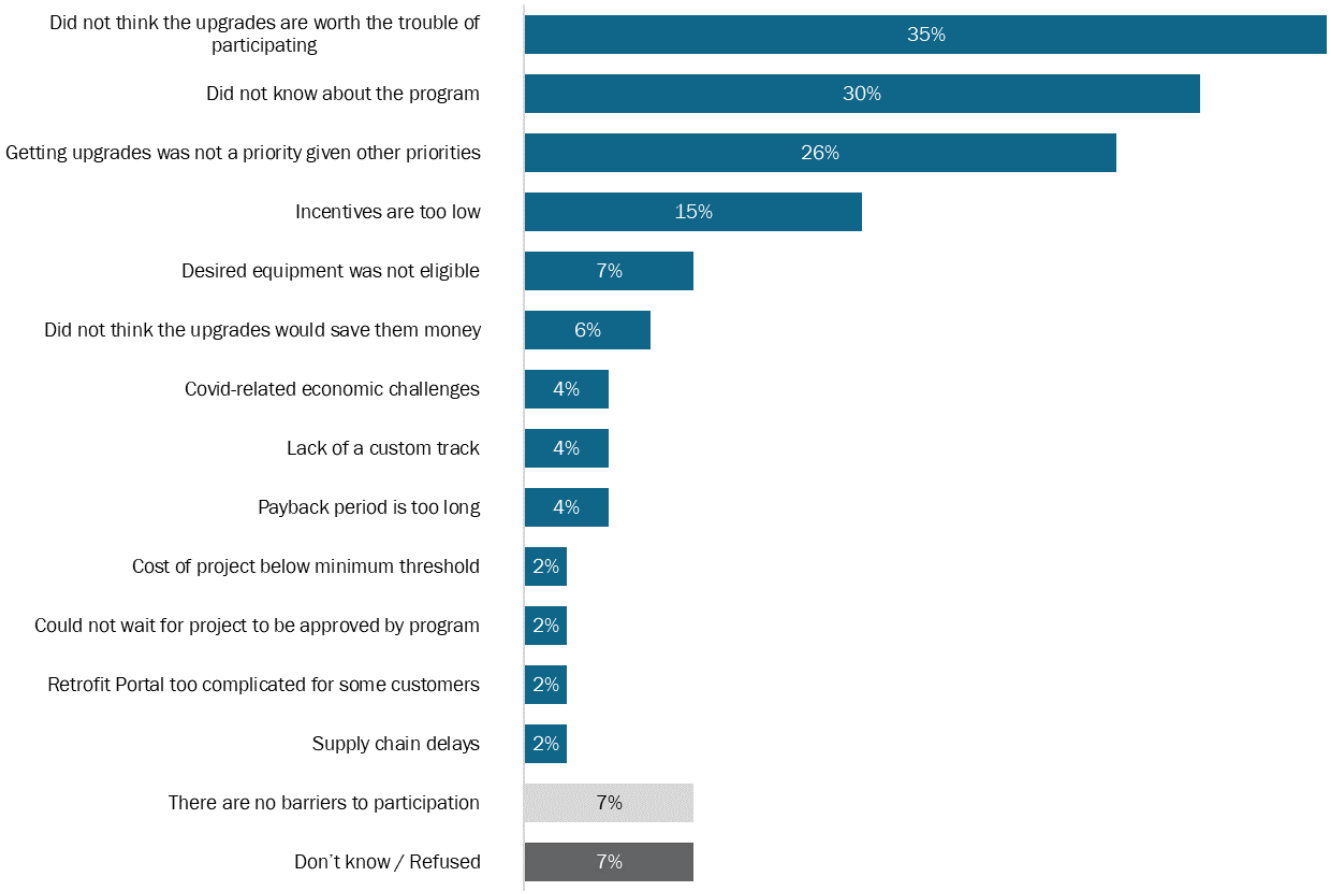
*Does not sum to 100% due to multiple responses.

Program Experience and Improvement Suggestions

Figure D-9 provides a full list of customer participation barriers, as reported by applicant representatives and contractors. Section 5.2.4 includes an additional discussion regarding program barriers.

Figure D-9: Barriers to Customer Participation

(Open-ended and multiple responses allowed; n=54)*

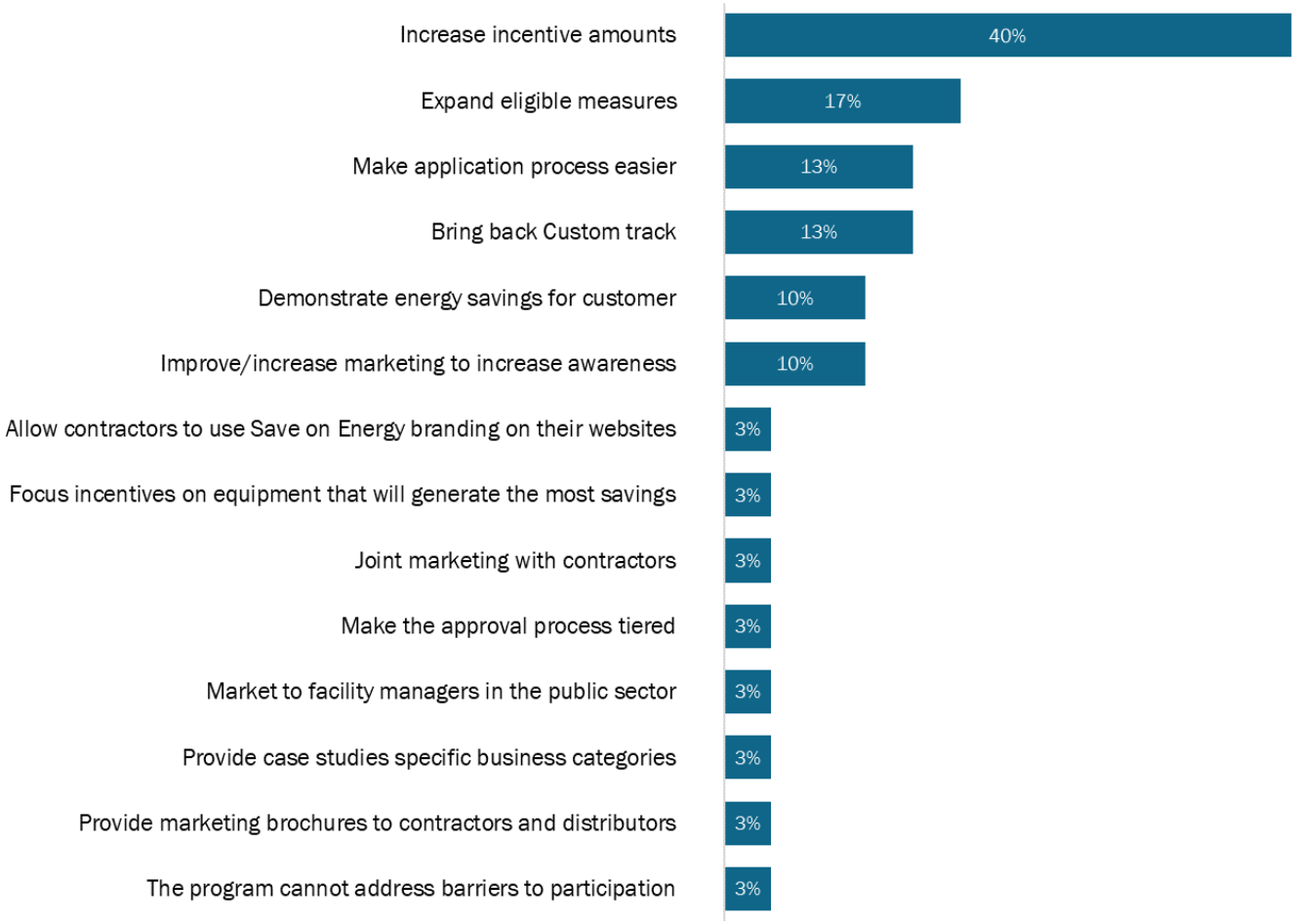


*Does not sum to 100% due to multiple responses.

Figure D-10 provides a full list of suggestions to overcome participation barriers, as reported by applicant representatives and contractors. Section 5.2.4 includes an additional discussion around overcoming customer barriers.

Figure D-10: Suggestions to Overcome Participation Barriers

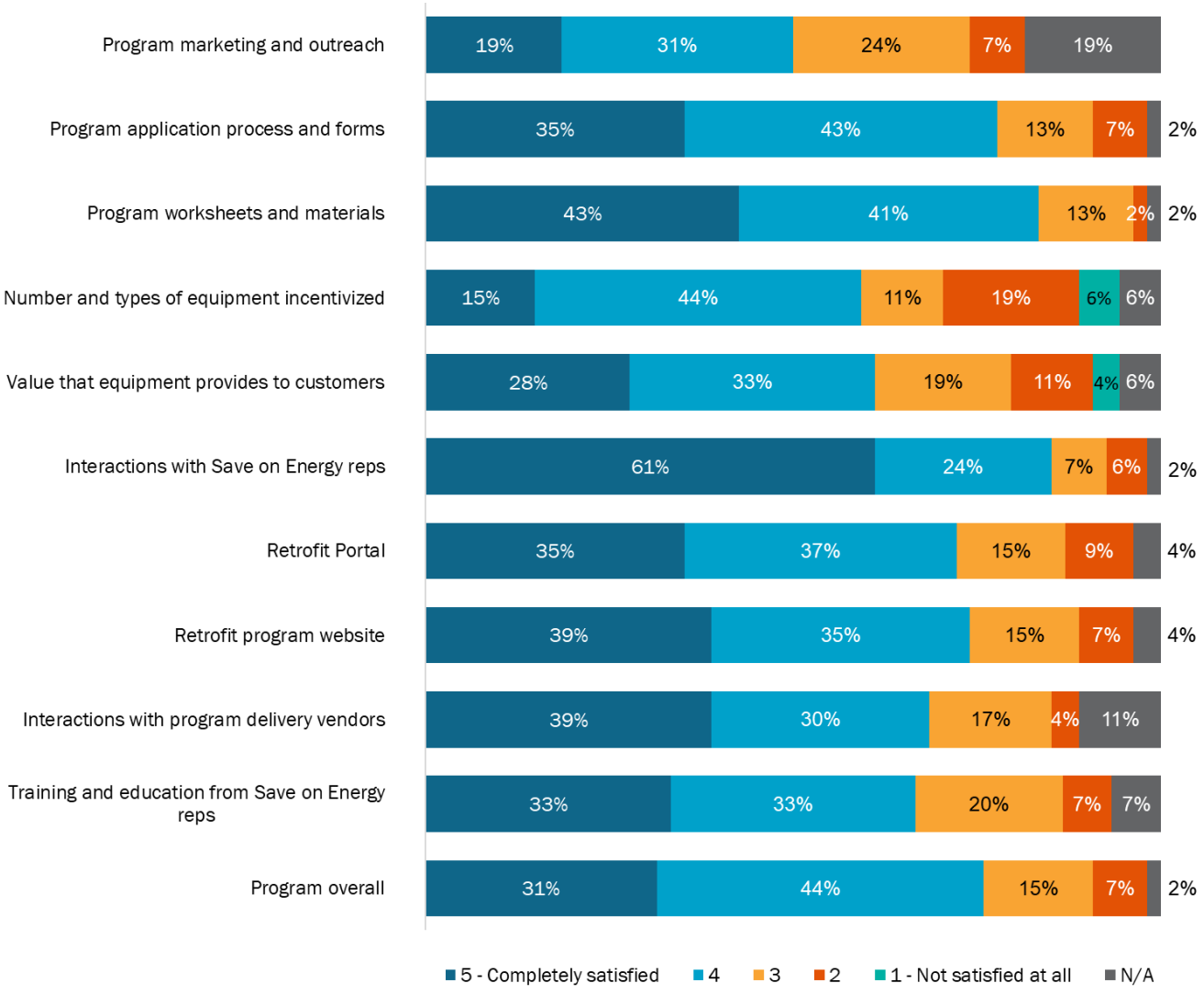
(Open-ended and multiple responses allowed; n=30)*



*Does not sum to 100% due to multiple responses.

Figure D-11 provides a full breakdown of results associated with applicant representatives' and contractors' satisfaction with various Retrofit Program aspects. Section 5.2.4 includes an additional discussion around satisfaction.

Figure D-11: Satisfaction with Aspects of the Retrofit Program (n=54)*



*May not sum to 100% due to multiple response.

The evaluation team asked respondents for suggestions on how to improve this the program going forward, as shown in Table D-4. The most common suggestions included bringing back the custom track (three respondents) and improving marketing (e.g., more social media, cross promotions) (two respondents). Section 5.2.4 includes an additional discussion around satisfaction.

Table D-4 : Suggested Improvements for Retrofit Program Overall

(Open-ended and multiple responses allowed; n=15)*

Retrofit Program Overall Improvements	Respondents
Bring back Custom track	3
Improve marketing (e.g., more social media, cross promotions)	2
Allow applicant reps to sign off on recycling declaration	2
Don't change to a midstream lighting approach	1
Ensure pre-project rules and instructions are better aligned with post project approvals to minimize changes	1
Lower minimum threshold to participate	1
Increase incentive amounts	1
Make portal more user friendly	1
More technical training for lighting contractors	1
Offer free energy audits	1
Offer incentives to contractors for customer lead generation	1
Save on Energy Staff should complete applications	1

*Does not sum to 15 due to multiple response.

Biannual Change Process

On the Save on Energy website, there is a change request form, which the public can submit a new equipment type or model for consideration in the Retrofit program. When asked if they were aware of this form, close to three-fifths of applicant representatives and contractors (57%) were unaware of it, nearly two-fifths (39%) were aware of it, and the remainder did not know or declined to answer. When respondents who were aware of the change request form were asked if they had used it, over three-fourths (76%) had not, close to one-fifth (19%) used the form, and the remainder did not know or declined to answer. When asked for suggestions on improving the change request form, one respondent suggested "Communicating the status of the request form after submitting a request."

Equipment Offerings

Table D-5 includes the full list of equipment of interest not eligible for the Retrofit program, as reported by applicant representatives and contractors. Section 5.2.7 includes an additional discussion around equipment offerings.

Table D-5 : Equipment of Interest Not Eligible for Retrofit Program Incentives

(Open-ended and multiple responses allowed; n=11)*

Ineligible Equipment	Respondents
Exterior lighting	8
ENERGY STAR appliances MURB	1
Large Air Compressors	1
LED Pylon Signs	1
Lighting Fixtures	1
Non-ENERGY STAR and DLC Lighting	1
Refrigerated LED Strips	1
Intelligent Motion Sensors	1
Wider array of screw in LED bulbs	1

*Does not sum to 11 due to multiple responses.

Table D-6 includes the full list of equipment recommended for inclusion in the Retrofit program, as reported by applicant representatives and contractors. Section 5.2.7 includes an additional discussion regarding equipment offerings.

