PROGRAM YEAR 2017 EVALUATION REPORT

CONSERVATION FIRST FRAMEWORK INDUSTRIAL PROGRAMS

Date: 15 November 2018

Prepared for: Independent Electricity System Operator (IESO)

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TABLES

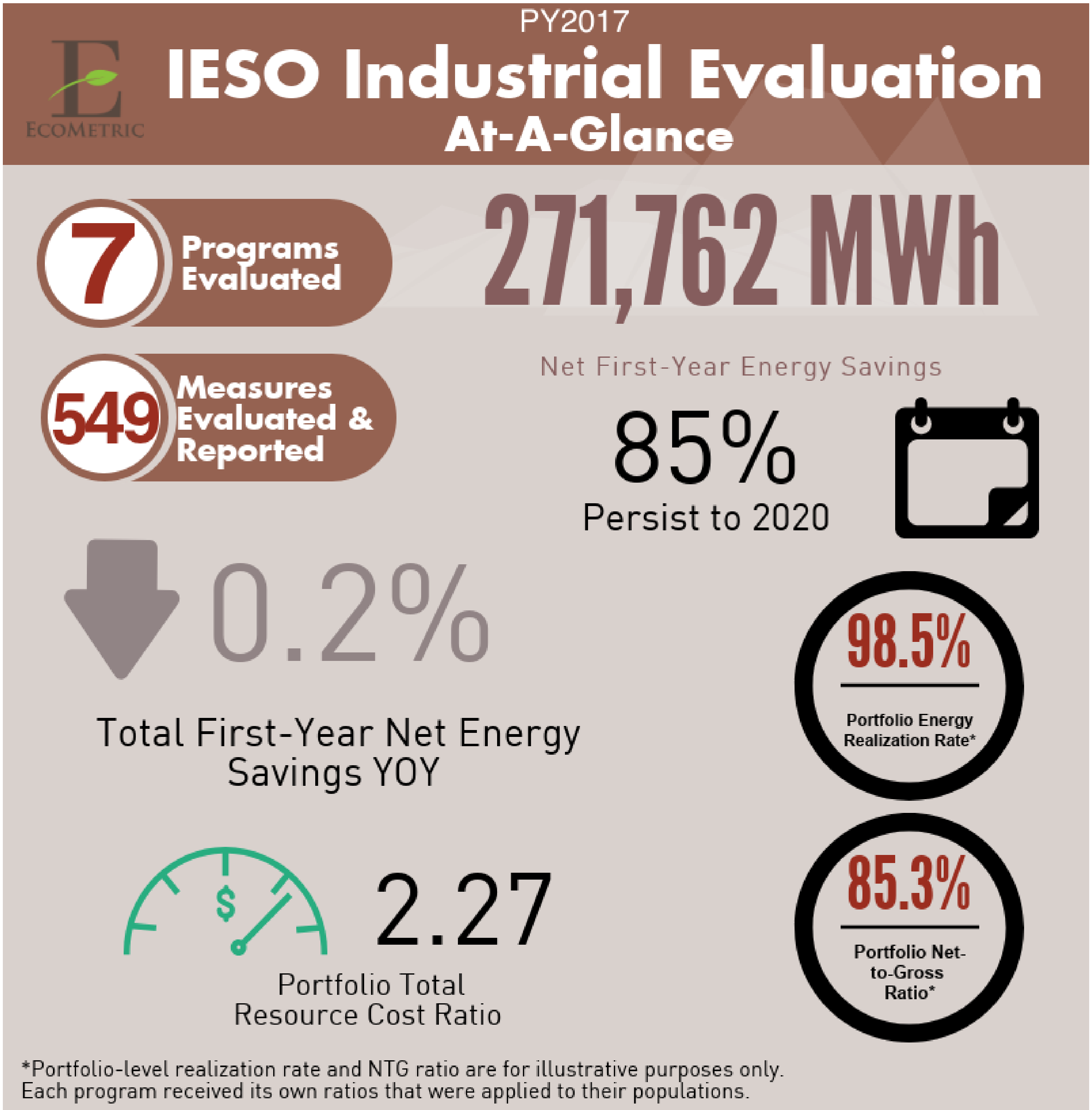
FIGURES

ABBREVIATIONS

AESP	Association of Energy Services Professionals
BMG	Behind-the-meter Generation
CBECS	Commercial Buildings Energy Consumption Survey
CDM	Conservation and Demand Management
CE	Cost Effectiveness
CFF	Conservation First Framework
CHP	Combined Heat and Power
CO2e	Carbon Dioxide Equivalent
CRM	Customer Resource Management
DST	Daylight Saving Time
EE	Energy Efficiency
EF	Emissions Factor
EIA	U.S. Energy Information Association
EM	Energy Manager
EM&V	Evaluation, Measurement and Verification
EPP	Energy Performance Program
EUL	Effective Useful Life
FR	Free-rider
GA	Global Adjustment
GHG	Greenhouse Gas
HPNC	High Performance New Construction
HVAC	Heating, Ventilation and Air Conditioning
IAC	U.S. Dept. of Energy's Industrial Assessment Center
IAP	Industrial Accelerator Program
IAP CI	Industrial Accelerator Program: Capital Incentives
ICI	Industrial Conservation Initiative
IESO	Independent Electricity System Operator
IPMVP	International Performance Measurement and Verification Protocol
IR	Information Request
ISP	Industry Standard Practice
kW	Kilowatt
kWh	Kilowatt hour
LC	Levelized Cost
LDC	Local Distribution Company
M	Million
M&T	Monitoring and Targeting
M&V	Measurement and Verification

MMBtu	One Million British Thermal Units
MPN	Modeled Partial Net
MW	Megawatt
MWh	Megawatt Hour
NAICS	North American Industry Classification System
NTG	Net-to-Gross
O&M	Operation and Maintenance
PAC	Program Administrator Cost
PES	Program Enabled Savings
PSUP	Process and Systems Upgrades Program
PY	Program Year
P&S	Process and Systems
QC	Quality Control
RR	Realization Rate
SO	Spillover
TRC	Total Resource Cost
YOY	Year-on-Year

Figure 1: PY2017 IESO Industrial Evaluation Results At-a-Glance



1 EXECUTIVE SUMMARY

The Independent Electricity System Operator (IESO) retained EcoMetric Consulting, LLC to conduct PY2017 evaluation of Conservation First Framework (CFF) Industrial Programs. Industrial Programs incentivize equipment measures, engineering studies and Energy Manager services for commercial and Industrial facilities in Ontario. This report contains gross and net energy and demand impacts, greenhouse gas (GHG) emissions impacts, cost-effectiveness results, process findings, and recommendations for improvement for the following industrial programs:

- Process and Systems Upgrades Program (PSUP),
- Industrial Accelerator Program (IAP),
- Energy Manager Non-Incented measures (EM)
- Monitoring and Targeting (M&T), and
- Program Enabled Savings (PES).

PSUP is LDC administered and offered to companies connected to the distribution system of Local Distribution Companies (LDCs). The program provides financial support for the implementation of energy efficiency projects and system optimization projects for facilities that are intrinsically complex and capital-intensive.

IAP is offered to companies connected directly to the transmission system. The initiative provides incentives through three program streams: Capital Incentives (referred to interchangeably as IAP Process & Systems), Retrofit, and Energy Manager.

The Energy Manager program is offered to both sets of customers noted above. The program subsidizes the salary of a trained energy manager to work directly with participating facilities to find energy savings, identify smart energy investments, secure financial incentives, and unleash competitive advantage.

The Monitoring and Targeting program encourages industrial distribution customers to install or upgrade M&T systems to relate a facility's energy consumption data to the weather, production schedule, or other measures in such a way as to provide a better understanding of how energy is being used.

Finally, the Program Enabled Savings initiative provides an opportunity for LDCs to quantify savings generated through their customer interactions outside of the existing suite of efficiency programs.

1.1 EVALUATION RESULTS SUMMARY

In the evaluation of the CFF industrial portfolio of programs for program year 2017 (PY2017), 549 projects were evaluated and reported. **Total industrial portfolio gross verified energy savings from the PY2017 evaluation are 318,491 MWh. Verified net first year energy savings are 271,762 MWh, or 85.3% of gross verified savings, indicating low levels of free-ridership, on average, across the programs.** There is no spillover attributed to the industrial programs across the portfolio.

Savings persistence is an important component of the CFF, and over 85% of first-year PY2017 savings persist through 2020. This is typical of industrial sector measures that tend to have relatively long measure lives.

Verified savings from the PY2017 evaluation of industrial programs is summarized in Figure 2 and Table 1 below. These results include projects that were evaluated during the PY2017, including projects that went into service starting in 2017 under the CFF, as well as projects that went into service in 2016 under the CFF which are referred to as 2016 adjustments. Results throughout this report also include projects that went into service in 2015 under the *2011 - 2014 + 2015 Extension Legacy Green Energy Act Framework* (Legacy) but were not included in prior evaluations.

Figure 2: PY2017 Reported, Gross Verified, and Net Verified Savings by Program (MWh)

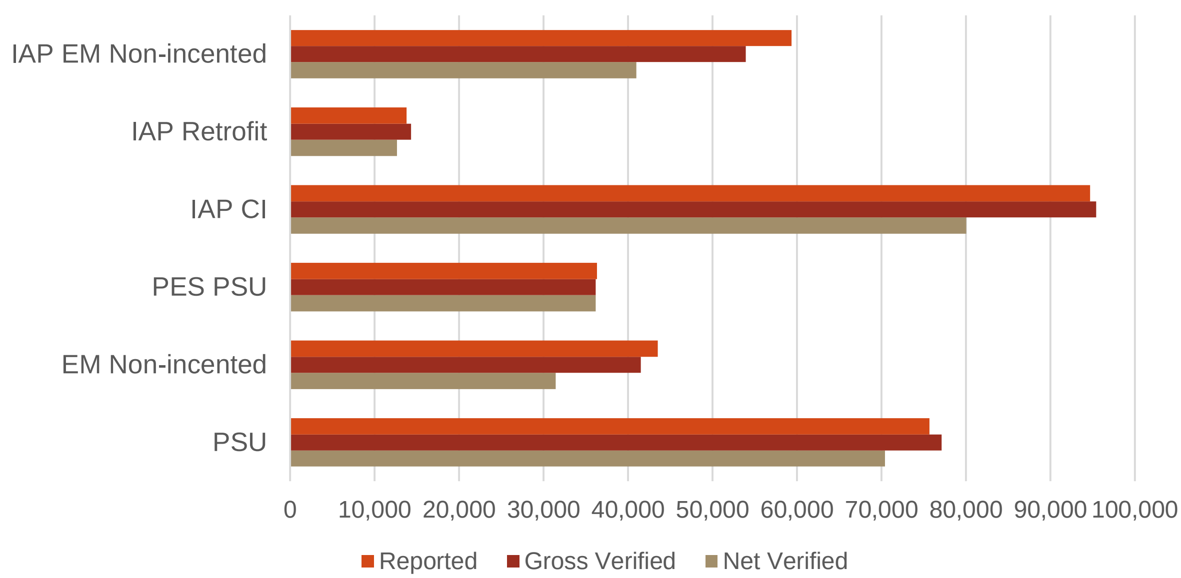


Table 1: Impact Evaluation Results Summary

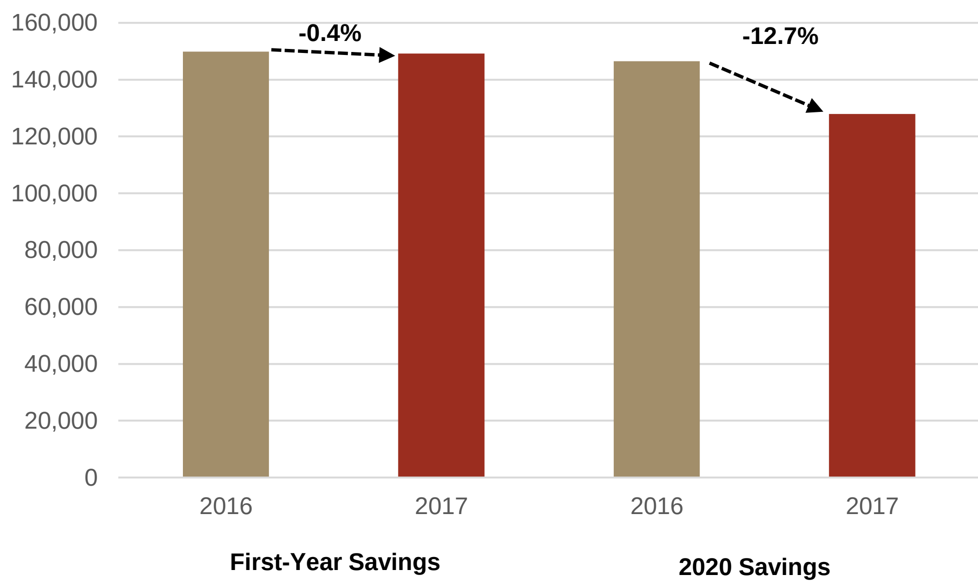
Program	# of Projects Evaluated & Reported	Energy RR	Gross Verified Energy Savings (MWh)	Demand RR	Gross Verified Summer Peak Demand Savings (MW)	NTG Ratio[1]	Net Verified Energy Savings (MWh)	Net Verified Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
LDC-Administered Programs									
Process & Systems Upgrades (PSUP)	31	101.9%	77,140	158.4%	11.00	91.3%	70,433	9.95	100%
Program Enabled Savings (PES)[2]	4	99.6%	36,185	n/a	-	100.0%	36,185	-	59%
Energy Manager Non-Incented (EM)	438	95.3%	41,503	104.5%	6.05	75.8%	31,442	4.63	64%
Monitoring & Targeting (M&T)	0	n/a	0	n/a	0.00	n/a	0	0.00	n/a
Total LDC	**473**	**98.6%**	**154,828**	**112.7%**	**17.05**	**86.4%**	**138,060**	**14.58**	**81%**
IESO-Administered Programs									
IAP Capital Incentives	4	100.7%	95,415	100.1%	10.92	83.9%	80,066	9.16	100%
IAP Retrofit	19	103.8%	14,316	111.3%	2.04	88.4%	12,654	1.80	100%
IAP Energy Manager Non-Incented	53	90.8%	53,932	89.2%	4.90	76.0%	40,982	3.77	68%
Total IESO	**76**	**97.5%**	**163,663**	**97.9%**	**17.86**	**81.7%**	**133,702**	**14.74**	**90%**
GRAND TOTAL	**549**	**98.5%**	**318,491**	**112.7%**	**34.92**	**85.3%**	**271,762**	**29.31**	**85%**

Total industrial portfolio net energy savings are summarized below in Figure 3. These results include all projects under the CFF that have been evaluated and their savings reported in PY2016 or PY2017. **As part of the CFF framework, the industrial portfolio has achieved 389,935 MWh of net first-year energy savings, representing 87.8% of gross verified first-year energy savings.** Growth in the portfolio's net first-year energy savings was relatively flat in PY2017 compared to the 149,797 MWh net first-year energy savings achieved and evaluated in PY2016. While the total number of projects evaluated and reported increased YOY in PY2017, total net first-year energy savings decreased just 0.4% YOY in PY2017 compared to PY2016 results without 2016 adjustment savings. Net first-year energy savings increased YOY for all

[1] Program-level NTG ratios are for illustrative purposes only. Summary NTG ratios in this table are total net verified savings divided by total gross verified savings.
[2] Includes only PES savings attributed to PSUP.

programs in PY2017 except for the IAP CI program which experienced a 27% decline YOY due to slightly lower participation. The IAP CI program is characterized by a small number of very large and impactful projects, representing over 29% of the industrial portfolio's net energy savings in PY2017.