Table D-6 : Suggestions of Equipment to Consider Adding to Program

(Open-ended and multiple responses allowed; n=28) *

Equipment Recommendation	Respondents
Exterior lighting	21%
Battery storage	11%
EV batteries/chargers	11%
Solar PV	11%
Custom Track	7%
Large compressed air systems	7%
Controls and sensors	7%
Heat pumps	7%
Solar net metering	7%
VFDs	4%
Accept design Light Consortium (DLC) 5.0	4%
Accept non-DLC lighting products	4%
Building automation system	4%
Circulation	4%
Cover energy audit costs	4%
Hot water	4%
HVAC	4%
Monitoring equipment for water measures (e.g., leak detection)	4%
Off-Grid solar LED lighting systems	4%
PL/CFL Lamps	4%
Variable refrigerant flow	4%
Sub metering	4%
Pump applications	4%

*Does not sum to 100% due to multiple response.

D.4 Additional Participant Net-to-Gross Results

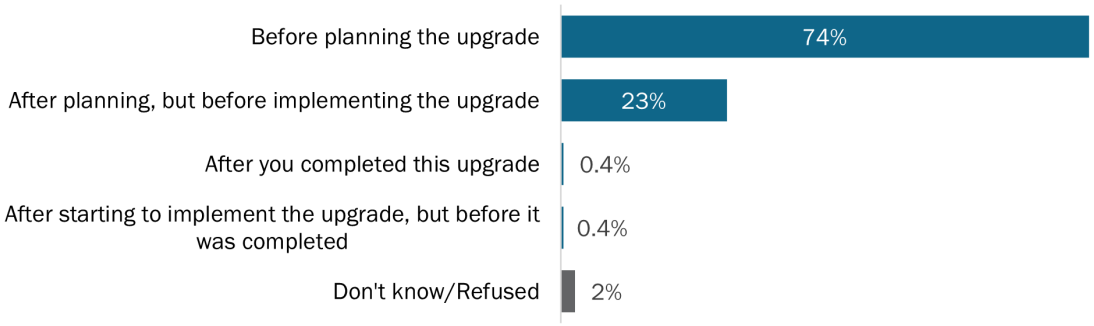
This section includes detailed FR and SO results associated with the NTG for Retrofit Program participants.

Free-ridership

The extent of FR within the program was assessed by surveying Retrofit program participants to understand their experiences and plans before they learned of the program, what they would have done in the program's absence, and how influential the program was on their decision to implement the energy-efficient upgrades.

Nearly three-fourths of respondents (74%) reported learning they could receive energy-efficiency incentives through the Retrofit Program before starting to plan upgrades, as shown in Figure D-12. This may suggest the program influenced many of these respondents' decisions to begin the project. Nearly one-fourth of respondents (23%) learned about the program after their planning started but before implementing the upgrade. While responses did not directly impact the FR score, they provided additional context for understanding participants' decision-making processes.

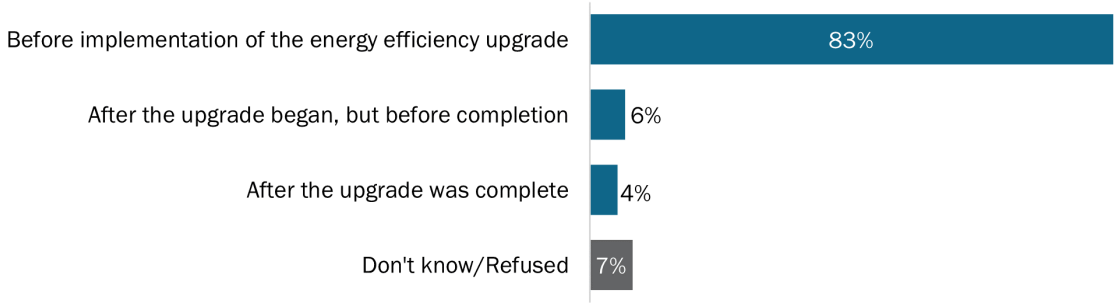
Figure D-12: When Participants First Learned about the Program (n=249)*



*Does not sum to 100% due to rounding.

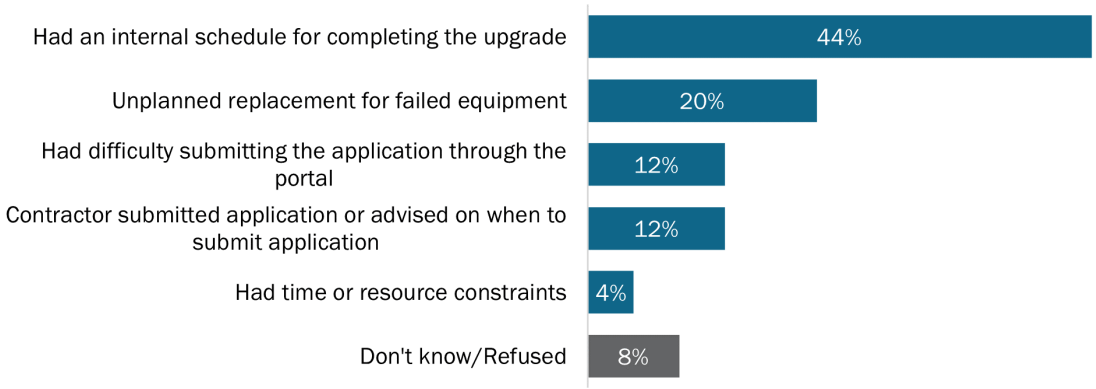
The survey then asked participants about the timing of their program application in relation to the start of their energy-efficient upgrades, as shown in Figure D-13. The majority of respondents (83%) indicated they applied before their company began implementing the upgrade, suggesting most participants applied to the program as intended. Less than one-tenth (6%) did so after their energy-efficiency upgrade began but before its completion. The remainder either did so after the upgrade was complete (4%) or did not know or refused to answer (7%). Similar to the previous question, this question was not used to calculate the FR score, yet it provides additional context regarding participant intentions.

Figure D-13: Timing of Program Application (n=249)



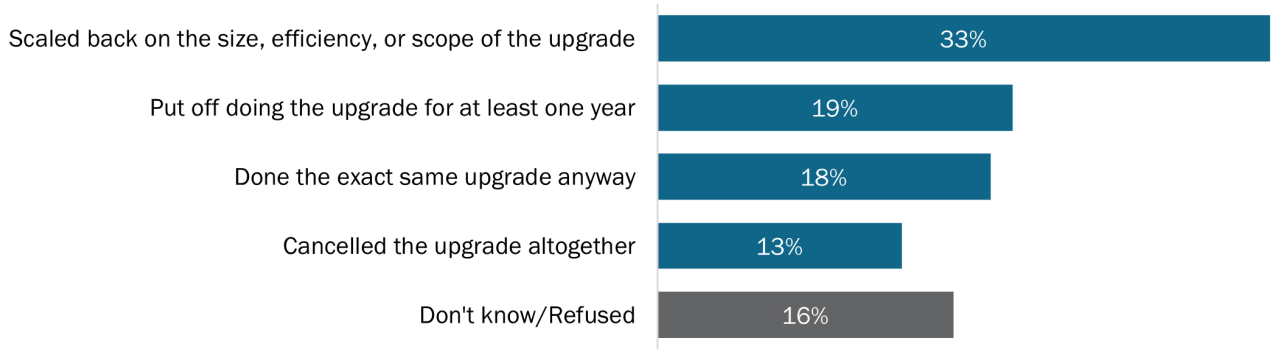
Respondents whose companies submitted a Retrofit Program application after starting an energy-efficiency upgrade were asked their reasons for doing so, as shown in Figure D-14. The most common reasons provided were sticking to an internal schedule (44%) or that an unplanned replacement occurred (20%). The responses suggest that many the respondents would have applied earlier, had it had been possible. While responses to this question did not directly impact the FR score, they provide additional context for understanding the participants' decision-making processes.

Figure D-14: Reason for Submitting After Starting Upgrade (n=25)



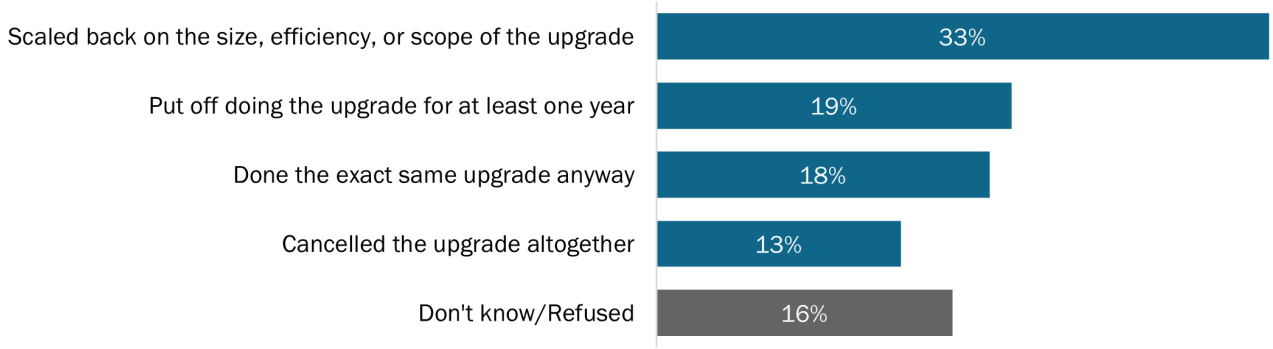
*Does not sum to 100% due to rounding.

Respondents were asked what they would have done in the program's absence, as shown in Actions in the Absence of Program (n=249)*



Close to one-fifth of respondents would have done the "exact same upgrade" anyway (18%), indicative of higher FR for these respondents. Nearly one-third of respondents (32%) showed no indication of FR as they stated they would have put off the upgrade for at least one year (19%) or cancelled their upgrade altogether (13%) had the program not been available to them. Other respondents were considered partial free-riders if they reported they would have scaled back on the size, efficiency, or scope of their project (33%) or if they did not know what they would have done in the program's absence or declined to answer (16%). The evaluation team factored responses from this participant intent question into the FR analysis.

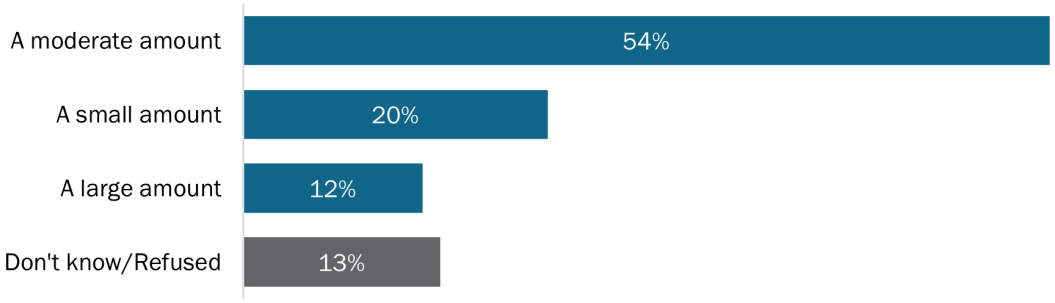
Figure D-15: Actions in the Absence of Program (n=249)*



*Does not sum to 100% due to rounding.

Respondents indicating they would have installed less energy-efficient or less expensive equipment were asked to describe how much they would have reduced the project's size, scope, or efficiency. Over one-half of these respondents (54%) would have scaled it back by a moderate amount (Figure D-16). These results indicate the program allowed these participants to increase their project's size and/or extent beyond what they would have achieved on their own. This question was not used to calculate the FR score, though it provided additional context for participant intentions.

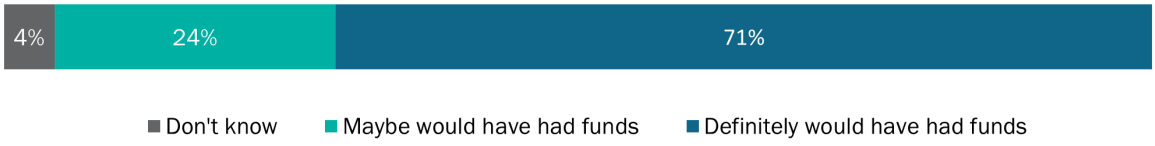
Figure D-16: Scaled Back Size or Extent of Upgrade in Absence of Program Incentives (n=83)*



*Does not sum to 100% due to rounding.

Respondents who stated they would have done the "exact same upgrade" in the program's absence were asked to confirm that they would have had funds to cover the project's entire cost without program funding, as shown in Figure D-17. Nearly three-fourths (71%) of respondents stated they definitely would have had the funds to cover all project costs, an amount more than twice as many as respondents who stated they might have had the funds (24%). This feedback indicates some degree of FR and suggests the program may have helped a portion of these participants complete projects they might not have been able to do independently. This participant intent question was factored into the FR analysis.

Figure D-17: Availability of Funds in Absence of Program Incentives (n=45)*



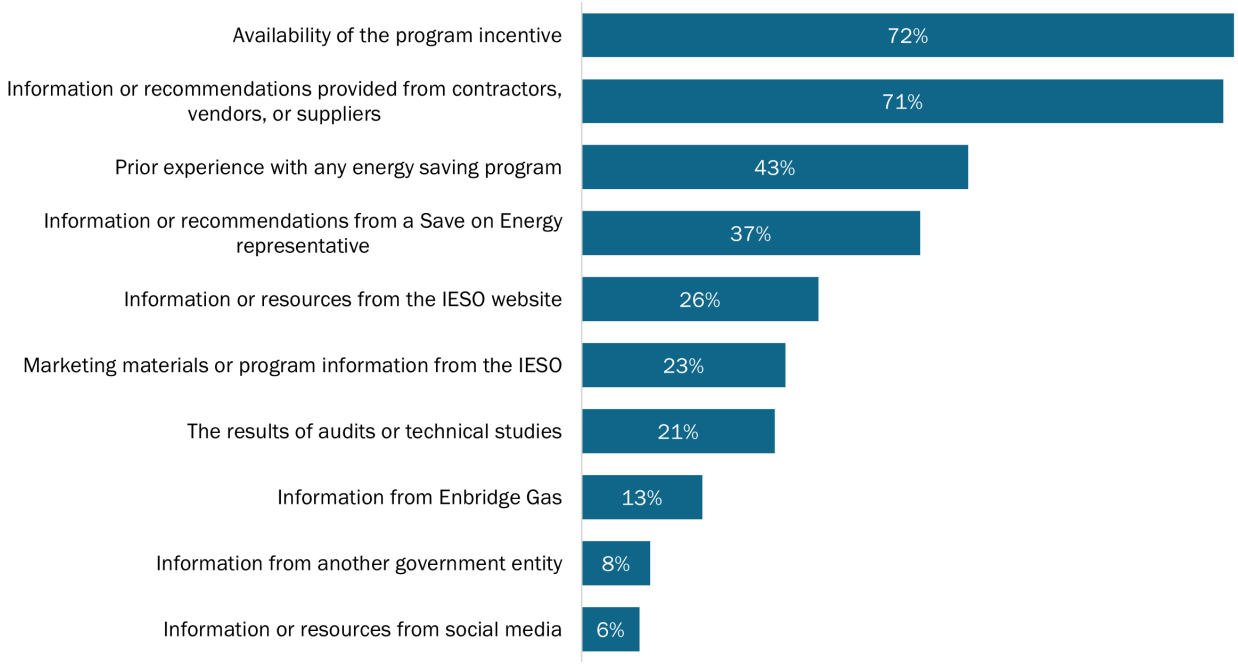
*Does not sum to 100% due to rounding.