Figure 3: Industrial Portfolio Total First-Year and 2020 Net Energy Savings (MWh)



2016 adjustment projects, those that were implemented in 2016 but evaluated in PY2017, account for 90,939 MWh of net first-year energy savings—23% of the total portfolio net energy savings achieved through the CFF to date. Adjustment savings are not included in Figure 3 but are detailed in *Section 4.1* and the following program-specific sections in *Chapter 5*. Adjustment projects account for a large part of the industrial portfolio's savings each year as projects tend to be much more complex in the industrial sector compared to residential and commercial and this complexity requires longer monitoring and verification processes. As such, projects in the industrial portfolio are often evaluated more than a year after they are implemented.

Projects implemented in the industrial portfolio in PY2017 and evaluated in PY2017 had 127,945 MWh of net 2020 energy savings—84% of gross first-year energy savings. Compared to PY2016 projects without 2016 adjustments from the PY2017 evaluation, total portfolio net 2020 energy savings decreased 12.7% YOY in PY2017. The main driver for this decline was the decrease in persistent savings from the Energy Manager non-incented program which experienced an uptick in PY2017 of operations and maintenance (O&M) measures that have shorter effective useful lives (EULs).

The industrial portfolio was highly cost-effective in 2017 according to both TRC and PAC tests, when using a benefit-cost threshold of 1.0. The cost effectiveness of the portfolio is supported by the IESO-administered programs which have a TRC ratio of 3.72, compared to a TRC ratio of 0.64 for LDC-administered programs. The IAP CI program accounts for 78% of the Industrial Portfolio's total TRC benefits in net present value terms, largely due to a large CHP project that resulted in major energy and natural gas savings. PSUP has the lowest TRC ratio at 0.54, due to the cost of increased natural gas consumption by the CHP units prevalent in the program. Compared to the one CHP unit in the IAP CI program that was highly cost-effective, the CHP units in PSUP resulted in increased net natural gas consumption and high fuel supply costs. The details of the PSUP cost effectiveness analysis, and the effect of CHPs on the TRC ratio, is detailed in *Section 5.1.5*.

Table 2 below includes select cost-effectiveness results for the industrial portfolio. While these results indicate an overall cost-effective set of programs, variance in the timing of costs incurred and savings achieved can impact the precision of these cost tests.

Detailed cost effectiveness assumptions by program are included in *Appendix D*.

Table 2: PY2017 Cost Effectiveness Results

Admin	Program	TRC Ratio	PAC Ratio	LC $/kWh
LDCs	PSUP	0.54	1.57	0.05
	PES PSUP	-	-	-
	EM	0.89	2.66	0.02
	M&T	-	-	-
	Total LDCs	**0.64**	**1.87**	**0.04**
IESO	IAP (CI)	3.71	2.84	0.03
	IAP (Retrofit)	3.23	7.88	0.01
	IAP (EM)	4.30	-	-
	Total IESO	**3.72**	**3.22**	**0.02**
PORTFOLIO TOTAL		**2.27**	**2.81**	**0.03**

EcoMetric designed a two-phase approach to comprehensively assess all CFF Industrial programs, document existing processes, and identify opportunities for improvement. The evaluators conducted a total of 189 interviews and surveys with IESO IAP staff, energy managers, participants (in concert with the NTG interviews), nonparticipants, and partial participants. This was supplemented by document review and targeted analyses. The key findings by program include the following:

- PSUP: Subsequent evaluations will monitor the impact of the program redesign and CHP phase-out in subsequent evaluations. It is not clear to what extent the redesign lessened the customer pain point on the application review process.
- EM: The EM program is seen as an enabling program and drives participation and savings in other Save on Energy/IAP programs. It has the highest satisfaction ratings of the industrial programs and produces non-energy benefits for both the facilities and LDCs/IESO.
- IAP: Like PSUP, IAP went through multiple changes in the past year, which will be monitored in subsequent evaluations. The application review process is a major barrier for customers and the largest source of complaints.

- PES: This is a unique offering that is challenging to administer from an evaluation perspective due to an inability to account for free-ridership or perform more rigorous analysis on some projects.
- M&T: There are substantial barriers to participation for this program, resulting in low participation and savings.

The EcoMetric team identified 17 opportunities for process improvement through this effort. Findings and recommendations can be found throughout *Chapter 4* and *Chapter 5*. Figure 22 in *Appendix E* shows a diagram of the potential outcomes of implementing the process recommendations provided in this report.

1.2 KEY FINDINGS AND RECOMMENDATIONS

The findings and recommendations below represent the most impactful results and analysis from the impact and process evaluations of the industrial portfolio in PY2017. Greater detail on the data and analysis that lead to these key findings and recommendations can be found in the portfolio overview in *Chapter 4* and the respective program-specific sections in *Chapter 5*.

1.2.1 CROSS-CUTTING KEY FINDINGS & RECOMMENDATIONS

Finding 1: Tracking data and project documentation is generally accurate and comprehensive but can be improved to ensure an accurate estimations of verified savings. (Cross-cutting, Section 4.1.4)

Recommendation 1: Open a channel of communication between the evaluator and technical reviewer, facilitated by the IESO, to ensure tracking data and project documentation issues are understood and impactful and realistic solutions can be implemented.

- In Q42018, the IESO facilitated an in-person meeting between the technical reviewer and evaluation team to discuss each stakeholder's processes, tracking systems and methodology regarding the technical review and evaluation of the industrial portfolio. A channel of communication and bi-weekly meetings have been established to improve a mutually beneficial relationship based on continuous feedback and improvement throughout the implementation and evaluation of the CFF.

Finding 3: Behind-the-meter generation (BMG) projects account for 56% of gross verified energy savings and account for the majority of savings in both LDC-administered and IESO-administered programs evaluated in PY2017. (Cross-cutting, Section 4.1.5)

- All BMG projects in the PY2017 evaluation were CHP units. The Government of Ontario's 2017 Long-Term Energy Plan ended funding for CHP projects that burn fossil fuels in both the CFF and IAP. Effective July 1, 2018 the IESO is no longer accepting applications for CHP projects. While many CHP projects are currently in the application phase and will create significant energy savings over the next few years, the number of BMG projects and their impact on the Industrial Portfolio will surely decline in the future. CHP units that use non-fossil fuels, such as biogas, are still eligible for funding, so opportunities to encourage energy savings through CHP projects still exist.

Recommendation 3: Create a standing committee with the IESO, LDCs and partners to develop a plan to sustain participation in the Industrial Portfolio following the removal of a popular energy efficiency measure. Investigate the potential for biogas-fueled CHPs in Ontario, as well as other projects that were overshadowed by CHPs.

Finding 4: The cost of natural gas used to calculate avoided costs of natural gas consumption in the IESO's Cost Effectiveness Tool is not frequently updated to reflect current market conditions, resulting in inaccurate calculations that do not account for actual natural gas costs incurred in the fuel market. (Cross-cutting, Section 4.1.7)

Recommendation 4: Update the avoided cost of natural gas used in the CDM Cost Effectiveness Tool on an annual basis to reflect current market conditions. A comparison study of marginal natural gas costs in Ontario and other provinces with similar markets is recommended to ensure the avoided costs used reflect industry practices.

Process Finding 3: Nonparticipants are generally aware of the Save on Energy programs and offerings with the exception of the EM program. (Cross-cutting, Section 4.2.2)

Process Recommendation 3: Increase nonparticipant awareness of the EM program by raising the profile of the program.

Process Finding 4: Administrators described significant overlap between IESO energy conservation programs and the Industrial Conservation Initiative (ICI). (Cross-cutting, Section 4.2.4)

Process Recommendation 4: Leverage the ICI to spur conversations with customers and use it to market to their priorities without making the project explicitly about demand reduction.

1.2.2 PSUP KEY FINDINGS & RECOMMENDATIONS

Process Finding 5: The application review process remains a major customer pain point for PSUP. (PSUP, Section 5.1.6)

Process Recommendation 5 (PSUP/IAP): Develop measure-specific applications or accompanying guidance to limit the number of information requests (See also Recommendation 13, Section 5.3.6.2, for IAP).

1.2.3 ENERGY MANAGER KEY FINDINGS & RECOMMENDATIONS

Finding 9: **The peak demand savings estimates for non-incented Energy Manager projects are inconsistent or non-existent. Projects are often submitted without peak demand savings estimates. When projects have demand impacts recorded, they are frequently the change in connected load rather than an estimate of demand reduction coincident with the system peak. (EM, Section 5.2.3)**

Recommendation 12: Make the quality and completeness of peak demand tracking and reporting a performance metric for technical reviewers. Although goals are based on energy savings, peak demand impacts are a key factor in system planning and cost-effectiveness.

Process Finding 6: **The EM program is seen as an enabling program and drives participation and savings in other Save on Energy/IAP programs. (EM, Section 5.2.6)**

Process Recommendation 6: Consider ways to reward EMs for overachieving the 10% non-incented target, provided that they submit enough documentation for the technical reviewer to fully review and the savings persist to 2020.

1.2.4 PES KEY FINDINGS & RECOMMENDATIONS

Process Finding 12: **PES savings may accrue above and beyond spillover already captured by the NTG analysis conducted for other programs, but they could also be double counted if not calculated properly. (PES, Section 5.4.6)**

Process Recommendation 14: Investigate the potential for double-counting of spillover savings from PES claims. Consider providing the PES claims to each evaluation team (Retrofit Program, etc.) to reduce the possibility of double-counting spillover savings.

Process Recommendation 16: Discontinue the PES initiative. Encourage LDCs and participants to leverage IESO support through existing programs that historically influenced PES claims.

1.2.5 M&T KEY FINDINGS & RECOMMENDATIONS

Process Finding 13: **There are substantial barriers to participation for the current iteration of the M&T program, resulting in low participation and a small contribution to portfolio savings. (M&T, Section 5.5.1)**

Process Recommendation 17: Discontinue the M&T program and direct relevant new customers to other program offerings such as the Energy Performance Program (EPP) unless there is a compelling reason to redesign the program instead.

1.3 EVALUATION METHODOLOGY AND GOALS

Approaches used to conduct this evaluation include engineering analysis, on-site inspections and measurement, interval billing analysis, telephone surveys, program and project documentation review, best practice review, and interviews with IESO and LDC staff, implementation vendors, technical reviewers, and program participants. The process evaluation component seeks to understand the Conservation First Framework (CFF) industrial programs' effectiveness from multiple perspectives: the IESO's oversight, the LDCs' implementation, the program-by-program processes, and the individual customer experiences. The evaluation methodology is explained in more detail in *Section 3.1* and *Appendix C*.

In abbreviated form, goals of this evaluation include:

- Verify energy and summer peak demand savings by program
- Estimate the net change in greenhouse gas emissions from changes in electricity and natural gas consumption
- Estimate program attribution, including free-ridership, participant & non-participant spillover through net-to-gross analysis
- Evaluate the overall effectiveness and comprehensiveness of key program elements
- Analyze the cost-effectiveness of each Industrial program
- Analyze and make recommendations to improve the Industrial programs
- Determine participating customer satisfaction with the programs
- Estimate the net change in greenhouse gas emissions from changes in electricity and natural gas consumption

2 INDUSTRIAL PORTFOLIO OVERVIEW

2.1 INDUSTRIAL PROGRAM OVERVIEW

2.1.1 PROCESS & SYSTEMS UPGRADES PROGRAM (PSUP)

The Process & Systems Upgrades Program provides financial support for the implementation of energy efficiency projects and system optimization projects for facilities that are intrinsically complex and capital-intensive. 16 PSUP projects in-service starting in PY2017 were ready for evaluation and reporting. Another 14 projects from PY2016 and one from PY2015 have been carried over to this year's evaluation; these PY2017 and PY2016 and PY2015 adjustment projects are collectively referred to as the PY2017 sample frame.

The LDCs and IESO recently completed a program redesign process through the Business Working Group, which made a number of changes to PSUP in order to streamline and simplify it in response to LDC and customer feedback. The revised rules were posted on April 6, 2018 and went into effect one month later. The redesign of the program is detailed in *Section 5.1.6.1*.

2.1.2 ENERGY MANAGER NON-INCENTED MEASURES (EM)

The Energy Manager program subsidizes the salary of a trained energy manager to work directly with participating facilities to find energy savings, identify smart energy investments, secure financial incentives, and unleash competitive advantage. Energy managers can identify capital improvements that are eligible for incentive payments through PSUP, IAP Retrofit, or IAP Capital Incentives. Savings from these projects accrue to, and are evaluated in, the program that incents the improvement.

Energy managers are also expected to identify and implement *non-incented* improvements for the organizations they support. Since 2016, Energy Manager contracts require that 10% of the savings goal be achieved through non-incented improvements. This is a reduction from the 30% requirement in place previously. These non-incented projects are the focus of the Energy Manager evaluation conducted by the EcoMetric team. Embedded Energy Managers completed 281 non-incented measures that went into service in 2017 and were ready for evaluation, and another 157 measures were evaluated as 2016 adjustments.

2.1.3 INDUSTRIAL ACCELERATOR PROGRAM (IAP)

The Industrial Accelerator Program Initiative is administered directly by IESO, offered to transmission-connected customers, and provides incentives through three program streams: Capital Incentives (referred to interchangeably as IAP Process & Systems), Retrofit, and Energy Manager. Program delivery for each of these initiatives closely mimics the respective LDC-administered programs, and as discussed previously, for the Energy Manager program, the evaluation here is limited to the non-incented measures.

Between the three programs within the IAP Initiative, 58 IAP projects were completed in 2017. Table 3 below provides detail of the IAP reported savings from the PY2017 evaluation at the program-level. While the IAP Retrofit and IAP Energy Manager initiatives account for the largest number of projects, these projects are typically smaller in size and comprise a smaller portion of the IAP savings. The IAP Capital Incentives initiative is responsible for the majority (57%) of the IAP reported energy savings included in this evaluation.