Respondents were asked how influential various program features were on their decision to install energy-efficient equipment, as shown in Figure D-18. They rated each feature's influence on a scale from one to five, where one indicates it was "not at all influential" and five indicates it was "extremely influential." The highest-rated responses were the availability of incentives (72% with a rating of 4 or 5 for each response) and recommendations from contractors, vendors, or suppliers (71% with a rating of 4 or 5). The least most influential program feature was information or resources on social media (6% with a rating of 4 or 5). This question, which focuses on the program's influence and prior questions about customer intentions, was used to estimate the FR score.

Findings from this question emphasize the contractor, vendor, and supplier networks' strength in driving Retrofit program engagement. Their interactions with customers were valuable on their own, but, more generally, they helped familiarize customers with energy-saving programs and could influence future participation beyond the Retrofit program.

Figure D-18: Influence of Program Features on Participation (n=249)*

(Rating of 4 or 5 on a scale from 1 to 5)

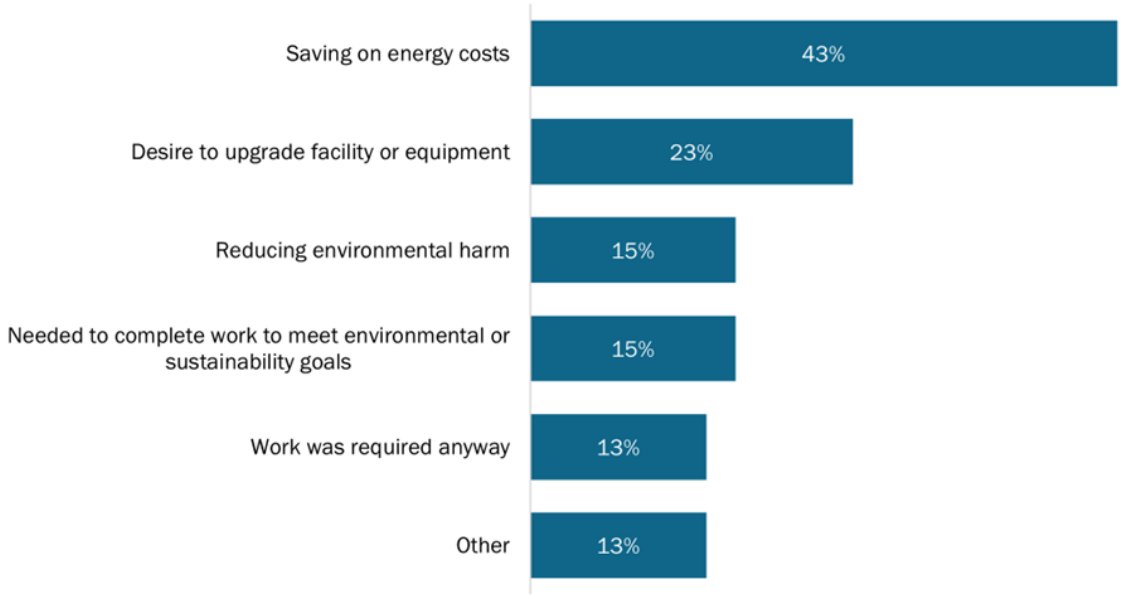


*Does not sum to 100% due to multiple responses.

Respondents were asked whether any other factors played “a great role” in influencing their organization to install energy-efficient equipment, as shown in Figure D-19. More than two-fifths (43%) reported savings on energy costs as an influential factor on their upgrade decisions. Other common responses included a desire to upgrade their facility or equipment (23%), reducing environmental harm (15%), and needing to complete work to meet environmental or sustainability goals (15%).

Figure D-19: Other Influential Factors on Upgrade Decision

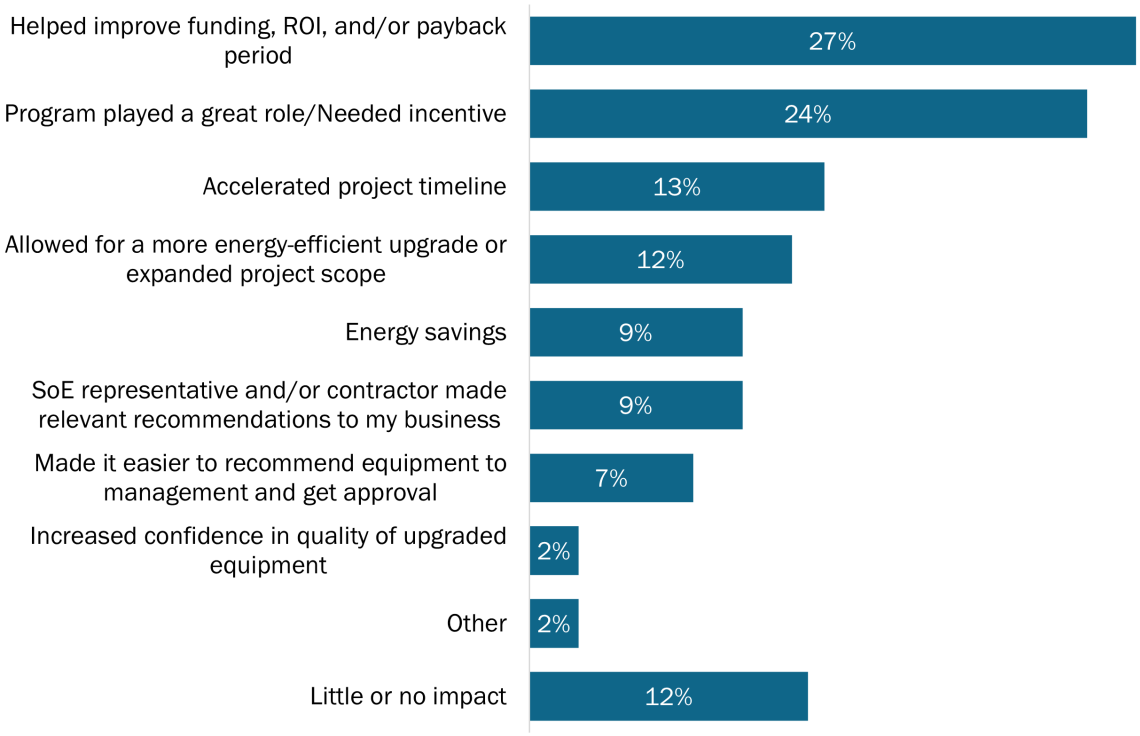
(Open-ended and multiple responses allowed; n=47)*



*Does not sum to 100% due to multiple responses.

The evaluation team asked respondents to explain, in their own words, what impact if any the financial support or technical assistance they received from the program had on their decisions to install the program-incentivized equipment when they did, as shown in Figure D-20. The most common responses included helping their funding, ROI, or payback period (27%), and the program playing a great role and that they needed the incentive (24%). Other common responses related to accelerating the project timeline (13%), the desire to complete a more energy-efficient upgrade or expanded project scope (12%), and a desire to achieve energy savings (9%).

Figure D-20: Program Impact on Decision to Install Equipment



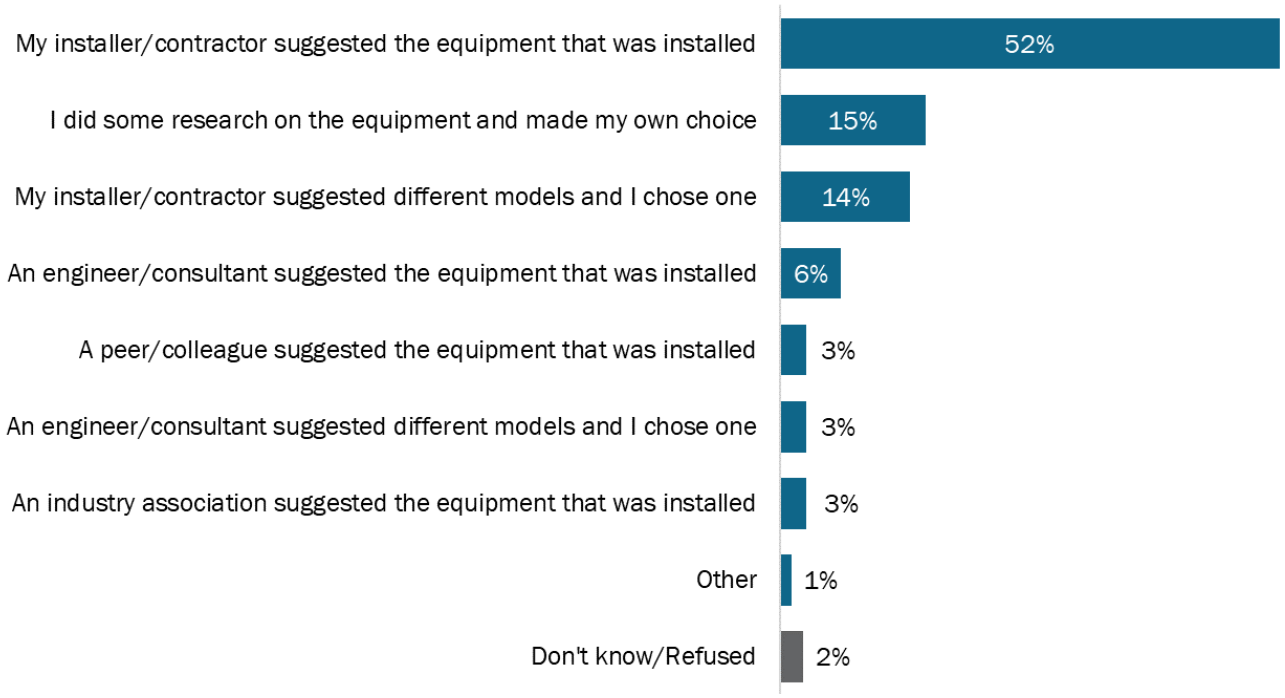
(Open-ended and multiple responses allowed; n=139)

*Does not sum to 100% due to multiple responses.

As shown in Figure D-21, over one-half (52%) of surveyed participants selected equipment based on their installer's or contractor's suggestions, which is more than three times the number of participants who chose from a shortlist of equipment models provided by their installer or contractor (14%), did their own research (15%) or followed an engineer's or consultant's suggestions (6%). This reinforces the importance of the contractors' role in helping drive customers to efficient equipment decisions.

Figure D-21: Equipment Selection Process

Open-ended and multiple responses allowed; n=248)



*Does not sum to 100% due to multiple responses.

Spillover

To estimate the SO rate, the evaluation team asked participants if they installed any energy-efficient equipment for which they did not receive an incentive following their Retrofit program participation. Nearly one-fifth of respondents (18%) reported installing new equipment. Table D-7 displays the types of non-incentivized equipment installed by companies after their Retrofit projects were completed. Some survey respondents installed multiple equipment types, with non-incentivized lighting the most common equipment installed. Over one-tenth of respondents (14%) installed lighting, more than two times the number reported by any other equipment type.

Table D-7 : Types of Upgrades Installed after Program Participation

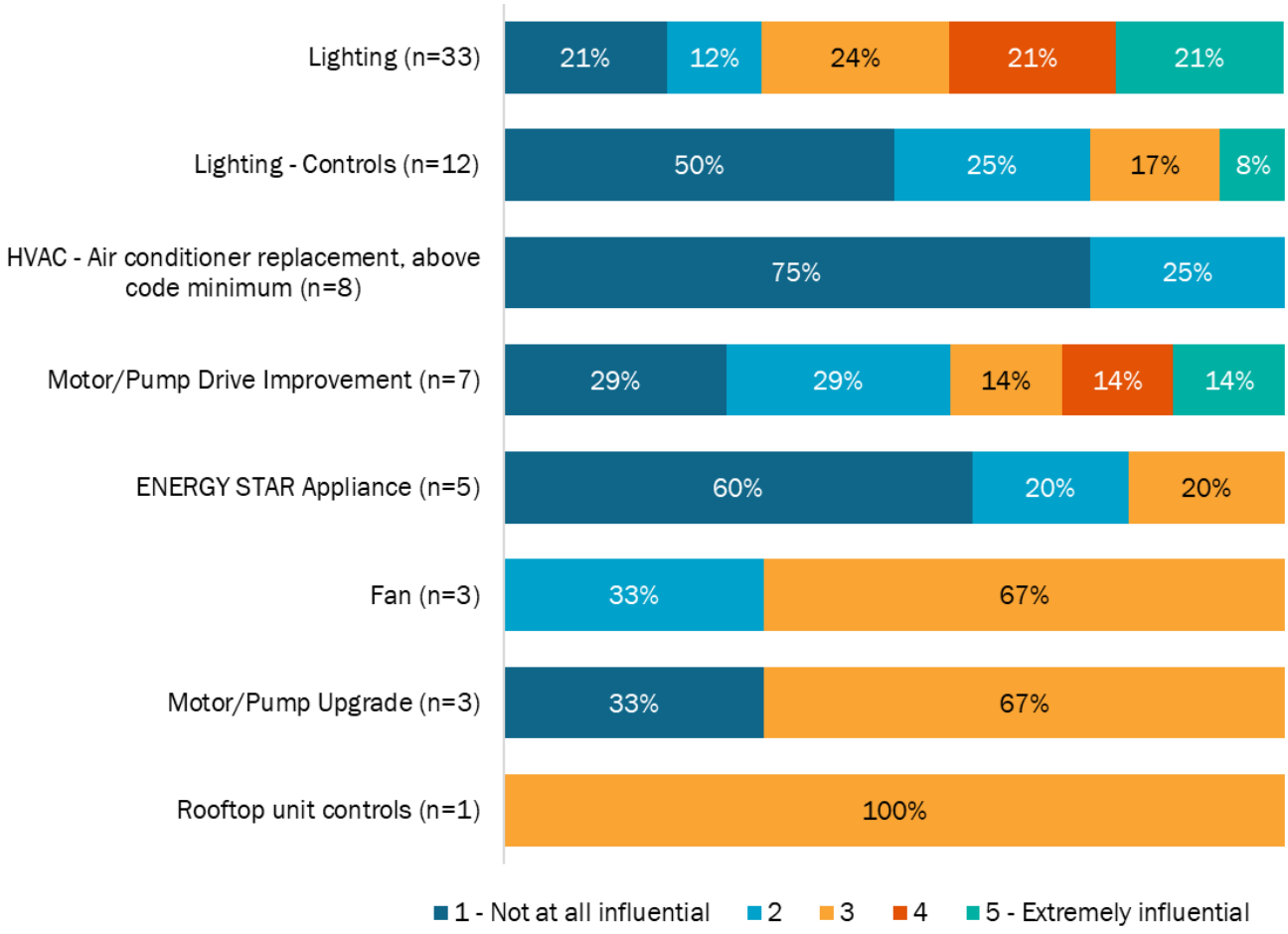
(Open-ended and multiple responses allowed; n=46)*

Upgrade	Respondents
Lighting	14%
Lighting - Controls	5%
HVAC - Air conditioner replacement, above code minimum	3%
Motor/Pump Drive Improvement	3%
ENERGY STAR Appliance	2%
Fan	1%
Motor/ Pump Upgrade	1%
Rooftop unit controls	0.4%

*Does not sum to 100% due to multiple responses.