Table 3: IAP Reported Savings

Program	2017 Projects Evaluated and Reported	2017 Reported Energy Savings (MWh)	2016 True-Up Projects Evaluated and Reported	2016 True-Up Reported Energy Savings (MWh)	2015 True-Up Projects Evaluated and Reported	2015 True-Up Reported Energy Savings (MWh)	PY2017 Evaluation Total Reported Energy Savings (MWh)	% of IAP Reported Savings
IAP (CI)	4	94,723	0	0	0	0	**94,723**	57%
IAP (Retrofit)	12	6,575	5	1,390	2	5,829	**13,794**	8%
IAP (EM)	42	39,956	7	19,416	0	0	**59,371**	35%
Total	**58**	**141,254**	**12**	**20,806**	**2**	**5,829**	**167,888**	

2.1.4 PROGRAM ENABLED SAVINGS (PES PSUP)

The Program Enabled Savings (PES) initiative provides an opportunity for LDCs to quantify savings generated through their customer interactions outside of the existing suite of efficiency programs. LDCs submit a PES claim form with substantiating documentation describing the project(s) and savings, which are credited to the appropriate efficiency program (PSUP, Retrofit or High Performance New Construction). The PES initiative is unique and does not exist in any North American jurisdiction with greater than $30M per year in annual CDM spending. The program design is deficient in several areas and it creates an alternative mechanism for LDCs to submit unsubstantiated savings claims.

Following a deep analysis of the PES initiative's design and processes, the EcoMetric team led a redesign of the initiative that was implemented by the IESO for the PY2017. As part of the redesign, projects applications and supporting data are scrutinized at the same level as all other programs in the Industrial Portfolio. Clear guidance as to the scope and level of detail required by the applicants to substantiate savings and IESO program influence was developed and has resulted in a marked improvement in the quality of claims submitted.

In PY2017, PES claims were approved and subject to an independent technical review process similar to other programs included in this evaluation. This is a change from PY2016, when PES claims did not go through an intermediate technical reviewer, rather; the claims were directly verified by the EcoMetric evaluation team.

Savings from PES claims are attributed to the industrial portfolio through PSUP. Four total PES claims were attributed to PSUP in the PY2017 evaluation, two going into service in 2017 and one going into service in 2016 and 2015 each. Meanwhile, savings from claims attributed to the Retrofit and High Performance New Construction (HPNC) are reported with their respective programs in the business portfolio. PES Retrofit claims were the most prevalent in the PY2017 evaluation with 46, while there were just three PES HPNC claims. Similarly to the IAP framework, retrofit projects were more plentiful but had lower per-project savings compared to PES claims attributed to PSUP and HPNC.

2.1.5 MONITORING AND TARGETING PROGRAM (M&T)

The Monitoring and Targeting (M&T) Program encourages industrial distribution customers to install or upgrade M&T systems to relate a facility's energy consumption data to the weather, production schedule, or other measures in such a way as to provide a better understanding of how energy is being used. M&T systems are expected to identify signs of avoidable energy waste or other opportunities to reduce consumption. Project eligibility is partly contingent on achieving a savings goal within 24 months of installation and sustaining these savings for the terms of the participant agreement, five years from the date the M&T system is installed.

Monitoring & Targeting had no projects in service starting in 2017 and ready for evaluation, therefore no verified impacts from the M&T program are included in this report. One project was technically ready for evaluation, but the supporting data used to verify savings was incomplete and out of date. Attempts to reach out to the participant did not result in sufficient data to support savings verification and projects were dropped from the evaluation. The two-year implementation schedule of M&T projects described above leads to a somewhat longer technical review phase. M&T program costs incurred in 2017 are included in the cost-effectiveness analysis.

2.2 REPORTED SAVINGS

IESO's Program Year (PY) 2017 industrial program portfolio comprises the programs and initiatives shown in Table 4 below. This table includes projects in-service starting in calendar year 2017 and ready for evaluation, meaning:

a) they have at least one quarter (3 months) of measurement and verification (M&V) data available (PSUP, IAP)

OR

b) they have been through the technical review process for the program and are not otherwise on hold for administrative reasons (Energy Manager non-incented, M&T).

Program Year 2017 evaluation activities also include PY2016 and PY2015 adjustments, defined as projects that went into service starting in calendar year 2016 or 2015 but did not have sufficient technical review to be ready for evaluation last year, or (less commonly) were otherwise incomplete as of April 1, 2018 due to contractual or administrative holds. Table 4 below shows reported savings and program contributions to the industrial portfolio including adjustment projects. The most notable adjustment contributions are to PSUP and PES PSUP.

Table 4: Completed Projects and Reported Savings for PY2017 Evaluation

Administrator	Program	2017 Projects Evaluated and Reported	2017 Reported Energy Savings (MWh)	2016 True-Up Projects Evaluated and Reported	2016 True-Up Reported Energy Savings (MWh)	2015 True-Up Projects Evaluated and Reported	2015 True-Up Reported Energy Savings (MWh)	PY2017 Evaluation Total Reported Energy Savings (MWh)	% of Industrial Sector Reported Savings
LDCs	PSUP	16	14,534	14	51,915	1	9,251	**75,701**	23%
	PES PSUP	2	430	1	18,568	1	17,337	**36,335**	11%
	EM*	281	31,243	157	12,302	0	0	**43,545**	13%
	M&T	0	0	0	0	0	0	**0**	0%
	Total LDCs	299	46,207	172	82,785	2	26,588	155,580	48%
IESO	IAP (CI)	4	94,723	0	0	0	0	**94,723**	29%
	IAP (Retrofit)	12	6,575	5	1,390	2	5,829	**13,794**	4%
	IAP (EM)*	42	39,956	7	19,416	0	0	**59,371**	18%
	Total IESO	58	141,254	12	20,806	2	5,829	167,888	52%
GRAND TOTAL		**357**	**187,461**	**184**	**103,591**	**4**	**32,416**	**323,468**	**100%**

3 EVALUATION METHODOLOGY

3.1 EVALUATION APPROACH

Methods used to conduct this evaluation include on-site inspections and measurement, engineering analysis, interval billing analysis, telephone surveys, documentation review, best practice review, and interviews with IESO and LDC staff, implementation vendors, technical reviewers, program participants, and non-participants. This section explains the evaluation approach in more detail, including the overall sample design and basic descriptions of the methods applied. More detailed descriptions of the methodology are included in *Appendix C.*

3.1.1 OVERALL SAMPLE DESIGN

This section outlines the statistical sample design across industrial programs. Sampling is employed for programs with greater volume of small to medium size projects, whereas a census-review (all projects) is conducted for programs with smaller population of large projects. This approach allows the evaluation team to balance evaluation cost and rigour. This section outlines the overall sample design across industrial programs. The program-specific sections include more detailed explanations of the sampling approaches for each program. One overarching theme that guided the sample design for the industrial programs is the limited population of program participants. Compared with other sectors, participation in the industrial programs consists of a relatively small number of large and unique projects. To accommodate this, a census of PSUP and IAP CI projects were included in project-level analysis and verification activities, providing a high level of certainty to the methods used to analyze a heterogeneous population. Other key elements of the sample design include the following:

1. EcoMetric utilized a single sample of program participants for the gross impact, net impact, and process evaluation. The net impact and process evaluations include multiple interviews/surveys in the same organization where appropriate.
2. For the Energy Manager non-incented projects, where the project volume is higher and per-project savings are smaller, sampling was utilized to accurately estimate savings without individually analyzing every project.
3. For the Industrial Accelerator Program Capital Incentive program, a census of projects and participants was evaluated. Sampling was utilized in the IAP Energy Manager and IAP Retrofit programs due to the higher number of projects in these initiatives.
4. For the Program Enabled Savings (PES) claims, sampling was also utilized.
5. A census evaluation of the Monitoring and Targeting program was planned, but no projects were ready for evaluation or had sufficient supporting documents to verify savings in PY2017.