The team then asked respondents what influence level their participation in the Retrofit program had on their decision to install additional energy-efficient equipment. Participants rated the program's influence on a scale from one to five, where one indicates the program was "not at all influential" and five indicates the program was "extremely influential." Figure D-22 displays that respondents offered varying answers regarding how important the program was in their decision to install the additional energy-efficient equipment. More than one-half of respondents who installed air conditioner replacements above code minimums, lighting controls, and ENERGY STAR appliances indicated that the program did not play a significant role in their decision (ratings below 3.0). More than one-half of respondents (66%) who installed lighting indicated the program was influential in their decision to do so (ratings of 3.0 and above).

Figure D-22: Program Influence on Equipment Installed Outside the Program (n=46)*



*May not sum to 100% due to rounding.

Participants who indicated they installed the program-influenced, non-incentivized equipment were then asked a series of follow-up questions addressing capacity, efficiency, annual HOU). These detailed questions, displayed in Table D-8 through Table D-17, were used within the NTG algorithm to attribute SO savings to each equipment installation. SO savings were primarily driven by the installation of 1,424 new linear LEDs.

Table D-8 : Type of ENERGY STAR® Appliance Installed

(Multiple responses allowed; n=2)

Spillover Appliance	Respondents
Refrigerator	2

Table D-9 : Diameter of Fans Installed

(Multiple responses allowed; n=1)

Diameter (ft)	Equipment
2 – 3.99	8
8+	24

Table D-10 : Type of Lighting Installed

(Multiple responses allowed; n=22)

Spillover Lighting	Respondents
LED linear or troffers	17
LED exterior	9
LED screw base	3
Compact fluorescent (CFL)	1

Table D-11 : LED Screw Base Wattage (n=3)

Spillover Appliance	Respondents	Equipment
11 - 20 watts	1	6
31+	1	3
< 10 watts	1	10

Table D-12 : Quantity of CFL Lamps (n=1)

Respondents	Equipment
1	50

Table D-13 : LED Exterior Lighting Mount (n=9)

Location	Respondents	Equipment
Against Building	6	99
Pole Mount	3	39

Table D-14 : Quantity of Linear LED Lamps

(Multiple responses allowed; n=3)

Respondents	Equipment	Max Installed
17	1424	312

Table D-15 : Lighting Controls and Lighting Type

(Multiple responses allowed; n=3)

Location	LED Linear	LED Exterior
Occupancy Sensor	2	2
Timer	1	0

Table D-16 : End Uses of Motor/Pump Upgrades (n=2)

Motor/Pump End Use	Efficiency	Size (hp)	Respondents	Equipment
Process	Premium	1.1 - 5.0	1	2
Process	Premium	15.1 - 30.0 hp	1	12

Table D-17: Size of Motor/Pump Drive Improvements Installed (n=3)

Motor/Pump End Use	Size (hp)	Respondents	Equipment
Variable speed drive/ VFD	1.1 - 5.0	1	12
Variable speed drive/ VFD	15.1 - 30.0	1	12
Variable speed drive/ VFD	50.1+	1	1

D.5 Additional Participant Process Results

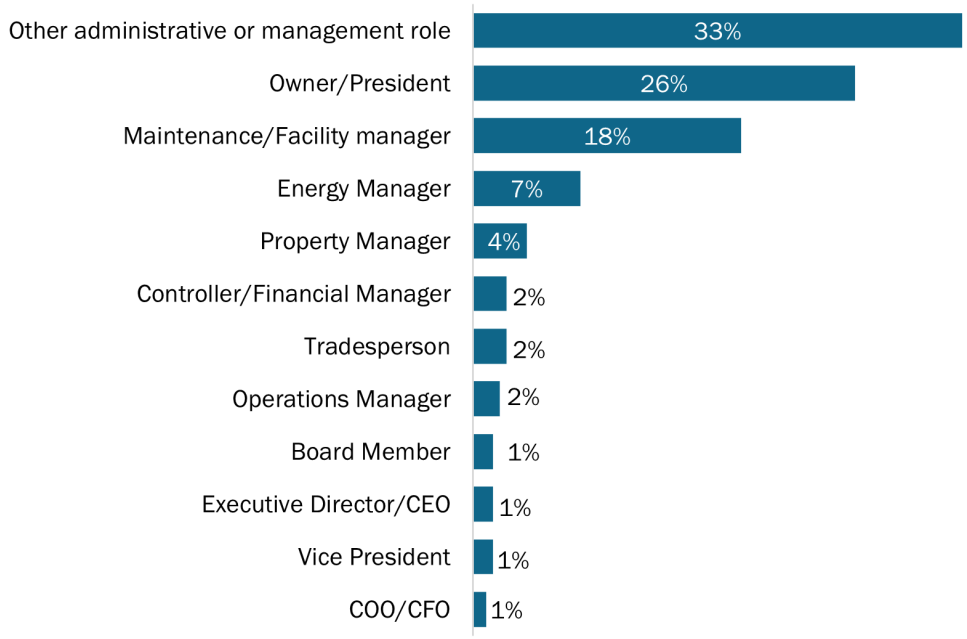
Firmographics

Respondents were asked various questions to collect information such as their job title, ownership status, responsibilities in relation to the program, and training received. Details on respondents' companies were also gathered during the survey.

As presented in Figure D-23, nearly all titles that respondents shared indicated they held either an administrative or managerial role. One-third (33%) specified an administrative or management role other than those listed in the survey. More than one-fourth of respondents (26%) were the company's owner and/or president, and nearly one-fifth were maintenance or facility managers (18%).

Figure D-23: Titles of Respondent

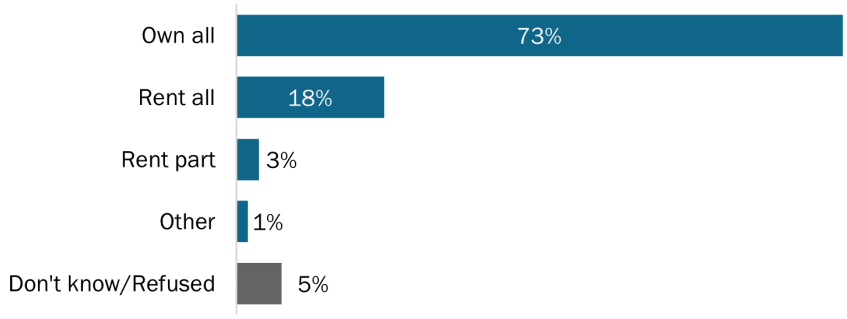
(Open-ended and multiple responses allowed; n=222)*



*Does not sum to 100% due to rounding.

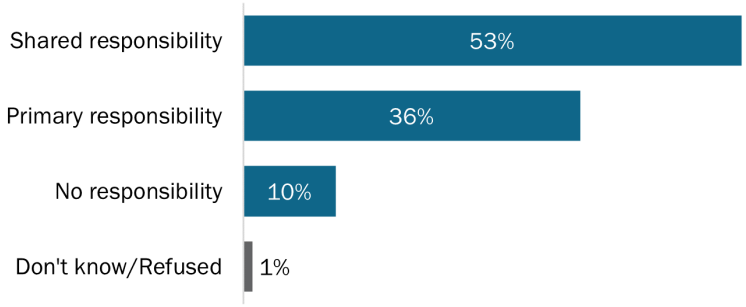
Respondents predominately owned the facilities for which they applied for incentives, as shown in Figure D-24. Close to three-fourths of respondents (73%) owned all affected facilities, while more than one in five (21%) exclusively rented all or part of the facilities.

Figure D-24: Ownership Status (n=220)



Respondents specified whether they held primary or shared responsibility for the budget and/or expenditures related to the Retrofit program project. More than one-half (53%) stated they shared such responsibilities, while more than one-third (36%) stated they had primary responsibility, as shown in Figure D-25. A relative few (10%) stated they had no responsibilities for budget and/or expenditure decisions.

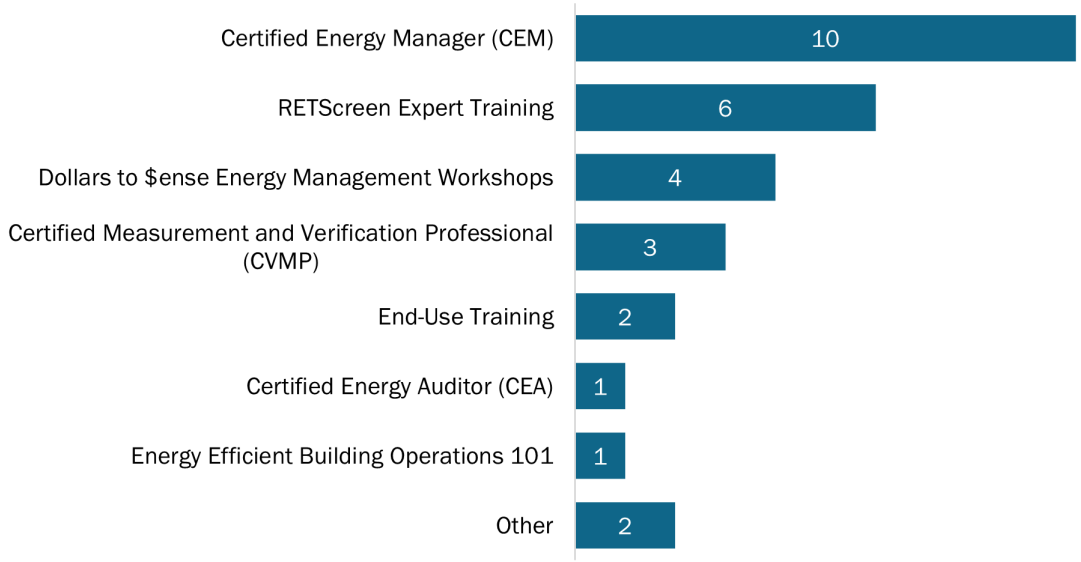
Figure D-25: Responsibility for Budget and Expenditures (n=222)



Less than one-tenth (7%) confirmed participation in the IESO's subsidized training programs. Of those with training experience, respondents most commonly referenced the Certified Energy Manager training (ten respondents), as shown in

Figure D-26. Other commonly cited training programs included RETScreen Expert Training (six respondents), Dollars to $ense Energy Management Workshops (four respondents), and the Certified Measurement and Verification Professional training (three respondents).

Figure D-26: Participation in IESO-Subsidized Training

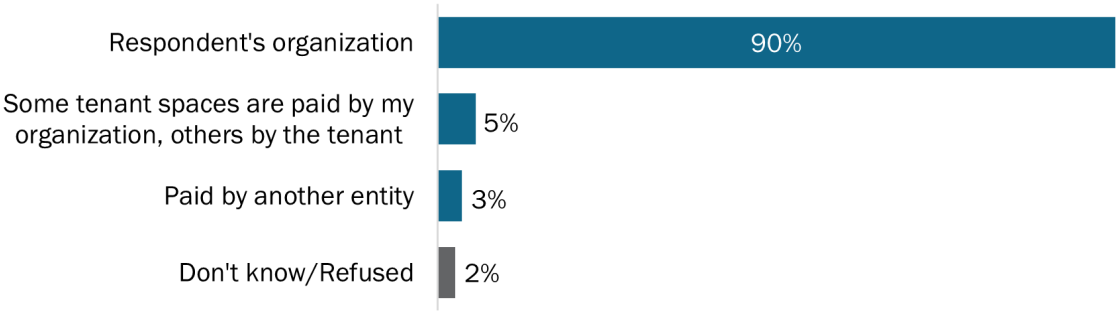


(Open-ended and multiple responses allowed; n=16)*

*Counts displayed rather than percentage due to small n. Does not sum to n=16 due to multiple responses.

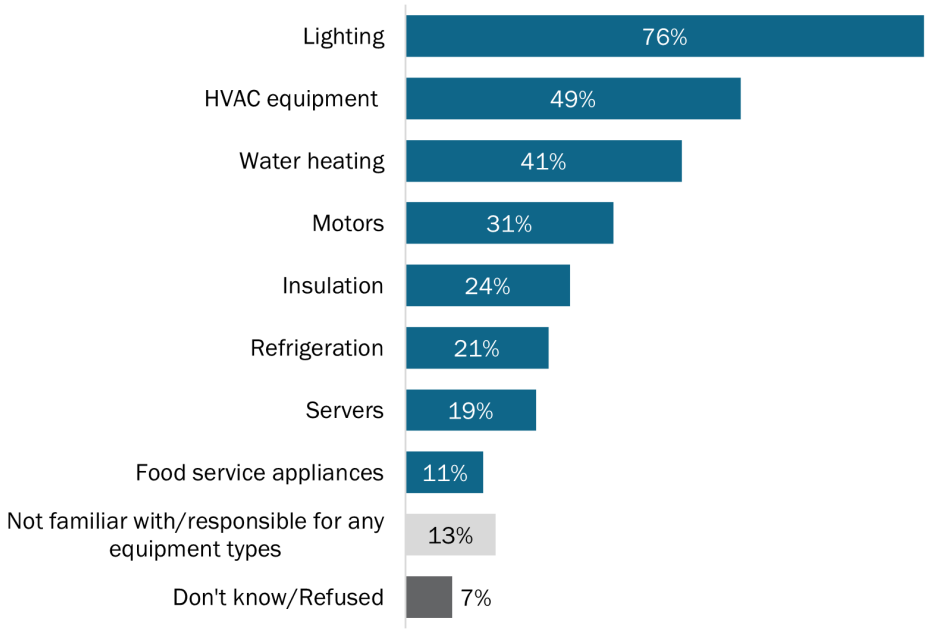
The majority of respondents (90%) indicated that their organization paid electricity bills for the facilities where program updates were made, as shown in Figure D-27. Less than one-tenth reported another entity (3%) or a mix of their organization and the tenant (5%) paid the electricity bills.

Figure D-27: Entity that Pays the Facility's Electricity Bills (n=220)



As shown in Figure D-28, more than three-fourths of respondents were most familiar with or responsible for lighting maintenance (76%). Respondents also commonly reported that they were familiar with or responsible for HVAC equipment maintenance (49%), water-heating equipment (41%), and motors (31%) at the facilities where the program upgrades were made. More than one-tenth of respondents (13%) were not familiar with or responsible for any equipment maintenance.

Figure D-28: Familiarity with or Responsibility for Equipment Maintenance

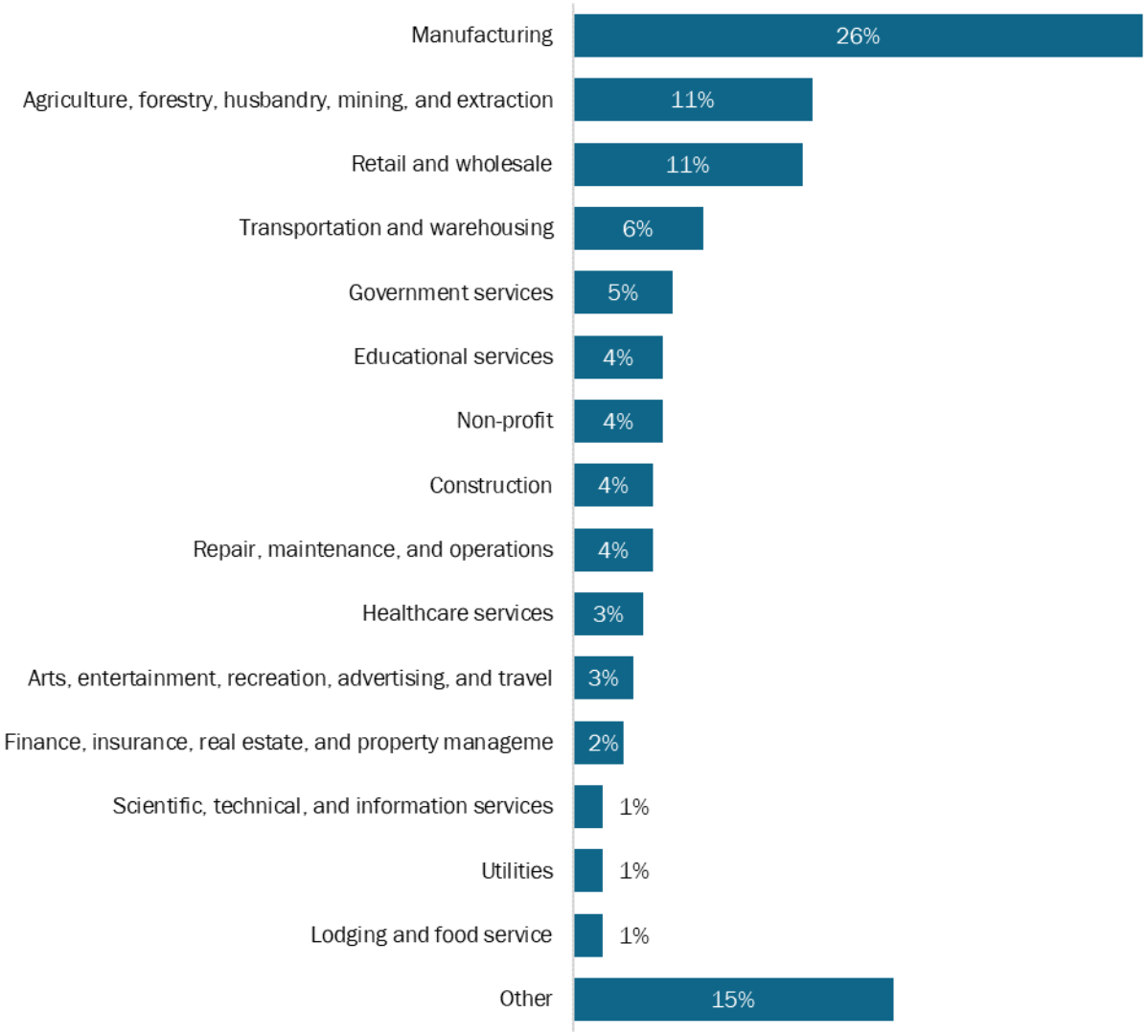


(Open-ended and multiple responses allowed; n=219)

*Does not sum to 100% due to multiple responses.

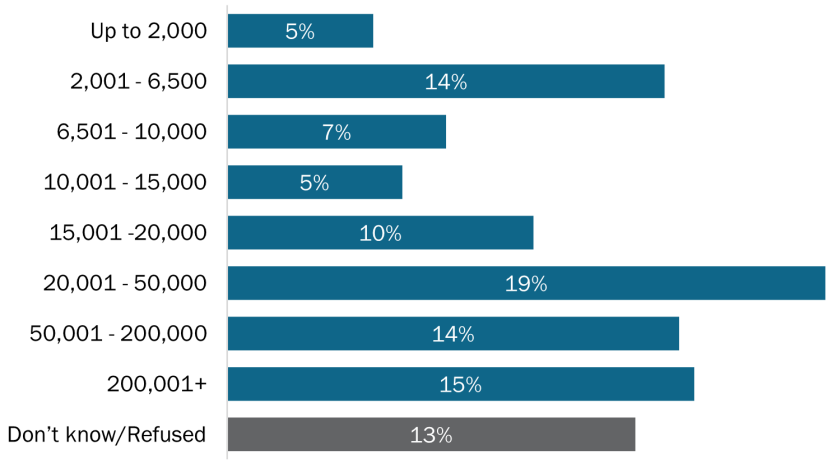
Respondent business categories varied, as presented in Figure D-29. More than one-fourth (26%) worked in manufacturing, and over one-tenth (each) worked in agriculture, forestry, husbandry, mining, or extraction (11%) and retail and wholesale (11%).

Figure D-29: Respondents' Business Category (n=219)



Participants were asked to provide their facilities' total area. Most-frequently, facility sizes ranged between 20,001 to 50,000 sq. ft. (19%) and 200,001+ sq. ft. (15%), as shown in Figure D-30.

Figure D-30: Total Square Footage for All Buildings (n=220)*

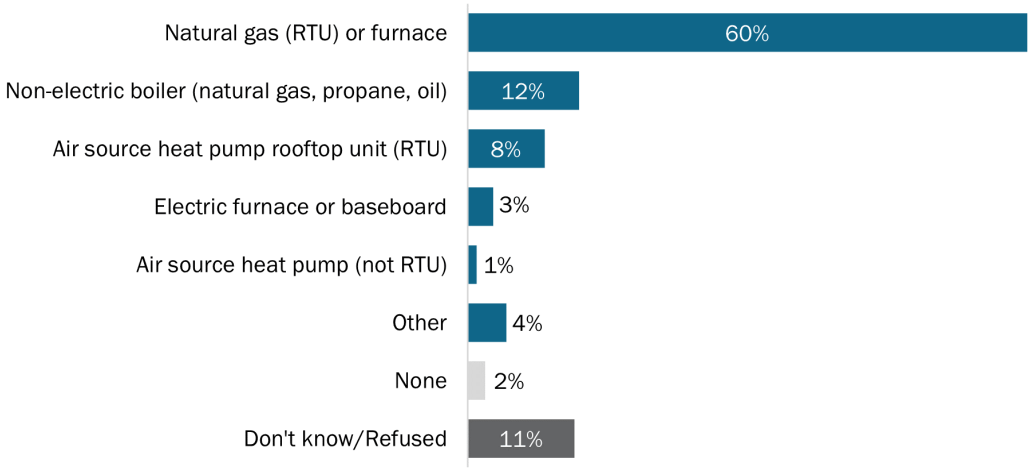


*Does not sum to 100% due to rounding.

Three-fifths of participants (60%) reported a natural gas RTU or furnace as a primary heating source at their facilities. More than one-tenth (12%) reported heating their facilities with a non-electric boiler, as shown in Figure D-31. On the cooling side, nearly two-thirds (64%) reported an air conditioner or air-source heat pump RTU, followed by one-tenth (10%) with chiller systems, shown in Figure D-32.

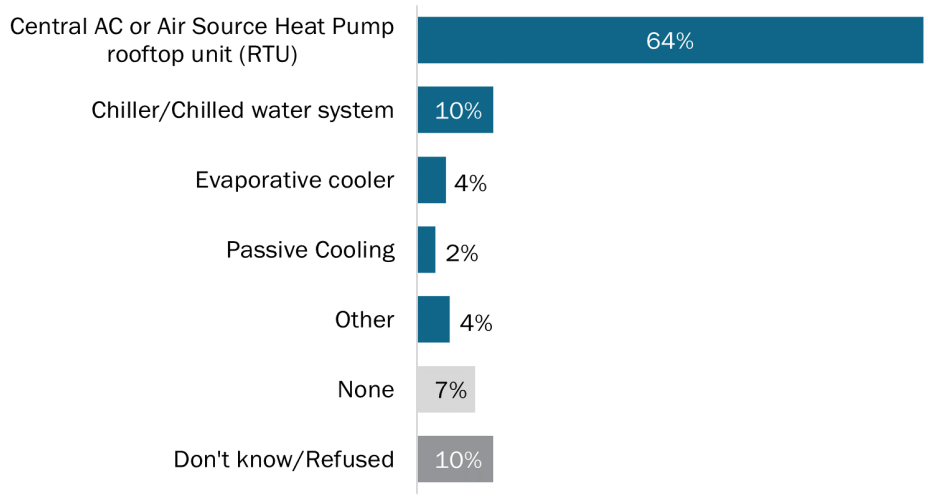
Figure D-31: Facility Primary Heating System

(Open-ended and multiple responses allowed; n=220)*



*Does not sum to 100% due to multiple responses.

Figure D-32: Facility Primary Cooling System



Open-ended and multiple responses allowed; n=220)*

*Does not sum to 100% due to multiple responses.

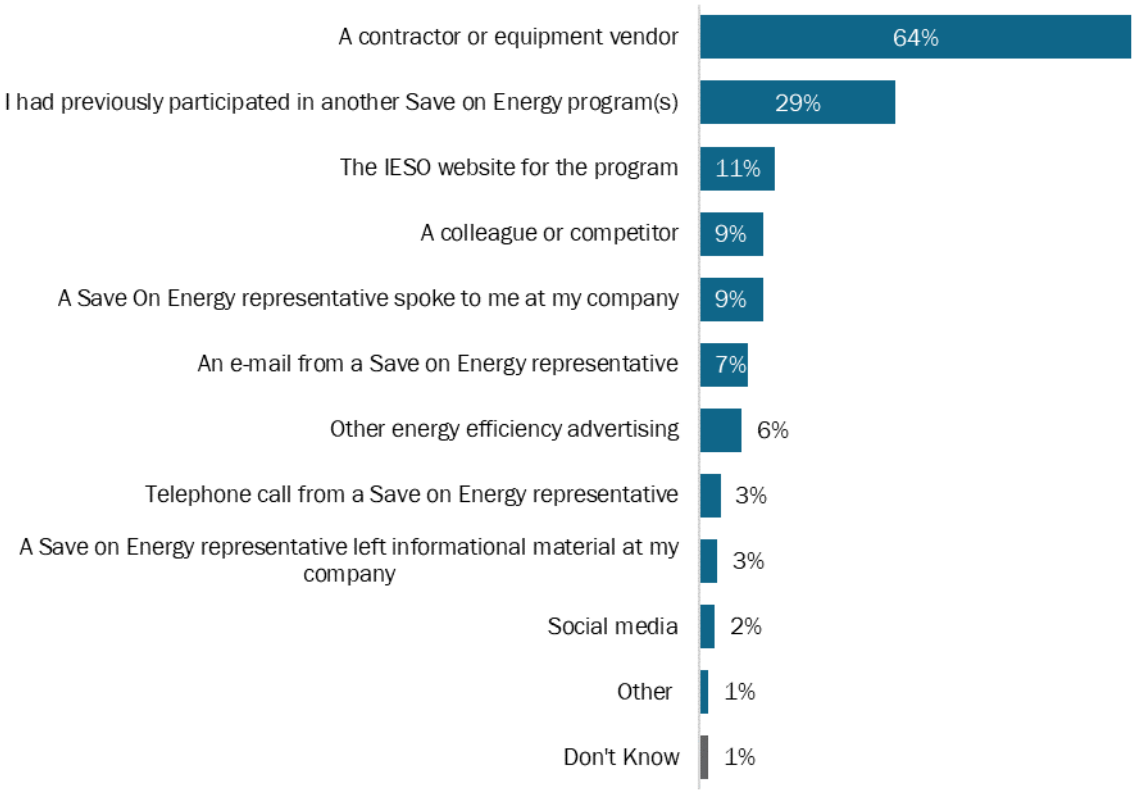
Program Awareness

How Respondents Heard About the Program

Figure D-33 lists ways that respondents heard about the program, with the most common way respondents heard about the program was through a contractor or equipment vendor (64%). Section 5.3.2 includes a more in-depth discussion of program awareness.

Figure D-33: Sources of Program Awareness

(Open-ended and multiple responses allowed; n=222)*



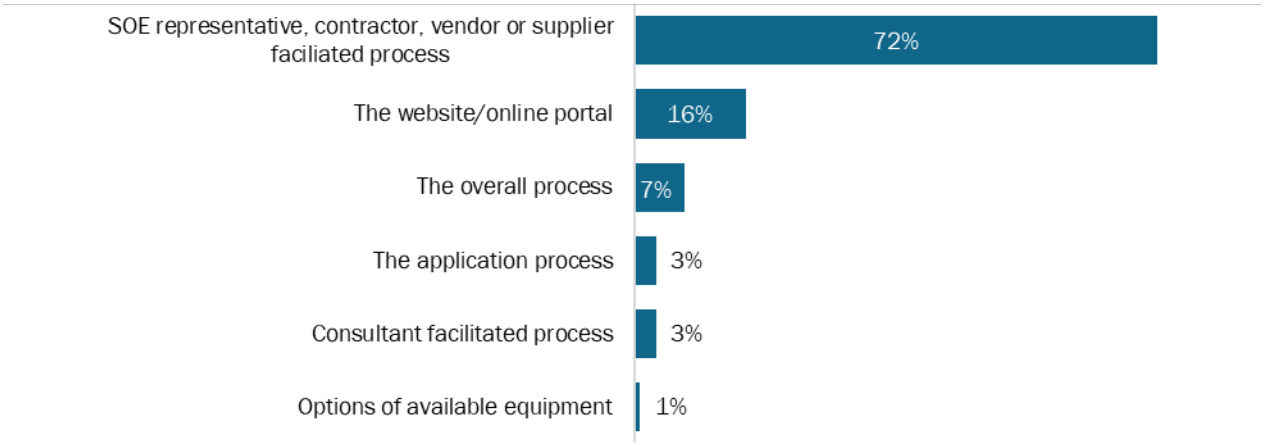
* Does not add to 100% due to multiple responses.