Table 5 includes participant sample sizes for impact evaluation (gross and net) and process evaluation based on the target confidence levels/precision (margin of error) ranges shown. 90% confidence and 10% precision was the target sampling requirement for the EM non-incented, IAP EM, IAP Retrofit and PES initiatives.

Table 5: PY2017 Sample Design

Program/Initiative	PY2017 Projects Completed[3]	Target Confidence/ Precision	Sample Size			
			PY2017	PY2016 Adjustments	PY2015 Adjustments	Total
PSUP	27	census	16	14	1	**31**
EM Non-Incented[4]	294	Sample (90%/10%)	281	92	0	**373**
IAP Capital Incentive	4	census	4	0	0	**4**
IAP EM	47	Sample (90%/10%)	28	4	0	**32**
IAP Retrofit	20	Sample (90%/10%)	16	3	1	**20**
Monitoring & Targeting	0	census	0	0	0	**0**
PES[5]	27	Sample (90%/10%)	16	9	5	**28**
TOTAL	419	-	361	122	7	488

3.2 GROSS SAVINGS VERIFICATION

Program-specific methodologies for verifying gross savings are described in more detail in *Sections 5.1* through *5.5*. Data sources and methods of data collection and review, including retrieval of tracking system and program documentation, telephone interviews, and on-site data gathering, are explained in more detail in *Appendix C*.

3.3 NET SAVINGS ANALYSIS

Net Savings and net-to-gross (NTG) ratios were calculated to incorporate free-ridership and spillover factors for the projects evaluated. Free-ridership accounts for any reductions to gross savings due to what the customer would have done absent the program's influence. The condition of what the customer

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[3] Several projects completed in 2017 did not have at least one quarter of M&V data, so they will be evaluated in PY2018 as adjustment projects.
[4] EM program participation and sample are reported in measures.
[5] Includes PES savings claims attributable to PSUP, as well as the Retrofit and HPNC programs in the Business Portfolio. Savings from the Retrofit and HPNC claims are reported with their respective programs.

would have done is commonly referred to as the counterfactual condition in NTG analyses. As in the past, the basis of free-ridership analysis for IESO's industrial programs was direct query (interviews with past participants) about the theoretical counterfactual condition. This method is considered best practice for programs with large savings per project, unique applications, and low participant counts.

More information on the net savings methodology, including data collection details, questionnaire design, can be found in *Appendix C.*

3.4 SUMMER PEAK DEMAND ANALYSIS

EcoMetric verified summer coincident peak demand impacts for each project based on the IESO-defined peak periods included in *Appendix A*. High-resolution energy savings load shapes, vital for calculating on-peak demand savings, were developed for each project and used to account for the seasonal, daily, and hourly variations in operating schedules and energy consumption. In cases where an accurate project-specific load shape could not be developed, existing IESO load shapes were selected based on measure and premise type.

3.5 COST-EFFECTIVENESS ANALYSIS

The IESO Conservation and Demand Management (CDM) Cost-Effectiveness tool was used to estimate measure-level costs and benefits, which were then aggregated to program- and portfolio-level cost effectiveness. Program administrative costs were provided to EcoMetric by IESO. Other key inputs for the cost effectiveness analysis include lifetime electric energy and demand savings, gas savings where applicable, measure lives, and energy savings load shapes. Program-specific cost effectiveness results are included in *Chapter 5.*

3.6 AVOIDED GREENHOUSE GAS EMISSIONS ESTIMATION

EcoMetric estimated net greenhouse gas (GHG) impacts for each project and program by utilizing measure-level energy savings load shapes based on metered data, natural gas consumption meter data, and emissions factors (EFs) provided by the IESO at the annual and hourly level and aggregated to the eight IESO peak periods as defined in the Conservation and Demand Management Energy Efficiency Cost Effectiveness Tool. In the industrial portfolio where behind-the-meter generation projects are commonplace, natural gas usage for combustion-based electricity production can significantly counteract emissions savings from avoided electricity consumption, resulting in a net increase in GHG emissions. More information on the GHG emissions impacts is included in *Chapter 4.*

3.7 PROCESS EVALUATION APPROACH

The PY2017 process evaluation is the second of a two-phase project to systematically assess the CFF industrial programs, document existing processes, and identify improvements. The team sought to understand the CFF industrial programs' effectiveness from multiple perspectives: the IESO's oversight, the LDCs' implementation, the program-by-program processes, and the individual customer experiences.

The first phase of research centered around developing a detailed overview of the programs from interviews with IESO staff and a sample of LDCs, and preliminary findings and recommendations from that effort were presented in a series of program snapshots in the PY2016 evaluation report. Phase 2 built off that effort by delving into areas that warranted a deeper look and supplemented the original observations with data from a wider group of stakeholders. Specifically, the second phase aimed to:

- Gather additional perspectives from stakeholders and program documentation to add depth and color to the preliminary observations and findings from the first phase.
- Study the specific program processes that were unclear to participants or the evaluators.
- Solicit feedback on participation experiences from a much broader range of stakeholders (participants in all programs, energy managers, partial and nonparticipants).
- Deliver a final comprehensive report with data from both phases and a full set of findings and recommendations, as well as details on progress made towards implementing Phase 1 preliminary recommendations.
- Identify further targeted research studies focusing on specific aspects of the programs that can be performed over the next three years.

Overall, the evaluation team conducted 189 interviews and surveys for the Phase 2 research, as shown in Table 6 below:

Table 6: Process Interview and Survey Counts

Interview/Survey Target	Count
IAP staff interviews	4
LDC surveys	39
EM interviews	10
Participant interviews	**48**
PSUP	24
EM - LDC	10
IAP	4
IAP Retrofit	5
EM - IAP	5
Nonparticipant surveys	**75**
Large	17
Medium	26
Small	32
Partial participant surveys	**13**
EM	6
M&T	4
IAP	3
Total	**189**

The EcoMetric team analyzed each group of interviews and surveys separately, and then grouped the data into programs and topics within each program. To best organize this data, the team has split the findings into two areas:

- Cross-cutting areas that focus on the overall portfolio and the aspects that exist across all programs, such as coordination and marketing
- Program-specific areas that delve into the performance of each program

Cross-cutting data, findings, and recommendations can be found in *Chapter 4*; all program-specific data can be found in each program's section in *Chapter 5*. More detailed descriptions of the methodology are included in *Appendix C.*

4 PORTFOLIO EVALUATION RESULTS

This chapter contains evaluation results for the entire industrial portfolio. Each sub-section contains impact results, related findings, and recommendations in the following areas:

- Tracking System and Program Documentation Review
- Gross Verified Savings
- Net Verified Savings
- Cost Effectiveness Results
- Greenhouse Gas Impact Results
- Process Evaluation Results

4.1 INDUSTRIAL PORTFOLIO IMPACT RESULTS OVERVIEW

Table 7 below summarizes verified savings from the 2017 impact evaluation. These results include projects from both the *Conservation First Framework (CFF)* and *the 2011 - 2014 + 2015 Extension Legacy Green Energy Act Framework (Legacy)*. The program-specific sub-sections in *Chapter 5* include more detailed breakdowns of verified savings.

4.1.1 GROSS SAVINGS OVERVIEW

The overall energy realization rate (RR), a ratio of *gross verified* (ex-post) savings to *reported* (ex-ante) savings, is 98.5% for the industrial portfolio, confirming a generally high level of accuracy of the technical review and ex-ante reporting. Program-specific energy RRs are close to 100% for all programs.

4.1.2 NET SAVINGS OVERVIEW

The portfolio net-to-gross (NTG) ratio, is 85.3%. The highest program-level NTG ratio belongs to PSUP (91.7%), while the lowest is Energy Manager (75.8%). The PES program has an NTG ratio of 100% by design, as the program was created to capture spillover and has no free-ridership.

4.1.3 PERSISTENCE TO 2020 OVERVIEW

A significant portion of first-year energy and demand savings (85%) across the PY2017 portfolio persist through 2020. Savings from the Energy Manager non-incented measures are the only savings where a significant portion does not persist through 2020 (64% of LDC Energy Manager non-incented savings persist through 2020, and only 68% of IAP Energy Manager savings persist).

Table 7: Industrial Portfolio Impacts Summary

Program	# of Projects Evaluated & Reported	Target Confidence/ Precision	Energy RR	Energy RR Relative Precision	Gross Verified Energy Savings (MWh)	Demand RR	Gross Verified Summer Peak Demand Savings (MW)	NTG Ratio[6]	Net Verified Energy Savings (MWh)	Net Verified Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
LDC-Administered Programs											
Process & Systems Upgrades (PSUP)	31	census	102%	n/a	77,140	158.4%	11	91.7%	70,433	9.95	100%
Program Enabled Savings (PES)[7]	4	Sample (90%/10%)	100%	±9.1%	36,185	n/a	-	100.0%	36,185	-	59%
Energy Manager Non-Incented (EM)*	438	Sample (90%/10%)	95%	±0.2%	41,503	104.5%	6.05	75.8%	31,442	4.63	64%
Monitoring & Targeting (M&T)	0	census	n/a	n/a	0	n/a	0	n/a	0	0	n/a
Total LDC	**473**		**99%**		**154,828**	**112.7%**	**17.05**	**86.4%**	**138,060**	**14.58**	**81%**
IESO-Administered Programs											
IAP Capital Incentives	4	census	100.7%	n/a	95,415	100.1%	10.92	83.9%	80,066	9.16	100%
IAP Retrofit	19	Sample (90%/10%)	103.8%	±6.5%	14,316	111.3%	2.04	88.4%	12,654	1.8	100%
IAP Energy Manager Non-Incented*	53	Sample (90%/10%)	90.8%	±0.2%	53,932	89.2%	4.9	76.0%	40,982	3.77	68%
Total IESO	**76**		**97.5%**		**163,663**	**97.9%**	**17.86**	**81.7%**	**133,702**	**14.74**	**90%**

[6] Program-level NTG ratios are for illustration purposes only. NTG ratios are calculated each program year for the evaluation sample and applied to the population of each program. For the PSUP and IAP CI programs, each project received its own NTG ratio.
[7] Includes only PES claims attributed to PSUP.

GRAND TOTAL	549		98.5%		318,491	112.7%	34.92	85.3%	271,762	29.31	85%

4.1.4 PORTFOLIO TRACKING SYSTEM & PROGRAM DOCUMENTATION REVIEW RESULTS

Most tracking data and other program/project documentation was provided to EcoMetric by IESO's technical reviewer. The technical reviewer works with industrial program participants from project inception through M&V, reporting the status of industrial customer applications, contracts, projects, and M&V plans to IESO through approximately 15 related data sets.

The list of findings and recommendations below includes a few opportunities for improvement to tracking systems that can mitigate reporting errors, whereby the reported savings or status of a given project or measure does not reflect actual conditions. Reporting errors not only present challenges for IESO and the evaluation teams, but more importantly, without rigourous review, these errors can lead to inaccurate estimates of verified/ex-post savings. Where applicable, these issues are described in more detail in the program-specific sections that follow.

Finding 1: Tracking data and project documentation is generally accurate and comprehensive but can be improved to ensure precise estimations of verified savings.

- "Lower-priority" project parameters are sometimes not reported at all. This can potentially impact verified savings, cost effectiveness, etc., especially when many projects prevent individual verification of each parameter.
- In some cases, unique project and measure level IDs were not consistently recorded across databases. For instance, several iCon IDs, a unique project identifier used by the IESO and technical reviewer, were different for the same projects between the Energy Manager Measure Extract Database and Application Tracking Database.

Recommendation 1: Open a channel of communication between the evaluator and technical reviewer, facilitated by the IESO, to ensure tracking data and project documentation issues are understood and impactful and realistic solutions can be implemented.

- In Q42018, the IESO facilitated an in-person meeting between the technical reviewer and evaluation team to discuss each stakeholder's processes, tracking systems and methodology regarding the technical review and evaluation of the industrial portfolio. A channel of communication and bi-weekly meetings have been established to improve a mutually beneficial relationship based on continuous feedback and improvement throughout the implementation and evaluation of the CFF.

4.1.5 PORTFOLIO GROSS VERIFIED SAVINGS RESULTS

Table 8 includes a summary of all projects evaluated in PY2017 for gross verified savings by program and framework from the PY2017 Evaluation. Most energy realization rates are close to 100%. Where they vary from 100%, it is usually attributable to changes in the baseline assumptions used.

Table 8: PY2017 Gross Verified Savings Detail

Program/Year	# of Projects Evaluated & Reported	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)[8]	Persistence of Savings in 2020
Process & Systems Upgrades (PSUP)					
2017	16	107.2%	15,586	2.81	100%
2016 Adjustments	14	99.9%	51,863	7.40	100%
2015 Legacy Adjustments	1	104.8%	9,691	0.79	100%
PSUP TOTAL	**31**	**101.9%**	**77,140**	**11.00**	**100%**
Program Enabled Savings (PES) PSUP					
2017	2	99.6%	428	-	100%
2016 Adjustments	1	99.6%	18,491	-	100%
2015 Legacy Adjustments	1	99.6%	17,265	-	13%
PES PSUP Total	**4**	**99.6%**	**36,185**	**-**	**59%**
Energy Manager Non-Incented (EM)					
2017	281	94.4%	29,476	3.98	56%
2016 Adjustments	157	97.8%	12,027	2.07	81%
EM TOTAL	**438**	**95.3%**	**41,503**	**6.05**	**63%**
IAP Capital Incentives					
2017	4	100.7%	95,415	10.92	100%
IAP CI Total	**4**	**100.7%**	**95,415**	**10.92**	**100%**
IAP Retrofit					
2017	12	103.8%	6,824	0.79	100%
2016 Adjustments	5	103.8%	1,443	0.35	100%
2015 Legacy Adjustments	2	103.8%	6,049	0.90	100%

[8] No demand savings are reported for the PES initiative because demand savings were not verified by the technical reviewer.

Program/Year	# of Projects Evaluated & Reported	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)[8]	Persistence of Savings in 2020
IAP Retrofit Total	19	103.8%	14,316	2.04	100%
IAP Energy Manager Non-Incented					
2017	42	93.7%	37,442	3.10	55%
2016 Adjustments	11	84.9%	16,491	1.80	91%
IAP EM Total	53	90.8%	53,932	4.90	66%
GRAND TOTAL	549	98.5%	318,491	34.92	85%

The relative precision[9] of the energy savings realization rates for the EM and IAP EM programs was 0.2% at the 90% confidence level. With more variation in the amount of energy savings per project, the relative precision of the energy RRs for IAP Retrofit and the PES initiative were 6.5% and 9.1%[10] at the 90% confidence level, respectively. PSUP and IAP CI were evaluated as a census with each project receiving an individual energy realization rate.