Aspects of the Save on Energy Retrofit Program that Made It Easy to Participate

Figure D-34 lists aspects that respondents named as facilitating their program participation. Most respondents (72%) stated that a Save on Energy representative, contractor, vendor, or supplier facilitated the process. Section 5.3.2 includes a more in-depth discussion of these aspects.

Figure D-34: Aspects that Facilitated Participation

(Open-ended and multiple responses allowed; n=116)*

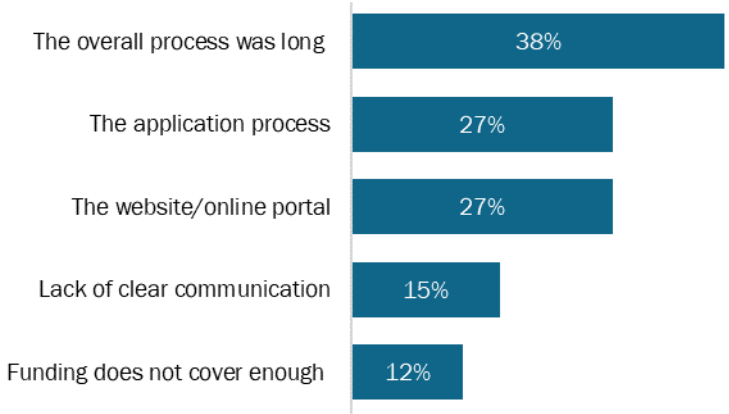


* Does not add to 100% due to multiple responses.

Save on Energy Retrofit Program Aspects that Made Participation Less Easy, as shown in Figure D-35, including aspects that respondents named as complicating their participation. The length of the overall process was the most common response to program aspects that made it less easy to participate in. Section 5.3.2 includes a more in-depth discussion of these aspects.

Figure D-35: Aspects that Complicated Participation

(Open-ended and multiple responses allowed; n=26)*

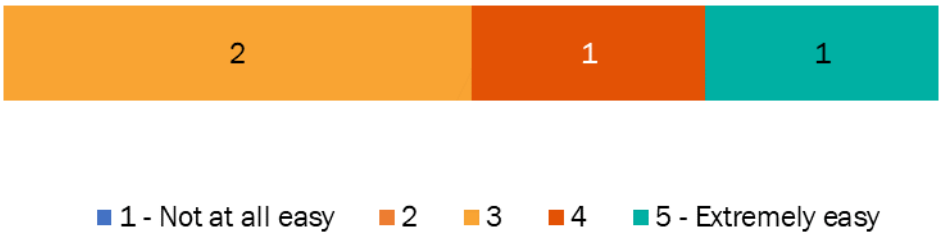


* Does not add to 100% due to multiple responses.

Change Request Form

Respondents were asked to rate the ease of using the change request form on a scale of one to five, where one means “not at all easy” and 5 means “extremely easy” Figure D-36).

Figure D-36: Change Request Form Ease of Use (n=4)



All four respondents indicated that the change request form was easy or somewhat easy to use (ratings of 3.0 and above). Section 5.3.3 includes a more in-depth discussion on this topic.

Decision to not Install Additional Energy-Efficient Equipment or Services

Table D-18 includes a full list of the average percentage of equipment cost that respondents would have required the program to cover for each equipment type installed. Respondents stated that, on average, they would have needed the program to cover anywhere between 40% to 50% of the equipment cost if they were to have installed that equipment. Section 5.3.4 includes a more in-depth discussion on this topic.

Table D-18: Percent of Cost Needed to Cover Additional Equipment Installations

(Open-ended and multiple responses allowed; n=49)*

Equipment	Average % Cost
ENERGY STAR® Appliance (n=7)	52%
Fan (n=12)	54%
Air conditioner replacement, above code minimum (n=19)	52%
Lighting (n=11)	43%
Lighting Controls (n=9)	54%
Motor/Pump Upgrade (n=10)	56%
Motor/Pump Drive Improvement (VSD and Sync Belt) (n=9)	44%
Other (n=10)	42%

* Does not sum to n=49 due to multiple responses.

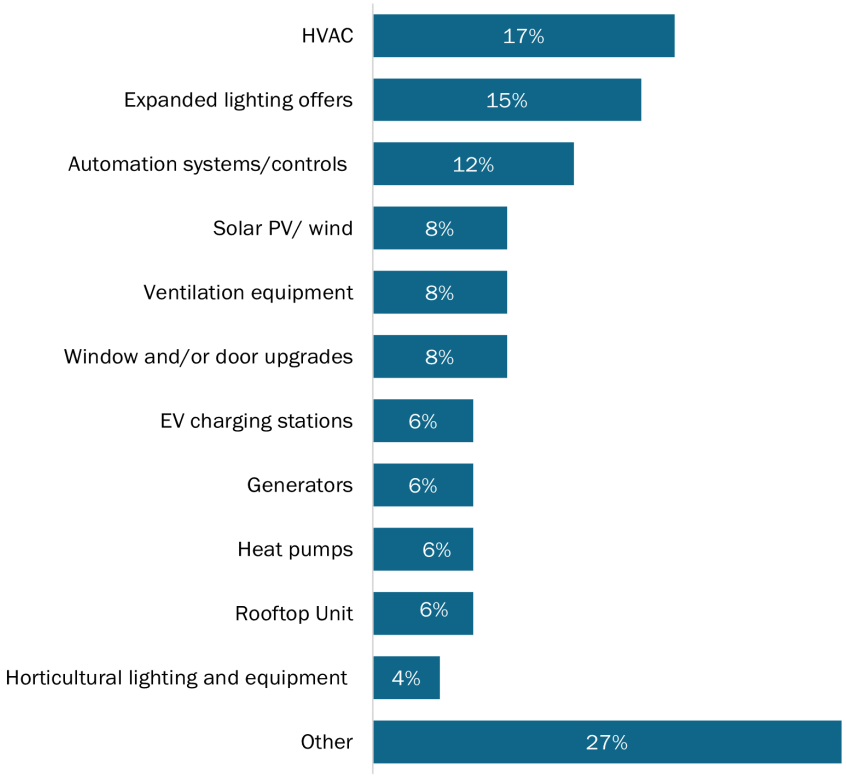
Recommendations for Retrofit Program Improvements

Recommended Equipment and Services

Figure D-37 includes a full list of additional energy-efficient equipment or services that respondents recommended for inclusion in the Retrofit Program during future years. Responses in the other category included the following: circulation fans, co-generation equipment, DHW tanks, electrical panels, ergonomic equipment, freezer/cooler, fuel, geothermal, industrial design, motor replacements, power factor correction, resistance welding machines, roof replacements, and VFDs. Section 5.3.5 includes a more in-depth discussion regarding these equipment recommendations.

Figure D-37: Recommended Energy-Efficient Equipment or Services to Improve the Retrofit Program

(Open-ended and multiple responses allowed; n=52)*

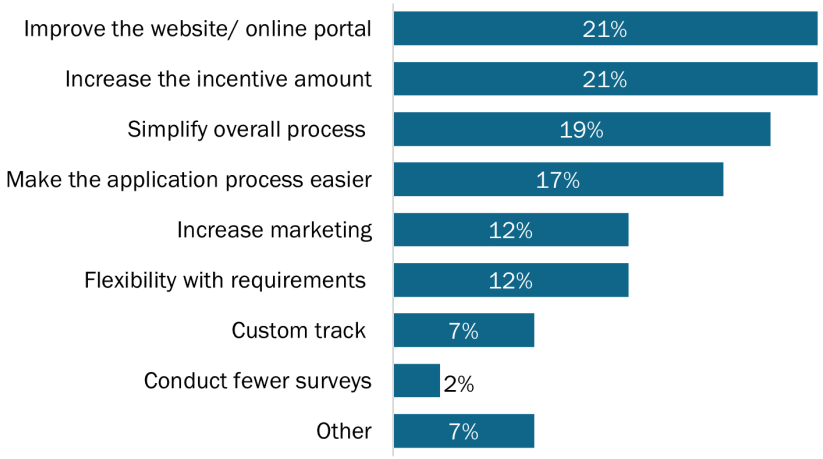


* Does not sum to 100% due to multiple responses.

Additional Recommendations for Program Improvement

Figure D-38 includes a full list of recommendations respondents provided to improve the Retrofit program. Responses in the Other category included the following: collaboration between utilities for thermal heating projects, a compressed air audit, and more commissioning. Section 5.3.5 includes a more in-depth discussion regarding these responses.

Figure D-38: Recommendations to Improve the Retrofit Program



(Open-ended and multiple responses allowed; n=42)

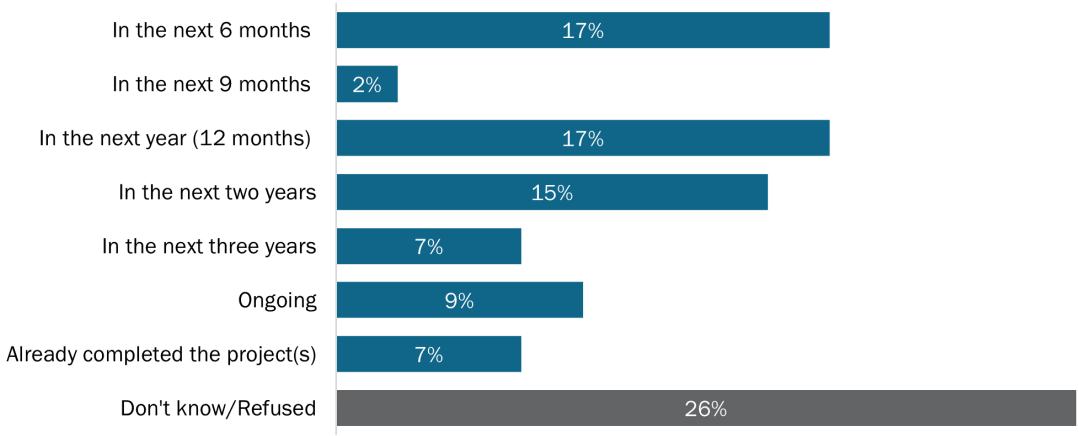
* Does not sum to 100% due to multiple responses.

Electrification Projects

Timelines for the Completion of Electrification Projects

Figure D-39 lists timelines when respondents expected to complete their electrification projects. Section 5.3.6 includes a more in-depth discussion on these projects' timing.

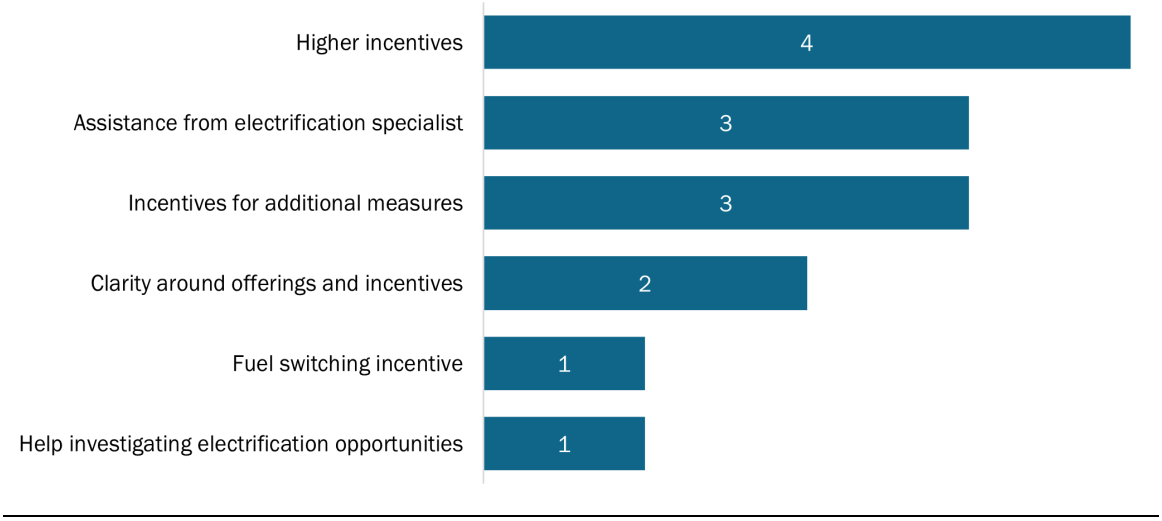
Figure D-39: Timing for Completion of Electrification Projects (n=46)



Recommendations on Ways to Aid in Electrification Projects

Figure D-40 includes a full list of recommendations provided by respondents on assistance that would be helpful for completing their electrification projects. Most commonly, respondents cited providing higher incentives (four respondents). A more in-depth discussion on these recommendations can be found in Section 5.3.6.

Figure D-40: Electrification Project Assistance Recommendations



(Open-ended and multiple responses allowed; n=13)*

*Counts displayed rather than percentage due to small n. Does not sum to 13 due to multiple responses.

Appendix E Job Impacts Methodology

This appendix provides a detailed breakdown of the Jobs Impact Evaluation methodology.

E.1 Developed Specific Research Questions

The first step in modeling the job impacts from the Retrofit program was to determine which specific research questions (RQs) the model would answer. In a scenario without the Retrofit program's existence, customers received electricity from the IESO and paid for it via the monthly billing process. Implementing the Retrofit program introduced a set of economic supply and demand shocks to different economy sector. The following four research questions illustrate these shocks:

1) **What job impacts arise from new demand for energy-efficiency measures and related program delivery services?** Funds collected for the Retrofit program generated demand for efficient equipment and appliances. Additionally, they generated demand for services related to program delivery, such as general overhead for program implementation and staffing. This demand created jobs among firms supplying these products and services. Third-party implementers collected funds from the IESO to cover portions of project costs, while participants covered the remainder of costs.

2) **What job impacts arise from business reinvestments?** Once energy-efficient equipment had been installed, customers realized annual energy savings for the useful life of the measures. Businesses could choose to use this money to pay off debt, disburse to shareholders as dividends, or reinvest in the business. This additional money and the decision whether to save or spend poses implications for additional job creation. For example, additional business spending on goods and services generates demand that can create jobs in other economic sectors.

3) **What job impacts arise from funding the energy-efficiency program?** IESO energy-efficiency programs were funded via volumetric bill charges for all customers—both residential and nonresidential. This additional charge could reduce the money that households realized for savings and for spending on other goods and services, resulting in a negative impact on jobs in the Canadian economy.

4) **What job impacts arise from reduced electricity production?** The energy-efficient measures allowed businesses to receive the same benefit while using less electricity. As a whole, the program would reduce the electricity demand in the commercial sector. This reduced demand could have upstream impacts on the utility industry (for example, generation) and related industries, such as companies in the generator fuel supply chain.

E.2 Developed Model Inputs

Modelling job impacts then moved to a second step: gathering data required for the StatCan IO model to answer each research questions. Model input data included dollar values of the exogenous shocks from program implementation. Data sources included the following:

1) **Demand for energy efficiency measures and related program delivery services:** The StatCan IO Model divides the Canadian economy into 240 industry classifications and 500 SUPCs. Each measure installed through of the program was classified into one SUPC. The evaluation team calculated the dollar value for each product-related demand shock using project cost and measure savings data from the impact evaluation (see Appendix F.1). The team also classified services that were part of the implementation process into SUPCs. These services were entirely program administrative services, the value of which was obtained from program budget actuals.

   The team had to specify the amount of each demand shock attributed to labour versus non-labour. For the product categories, the team used a representative sample of invoices to estimate average labour versus non-labour cost proportions. For the service categories, the IO model contained underlying estimates that defined the portion of labour versus overhead (non-labour).

2) **Business energy bill savings:** The team calculated this value for the model as the net present value (NPV) of the discounted future stream of energy bill savings by participants. The team calculated this by multiplying net energy savings (in kWh) in each future year by that future year's retail rate ($/kWh). The calculation was performed for each future year, through the end of the measure's EUL. Savings beyond the EUL were assumed to be zero. Project-level net energy savings were obtained using results from the impact evaluation and had already been accounted for through other calculation parameters (i.e., discount rate, measure EULs, and retail rate forecasts).

3) The team identified customers' intentions regarding whether to reinvest, save, or distribute to owners/shareholders money saved on energy bills via the following **short** section of the participant surveys:

   J1. *How do you anticipate your company will spend the money it saves on its electricity bill from the energy efficient equipment upgrades?*

   1. *Pay as dividends to shareholders or otherwise distribute to owners*
   2. *Retain as savings*
   3. *Reinvest in the company (labour/additional hiring, materials, equipment, reduce losses, etc.)*
   4. *Split – Reinvest and pay as dividends/retain as savings*

   96. Other, please specify:

   98. Don't know

99. Refused

J2. Do you anticipate the distribution of these electricity bill savings to be treated differently than any other earnings?

1. *Yes – More distributed to shareholders/owners*
2. *Yes – More to savings*
3. *Yes – More to reinvestment*
4. *No*

98. Don't know

99. Refused

J3. Approximately what would be the split between distribution, retention, and reinvestment of money saved on electricity bills? [ALLOW MULTIPLE RESPONSE OPTION]

1. *Percent distribute [NUMERIC RESPONSE BETWEEN 0 AND 100]*
2. *Percent save/retain earnings [NUMERIC RESPONSE BETWEEN 0 AND 100]*
3. *Percent reinvest [NUMERIC RESPONSE BETWEEN 0 AND 100]*

For estimating job impacts, the amount of bill savings that a business would reinvest served as the key input value rather than paying down debt or redistributing to shareholders.

4) **Retrofit funding:** the IESO fund its energy-efficiency programs through a volumetric charge on electricity bills;volumetrically, in 2021, residential customers accounted for 35% of consumption, and nonresidential customers accounted for 65%. The overall program budget, distributed between these two customer classes by these percentages, served as input values for the analysis.

5) **Reduced electricity production:** The NPV of retail savings (estimated as part of RQ2) also provided the input for examining potential impacts of producing less electricity.

E.3 Run Model and Interpret Results

Determining total job impacts from the Retrofit program required considering possible impacts from each of the four shocks represented by the research questions. Addressing required three runs of the StatCan IO model, as certain shock components could be consolidated; others could be addressed without full runs of the model. The following three shocks were modelled as follows:

1) Demand shock, as outlined in RQ1, representing the demand impact of energy-efficiency products and services resulting from the Retrofit program.

2) Business Reinvestment shock, representing the net amount of additional spending that the commercial sector would undertake, as described in RQ2. This was estimated by taking the

NPV of energy bill savings and subtracting the amount of project costs covered by participants.

3) Household Expenditure shock, representing the portion of household funds captured by increased bill charges, thus acting as a negative shock to the economy (RQ3). The evaluation team estimated this by taking the portion of program funding paid for by increases to residential electricity bills.

The model output generated three types of job impact estimates:

Direct Impacts

Direct impacts are jobs created during the initial round of spending from the exogenous shocks. For the demand shock for energy-efficiency products and services, direct impacts resulted from adding employees to installed measures and handling administrative duties. For the business reinvestment shock, direct impacts could be internal jobs created by businesses reinvesting savings back into the company or jobs created by businesses buying additional goods and services using energy bill savings.

Indirect Impacts

Indirect impacts are job impacts due to interindustry purchases as firms respond to the new demands of directly affected industries. These include jobs created up supply chains due to demand created by the energy-efficiency program, such as manufacturing goods or supplying inputs.

Induced Impacts

Induced impacts are job impacts resulting from 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 direct and indirect requirements.

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

Total number of jobs: This covers 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 account for the number of hours worked per employee.

Full-time Equivalent number of jobs: This only includes employee jobs converted to FTE based on overall average full-time hours worked in the business or government sectors.

The evaluation team presents model run results in terms of the above job-impact types (i.e., direct, indirect, and induced) and the job type (total jobs vs. FTEs). These results—along with the model

input shock values—are presented and discussed at a high level in Section 6.2, and in more detail in Appendix F.1.

Appendix F Detailed Job Impacts Inputs and Results

This section presents the detailed results of job impact analysis, as summarized in Section 6.2. Table F-1 presents total jobs impacts by type. As the fourth and fifth columns indicate, the analysis estimated that the Retrofit program would create 3,274 total jobs in Canada, with 2,886 jobs created in Ontario. Of 3,274 estimated total jobs, 1,590 are direct jobs, 840 are indirect jobs, and another 844 are induced. In terms of FTEs, numbers run slightly lower, with 2,703 FTEs created in Ontario and 2,383 FTEs created nationwide. Of the 2,703 FTEs, direct jobs account for 1,374 FTEs, indirect jobs account for 703 FTEs, and induced jobs account for 626 FTEs. In total, the Retrofit program created 81.6 jobs per million dollars of investment (i.e., the program budget).

Table F-1: Total Job Impacts by Type

Job Impact Type	FTE *(in person-years)*	FTE *(in person-years)*	Total Jobs *(in person-years)*	Total Jobs *(in person-years)*	Total Jobs per $1M Investment *(in person-years)*
	Ontario	Total	Ontario	Total	
Direct	1,317	1,374	1,528	1,590	39.7
Indirect	561	703	675	840	30.9
Induced	504	626	683	844	21.1
Total[1]	**2,383**	**2,703**	**2,886**	**3,274**	**81.6**

Section F.1 details impact values used in the model runs. Section F.2 presents the analysis results, including the details of job impacts and assumptions.

F.1 Model Inputs

The evaluation team used the model to estimate the impacts of three economic shocks:

- Demand shock, representing demand for energy-efficient products and services from Retrofit.
- Business reinvestment shock, representing increased business reinvestment due to bill savings (net of project funding).
- Household expenditure shock, representing decreases in household spending on goods and services due to increases in the residential portion of program funding.

Table F-2 displays input values for demand shock, representing products and services related to Retrofit. Each measure installed as part of the program was categorized according to the StatCan IO SUPCs.

The first 12 rows of Table F-2 contain categories corresponding to products (i.e., measures installed in businesses). The last row contains services. Lighting fixtures had the highest total cost among the product categories, accounting for $88.2 million of the overall program cost. The second largest product category—switchgear, switchboards, relays and industrial control apparatus—had $14.7 million of total costs. Each measure's cost was divided into labour and non-labour, as the IO Model

required this distinction to determine direct versus indirect impacts. Labour costs were determined by examining a random sample of program invoices. The analysis used a sample size of 122 invoices that specified the portion of project costs for labour versus materials. Labour percentages were calculated and applied by measure type, based on when the project was completed in the year. Of 122 invoices examined, these projects had a weighted average labour percentage of 34%. Thus, demand shock for each SUPC was assumed to be 34% labour and 66% non-labour.

The table's single service category--office administrative services—included general overhead and administrative services associated with program delivery. The labour and non-labour amounts were not specified for this category, as the IO Model used built-in assumptions for this category.

Table F-2: Summary of Input Values for Demand Shock

Category Description	Non-Labour	Labour	Total Demand Shock
	($ Thousands)		
Lighting fixtures	55,798	32,355	88,153
Switchgear, switchboards, relays and industrial control apparatus	9,487	5,196	14,683
Electric light bulbs and tubes	8,696	5,039	13,735
Heating and cooling equipment (except household refrigerators and freezers)	6,577	3,541	10,118
Industrial and commercial fans, blowers and air purification equipment	6,175	3,325	9,501
Metalworking machinery and industrial moulds	1,605	864	2,469
Pumps and compressors (except fluid power)	1,086	585	1,671
Glass (including automotive), glass products and glass containers	457	246	703
Measuring, control and scientific instruments	329	178	506
Boilers, tanks and heavy gauge metal containers	90	48	138
Electric motors and generators	60	32	92
Agricultural, lawn and garden machinery and equipment	52	28	80
Subtotal	90,413	51,438	141,850
Office Administrative Services	-	-	11,220
Total			**153,070**

The second shock modelled through the IO Model was the business reinvestment shock. This shock represented the amount that businesses would reinvest and inject back into the economy. The net amount that businesses had available to reinvest, pay off debt, or distribute to owners/shareholders ($435.7 million) was the net of electricity bill savings (NPV = $548.7 million) and the portion of project costs not covered by incentives ($113.0 million). The portion of this $435.7 million reinvested was estimated using surveys administered to participants as part of the Retrofit Process Evaluation. The surveys included several questions about what businesses would do with money they saved on electricity bills and the business type. Overall, respondents indicated that 73% of bill

savings would be reinvested ($318.3 million). Remaining savings would be used to pay off debt or disbursed to owners/shareholders.

To properly model the business reinvestment shock effects, the IO Model required reinvestment estimates by industry. Each industrial category had a production function in the model, and these functions were adjusted to account for the reinvestment shock. Table F-3 presents input values for the business reinvestment shock by industry. The total business expenditure shock would be $318.3 million over 29 industries, as shown.

Table F-3: Summary of Input Values for Business Reinvestment Shock

Category Description	Business Reinvestment Shock *($ Thousands)*
Other	51,434
Crop and animal production	29,635
Retail trade	26,259
Educational services	25,175
Health care and social assistance	18,937
Non-profit institutions serving households	16,881
Primary and fabricated metal	16,478
Other municipal government services	15,047
Automotive and transportation	14,533
Chemical, soap, plastic, rubber, and non-metallic minerals	13,616
Transportation and warehousing	13,616
Arts, entertainment and recreation	10,643
Accommodation and food services	5,835
Furniture, cabinet, and fixtures	5,835
Government education services	5,835
Machinery	5,835
Wholesale trade	5,835
Non-residential building construction	5,321
Repair, maintenance and operating and office supplies	5,321
Other services (except public administration)	3,890
Textile and clothing	3,890
Crop, animal, food, and beverage	3,376
Utilities	3,376
Computer and electrical	1,945
Finance, insurance, real estate, rental and leasing and holding companies	1,945
Forestry and logging	1,945
Government health services	1,945
Owner occupied dwellings	1,945
Repair construction	1,945
Total	**318,276**

The third model input was the household expenditure shock,[12] representing the incremental increase in electricity bills to the residential sector due to funding the program. The team assumed that the IESO programs were funded by all customers in proportion to overall electricity consumption. Thus, the residential funding portion was 35% of the $28.9M program budget or $10.1M.

F.2 Results

The StatCan IO Model generated results based on input values detailed in Sections 6.2.2 and Section F.1. Table F-4 shows the model run results for demand shock for products and services. This shock accounted for over one-half of job impacts. As the table's two right columns show, the model estimated that demand shock would result in the creation of 1,326 total jobs (measured in person-years) in Canada, 1,206 of which would be in Ontario. Of 1,326 jobs, 656 were direct, 300 indirect, and 370 induced. In terms of FTEs, the numbers were slightly lower; 982 FTEs were estimated to be created in Ontario and 1,082 in total across Canada. Of 1,082 FTEs, 546 were direct, 263 indirect, and 274 induced. Direct jobs impacts were realized exclusively in Ontario, as the table shows. As we move to indirect and induced jobs, impacts disperse outside of the province.

Table F-4: 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	546	546	656	656
Indirect	209	263	240	300
Induced	228	274	310	370
Total	**982**	**1,082**	**1,206**	**1,326**

Table F-5 shows the model run results for the business reinvestment shock. Job impacts generated by business investment equaled to 871 direct total FTEs and 993 direct total jobs. Overall, business investments were responsible for 1,698 FTEs and 2,052 total jobs across Canada.

Table F-5: Job Impacts from Business Reinvestment 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	812	871	927	993
Indirect	369	461	455	567
Induced	287	366	388	493
Total	**1,467**	**1,698**	**1,771**	**2,052**

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

The third shock was the reduction in household spending from the increase in electricity bills that funds the program. Table F-6 presents job impacts from the model run. This represents the number of jobs attributed to reduced household spending; this amount could have been spent in other sectors of the economy. Instead, it was spent on funding the Retrofit program. The model estimated a reduction of 78 FTEs and 105 total jobs across Canada due to decreased household spending.

Table F-6: Job Impacts from Residential Funding 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	40	43	55	59
Indirect	16	21	21	27
Induced	11	14	15	19
Total	**67**	**78**	**91**	**105**

The nonresidential sector also contributed to program funding. The StatCan IO Model did not adjust production functions for all industries experiencing marginally higher electricity price changes; so this portion of the shock would be modeled by assuming surplus would be reduced by the extra amount spent on electricity. The model captured energy bill increases from program funding as an impact on direct GDP (value-added) and not as a reduction in employment. The GDP impact is equivalent to the profit loss resulting from the increase in electricity bills due to program funding.

Another potential economic shock was the economic impact of electricity production reduction as a result of increased in energy efficiency. Technically speaking, this could be estimated using StatCan Input-Output multipliers without running the model. As the IO model is linear and not well suited to modeling small decreases in electricity production. Total electricity demand has increased over time and is projected to continue increasing.[13] The relatively small decrease in overall consumption attributed to Retrofit program savings 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 IO model's linearity means it will provide estimates regardless of the impact size. Given the nature of electricity production, it was reasonable to conclude that the linear IO multiplier was not appropriate for estimating job impacts. Consequently, this analysis assumed job losses from decreased electricity production would be negligible.

Table F-7 shows total estimated job impacts by type, calculated by combining the jobs estimated in Table F-5, Table F-6, and Table F-7. Of 1,590 estimated total direct jobs, 1,528 were in Ontario. A slightly smaller proportion of indirect and induced jobs were in Ontario, with 675 out of 840 indirect jobs and 683 of 844 induced jobs estimated to be created within the province. FTE estimates were slightly lower overall than total jobs, with 2,383 FTEs (of all types) created in Ontario and 2,703 FTEs added nationwide. Almost all direct FTEs (1,317 of 1,374) were added in Ontario, with this number

[13] *Annual Planning Outlook—A View of Ontario's Electricity System Needs*; 2022. IESO.

representing approximately 55% of total FTEs added in Ontario and 49% of all FTEs created across Canada.

In 2022, each $1M of program spending resulted in the creation of 81.6 total jobs, compared to 52.0 jobs per $1M in 2021. The sharp increase in the jobs created per $1M of program spend likely resulted from the relative proportions of spending within the program as well as from a significant increase in overall demand and reinvestment shocks. As a program performs more effectively, the same relative dollar value of program costs (i.e., money spent by the IESO on incentives or general administrative costs pertaining to the Retrofit program) results in a larger overall amount spent by participants, which in turn drives the creation of more jobs. In 2021, participants were responsible for $0.61 of every dollar spent within the Retrofit program and participants accounted for $0.73 of every dollar spent.

This means that for each dollar spent by the IESO in 2021, participants spent 20% more than they did in the prior year. Additionally, total demand shock in PY2022 was almost four times higher than in PY2021 ($153.1M vs. $40.6M), representing a significant increase in the magnitude of dollars cycled into the economy to buy goods and services to support the program. A similar trend occurred with the reinvestment shock; in PY2022, customers stated that they planned to reinvest $318M based on bill savings created by the Retrofit program, compared to $67M reinvested by businesses in PY2021. These factors lead to larger positive economic shocks and, consequently, to the observed job creation increase.

Table F-7: Total Job Impacts by Type

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	Total Jobs per $1M Investment *(in person-years)*
Direct	1,317	1,374	1,528	1,590	39.7
Indirect	561	703	675	840	20.9
Induced	504	626	683	844	21.1
Total[1]	**2,383**	**2,703**	**2,886**	**3,274**	**81.6**

Though the model did not provide year-by-year results for job impacts, the evaluation team made some estimates about the temporal nature of impacts. Table F-8 shows total jobs created due to program activities and energy savings in the first year versus those after the first year. The table assumes “first year activities” pose the initial demand shock for energy-efficiency products and services, the program funding shock, and the first-year energy savings (resulting in bill savings and reinvestment).

Job impacts after the first year resulted from energy savings over the course of the measures’ EULs. Job impacts from first-year activities made up roughly 6.5% of the total, representing 216 out of 3,274 person-years, with 135 of these person-years derived from first-year energy savings. The remaining 3,058 total job-years resulted from energy savings after the first year and reinvestment generated by the bill savings.

Table F-8: Job Impacts from First-Year Shocks

Job Impact Type	Total Jobs *(in person-years)*		
	From First Year Activities	From Bill Savings After First Year	Total
Direct	105	1,485	1,590
Indirect	55	784	840
Induced	56	789	844
Total*	**216**	**3,058**	**3,274**

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

Table F-9 shows job impacts in greater detail, with jobs added by type and industry category. The table sorts industries from top to bottom, from with the greatest impacts to the least, with industries showing no impacts not included in the table. The table shows that the industry with the largest job impacts was administrative and support, waste management and remediation services, which added 773 jobs. This category is large and non-specific and reflects the need to hire individuals to fill a large range of roles, based on program needs (e.g., office administration, call centre operations, program management). Retail trade and nonresidential building construction were industries with the next most added jobs, gaining 345 and 309 jobs, respectively.

Table F-9: Job Impacts by Industry

Output Industry Category	FTE *(in person-years)* Ontario	FTE *(in person-years)* Total	Total Jobs *(in person-years)* Ontario	Total Jobs *(in person-years)* Total
Administrative and support, waste management and remediation services	614.7	629.9	751.6	773.0
Retail trade	232.0	254.3	315.3	345.2
Non-residential building construction	267.2	267.2	309.0	309.0
Manufacturing	201.0	285.1	208.0	296.4
Wholesale trade	217.1	256.2	223.4	264.4
Professional, scientific and technical services	165.8	199.7	209.6	252.3
Finance, insurance, real estate, rental and leasing and holding companies	119.8	141.7	147.4	174.5
Accommodation and food services	62.1	82.6	94.9	124.9
Transportation and warehousing	79.8	102.8	94.6	121.7
Government education services	81.6	83.3	98.1	100.1
Information and cultural industries	46.1	64.5	52.8	74.3
Engineering construction	68.6	68.6	70.0	70.0

Output Industry Category	FTE *(in person-years)* Ontario	FTE *(in person-years)* Total	Total Jobs *(in person-years)* Ontario	Total Jobs *(in person-years)* Total
Other services (except public administration)	39.3	48.3	56.8	69.9
Health care and social assistance	28.1	31.0	44.7	49.8
Residential building construction	27.8	27.8	38.1	38.1
Repair construction	28.0	31.3	32.9	36.9
Arts, entertainment and recreation	12.0	15.8	22.8	29.9
Other federal government services	20.6	21.2	22.1	22.7
Educational services	8.2	9.3	19.5	21.8
Non-profit institutions serving households	14.0	16.0	18.0	20.6
Other municipal government services	15.8	17.8	16.8	19.0
Crop and animal production	6.0	10.2	10.6	18.9
Utilities	10.4	12.0	10.7	12.5
Government health services	7.6	9.2	8.4	10.1
Mining, quarrying, and oil and gas extraction	4.8	9.6	4.4	8.9
Other provincial and territorial government services	2.6	3.5	2.7	3.6
Support activities for agriculture and forestry	0.6	1.3	0.9	1.7
Other activities of the construction industry	0.6	0.7	1.4	1.7
Forestry and logging	0.5	1.3	0.5	1.3
Total*	**2,383**	**2,703**	**2,886**	**3,274**

*Columns may not add to totals due to rounding. Real values are rounded to the nearest whole number, and whole numbers do not sum exactly to the whole number total in every column. Values presented in this table are rounded to the nearest 0.1 to better show the distribution of small jobs impacts.

The retrofit contractor and applicant representative survey responses supported the model results showing positive job impacts. The survey instrument contained questions for contractors and applicant representatives related to impacts of the Retrofit program on their firms and employment levels. Two questions in particular proved informative in understanding the nature of impacts to respondents, which would be considered direct impacts. Relevant illustrative verbatim responses follow:

1) Did the 2022 program help or hinder the growth of your business in any way? If so, please explain how:

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

   - *"Generated additional revenue."*

- *"Program participation provides an added motivation to clients to carry out retrofit projects."*
- *"Additional sales and new clients."*
- *"Clients were unaware of the program and therefore happy to work with us to get their rebate and move forward on projects. Clients were able to retrofit more square footage of their existing buildings due to the cost-savings realized by a rebate. Clients were able to justify costs of moving to higher-efficiency equipment due to the rebate (shortening ROI time)."*
- *"Increase lighting sales and new customer relations."*

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

- *"Could have done more projects if Exterior Lighting and Custom tracks were available."*
- *"We lost many deals because exterior lighting is not included in the program. People asked for HID lamp replacement."*
- "Did the 2022 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:

- *"One site manager was hired."*
- *"We received more projects which led to 2 full time and 1 part time employee being brought on board."*

Negative Impacts:

- *No negative impacts provided by respondents this year*

Respondents indicated that the program generally resulted in slight increases in overall staffing. Participants additionally stated that the program added value to projects and allowed contractors to win projects that otherwise would have been lost. Lighting measures were called out as a specific measure category that helped secure contracts. Contractor verbatims further supported the model's estimated direct job gains, with respondents indicating that additional staff had been hired due to the Retrofit program.

No respondents stated that program activities in PY2022 resulted in negative employment impacts. In general, responses revealed the potential for beneficial impacts the program could have on firms. Respondents indicating a negative effect on their businesses primarily stated that program changes served as the biggest drivers, particularly removing exterior lighting measures and cancelling the custom project track. This issue could be examined further if parts of the program were redesigned to enhance job impacts.

Input-Output models produce informative results, useful in understanding the potential magnitude and dynamics of economic shocks created by policies and programs. While useful, the StatCan IO Model represents is a simplified vision of the Canadian economy and thus faces limitations. Based on the assumption of fixed technological coefficients, the model does not account for economies of scale, constraint capabilities, technological change, externalities, or price changes. This makes analyses less accurate in estimating 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 tends to be overestimated. For household consumption, the model is based on assumptions regarding constant consumption behaviour and fixed expenditure shares relative to incomes.

Appendix G Detailed Non-Energy Benefits Methodology and Additional Results

This appendix provides additional detail about the NEB methodology as well as additional NEB results. Section 1.1 summarizes the methodology.

G.1 Methodology

Participant Survey

The two previous studies—the *PY2021 Retrofit Evaluation Report* and the *Non-Energy Benefits Study: Phase II*—assessed NEBs from energy-efficiency projects funded by the IESO over the 2017-2021 period.[14] The PY2022 evaluation applied the same methodology as previous studies in assessing NEBs, using two different question types to determine the NEBs' value that program participants realized by installing program measures:

- **Relative scaling:** Relative scaling questions ask participants to state the value of an item of interest relative to some base. For this survey, participants were asked to state the value of each NEB relative to annual electricity bill savings that they estimated, or, if they could not estimate savings, their annual electricity bill.
- **Willingness-to-pay:** Willingness-to-pay questions ask participants to assign the dollar value that they would be willing to pay for an item of interest. In this case, participants were asked what they would be willing to pay for each relevant NEB.

All survey respondents were asked to value all NEBs using both techniques. Data collected from these questions then were used to quantify the NEBs.

NEBs Quantification

For each individual NEB, the total value across all participants was divided by total gross savings values across all participants. This was completed using both relative scaling and willingness-to-pay NEB values. Two hybrid approaches were calculated to better represent the sample:

- **Hybrid, relative scaling priority.** In which the team gave priority to the relative-scaling response value. Through this approach, the team only considered willingness-to-pay if the participant did not answer the relative scaling question.
- **Hybrid, minimum approach** . In which the team considered the lowest non-null response between relative scaling and willingness-to-pay questions.

[14] Dunsky. (July 2021). *Non-Energy Benefits: Phase II; Quantified Benefits and Qualitative Insights*. https://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation-reports/Non-Energy-Benefits-Study-Phase-II.ashx

As a final step, the evaluation team calculated the average value ($/kWh) for each NEB, weighted by energy savings across all participants. Table G-1 presents average NEB values, based on two different calculation approaches:

- **Average (per participant).** A $/kWh value calculated for each individual participant, with all values then averaged.
- **Average (overall).** An overall average value, where total NEB benefits ($s) were summed across all participants, and then divided by total energy savings (kWh) across all participants.

Table G-1: Quantified NEBs by Participant and by Savings, Phase II & PY2021

NEB	PY2022 (Retrofit) Average (per participant)	PY2022 (Retrofit) Average (Overall)	PY2021 (Retrofit) Average (per participant)	PY2021 (Retrofit) Average (Overall)	Phase II (Retrofit & SBL) Average (per participant)	Phase II (Retrofit & SBL) Average (Overall)
Hybrid (min approach) ($/kWh)						
Reduced building & equipment O&M	$0.18	$0.05	$0.26	$0.20	$0.12	$0.08
Thermal comfort	$0.08	$0.02	$0.06	$0.07	$0.63	$0.05
Improved indoor air quality	$0.04	$0.01	$0.02	$0.02	$0.09	$0.01
Reduced spoilage	$0.00	$0.00	$0.00	$0.00	$0.01	$0.00
Hybrid (RS-priority) ($/kWh)						
Reduced building & equipment O&M	$0.50	$0.12	$0.31	$0.24	$0.72	$0.17
Thermal comfort	$0.29	$0.07	$0.19	$0.28	$0.65	$0.09
Improved indoor air quality	$0.10	$0.02	$0.08	$0.10	$0.10	$0.02
Reduced spoilage	$0.01	$0.01	$0.00	$0.00	$0.01	$0.00

All recommended values in the Phase II study were based on the hybrid, minimum approach. Additional detail on the methodology and NEBs quantification can be found in the Phase II study.

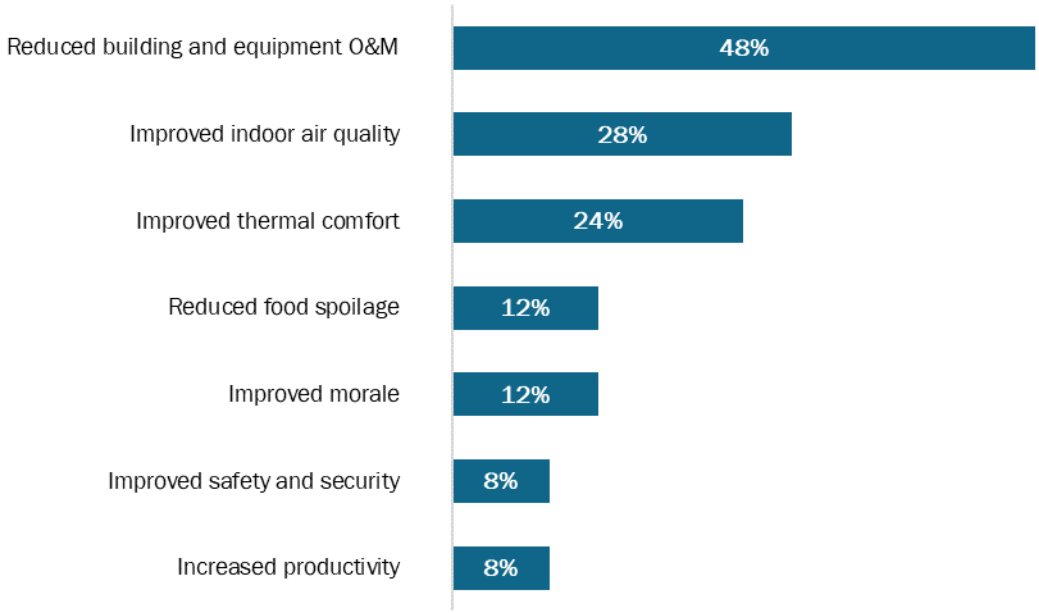
G.2 Applicant Representative and Contractor Non-Energy Benefits Results

As part of the applicant representative and contractor survey, contractors were asked to indicate NEBs that they believed their customers might have experienced due to their Retrofit Program participation, as shown in Figure G-1. Among contractors reporting NEBs, nearly one-half (48%) indicated that their customers experienced reduced building and equipment O&M. More than one-fourth (28%) indicated their customers experienced improved indoor air quality. When asked to rank

the importance of various NEBs to their customers, one-half of the contractors (three of six) rated the time and costs for operations and maintenance as the most important elements.

Figure G-1: Contractor Reported Non-Energy Benefits

(Open-ended and multiple responses allowed; n=25)*



*Does not add to 100% due to multiple responses.