Finding 2: The technical review process generally yielded accurate energy savings calculations but could benefit from a more uniform methodology.

- Metered data provided by the technical reviewer is inconsistent, subject to issues such as duplicate or missing hourly data due to daylight savings time and leap years.
- For projects evaluated with one quarter of post-project data, the technical reviewer did not forecast annual savings using consistent methodology. Several annual savings values were forecasted by simply multiplying quarterly savings by four while others were extrapolated based on annual expected operating days compared to operating days in the metered period. Multiple projects extrapolated one quarter of metered data to one year of savings by applying the average of the metered period to all non-metered hours. However, some measures are expected to vary based on season, month, weekday, hour, etc.

[9] Relative precision represents the uncertainty of the calculated realization rate for the program's population relative to the value of the program's realization rate for the sample at the 90% confidence level.
[10] Relative precision metric is for all projects in the PY2017 PES evaluation, including PES projects attributed to the Retrofit and HPNC programs as part of the IESO Business Portfolio.

- Measure and baseline classifications and calculations were not consistent between evaluation years. For example, during the PY2016 evaluation, CHP projects were classified as a lost opportunity with an Industry Standard Practice (ISP) baseline instead of a retrofit with preexisting conditions as the baseline as was used by the technical reviewer in the PY2017 evaluation. Differing baseline calculation methodologies can result in vastly different savings results for similar projects between program years.

Recommendation 2: Create a standard procedure or similar guidance for the technical review process, including baseline classifications and calculations based on measure type. Require the technical reviewer to consider seasonal variations and other correlations when forecasting annual savings and encourage the technical reviewer to provide clear explanations of the methods used to extrapolate partial-year results to annual results.

As shown in Table 9 below, **56% of Industrial portfolio energy savings in PY2017 came from behind-the-meter generation (BMG) projects.** BMG projects account for the majority of energy savings in both LDC-administered and IESO-administered programs.

Table 9: PY2017 Portfolio Gross Verified Savings by Project Type

Program/Type	Gross Energy Savings (MWh)	% of Savings	Gross Demand Savings (MW)	% of Savings
LDC-Administered Programs				
BMG	87,552	57%	6.34	37%
EE	67,276	43%	10.72	63%
Total LDC	**154,828**		**17.05**	
IESO-Administered Programs				
BMG	90,581	55%	10.35	58%
EE	73,083	45%	7.51	42%
Total IESO	**163,663**		**17.86**	
All Industrial Programs				
BMG	**178,133**	**56%**	**16.69**	**48%**
EE	**140,358**	**44%**	**18.23**	**52%**
Grand Total	**318,491**		**34.92**	

Finding 3: Behind-the-meter generation (BMG) projects account for 56% of gross verified energy savings and account for the majority of savings in both LDC-administered and IESO-administered programs evaluated in PY2017.

- All BMG projects in the PY2017 evaluation were CHP units. The Government of Ontario's 2017 Long-Term Energy Plan ended funding for CHP projects that burn fossil fuels in both the CFF and IAP. Effective July 1, 2018 the IESO is no longer accepting applications for CHP projects. While many CHP projects are currently in the application phase and will create significant energy savings over the next few years, the number of BMG projects and their impact on the industrial portfolio will surely decline in the future. CHP units that use non-fossil fuels, such as biogas, are still eligible for funding, so opportunities to encourage energy savings through CHP projects still exist.

Recommendation 3: Create a standing committee with the IESO, LDCs and partners to develop a plan to sustain participation in the Industrial Portfolio following the removal of a popular energy efficiency measure. Investigate the potential for biogas-fueled CHPs in Ontario, as well as other projects that were overshadowed by CHPs.

4.1.5.1 Total CFF Gross Savings

In PY2016, EcoMetric carried out the impact evaluation for the industrial portfolio, including projects in-service in 2016 under the *Conservation First Framework* (CFF) and projects in service in 2015 under the *2011 - 2014 + 2015 Extension Legacy Green Energy Act Framework* (Legacy). Total industrial portfolio gross verified energy savings were 345,417 MWh in the PY2016 evaluation. Verified net first-year energy savings were 297,303 MWh, or 86.1% of gross verified savings, with 57% of savings coming from the LDC-administered programs. Nearly all first-year PY2016 savings across the portfolio (95.3%) persist through 2020.

Solely focusing on the current CFF framework, consisting of projects in service starting in 2016 and later, the industrial portfolio achieved 444,125 MWh of gross first-year energy savings and 111.2 MW of gross summer peak demand savings. The IAP CI program, despite having only 14 of the 704 CFF projects evaluated and reported, accounted for 47% of the CFF industrial portfolio's total gross energy savings.

Projects completed in 2016 in the industrial portfolio achieved 258,954 MWh of gross verified energy savings and 89.6 MW of demand savings. 158,640 MWh of these energy savings and 78.0 MW demand savings were verified as part of the PY2016 evaluation, while 100,314 MWh of energy savings and 11.6 MW of demand savings were verified in the PY2017 evaluation as adjustments. Projects completed in 2017 totaled 185,171 MWh of gross verified energy savings and 21.6 MW of demand savings. Detailed savings by program and implementation year are summarized in Table 10 below.

Table 10: CFF Gross Savings Detail

Project Implementation Year	Evaluation Year	# of Projects Evaluated & Reported	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)[11]	Persistence of Savings in 2020
Process & Systems Upgrades (PSUP)						
2017	PY2017	16	107.2%	15,586	2.81	100%
2016	PY2017	14	99.9%	51,863	7.40	100%
2016	PY2016	4	101.6%	14,026	2.05	100%
PSUP TOTAL		**34**	**101.5%**	**81,475**	**12.27**	**100%**
Program Enabled Savings (PES)						
2017	PY2017	2	99.6%	428	-	100%
2016	PY2017	1	99.6%	18,491	-	100%
2016	PY2016	1	100.5%	339	0.02	100%
PES PSUP Total		**4**	**99.6%**	**19,259**	**0.02**	**100%**
Energy Manager Non-Incented (EM)						
2017	PY2017	281	94.4%	29,476	3.98	56%
2016	PY2017	157	97.8%	12,027	2.07	81%
2016	PY2016	123	97.9%	19,026	1.76	82%
EM Total		**561**	**96.1%**	**60,529**	**7.81**	**69%**
IAP Capital Incentives						
2017	PY2017	4	100.7%	95,415	10.92	100%
2016	PY2017	0	-	0	0.00	-
2016	PY2016	10	97.6%	111,958	16.31	100%
IAP CI Total		**14**	**99.0%**	**207,373**	**27.23**	**100%**
IAP Retrofit						
2017	PY2017	12	103.8%	6,824	0.79	100%
2016	PY2017	5	103.8%	1,443	0.35	100%
2016	PY2016	10	104.5%	1,293	0.14	100%
IAP Retrofit Total		**27**	**103.9%**	**9,560**	**1.28**	**100%**
IAP Energy Manager Non-Incented						
2017	PY2017	42	93.7%	37,442	3.10	55%
2016	PY2017	11	84.9%	16,491	1.80	91%

[11] No demand savings are reported for the PES initiative because demand savings were not verified.

Project Implementation Year	Evaluation Year	# of Projects Evaluated & Reported	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)[11]	Persistence of Savings in 2020
2016	PY2016	11	116.6%	11,997	57.70	100%
IAP EM Total		**64**	**94.6%**	**65,929**	**62.60**	**72%**
Industrial Portfolio Total						
2017	PY2017	**357**	**98.8%**	**185,171**	**21.60**	**84%**
2016	PY2017	**188**	**96.8%**	**100,314**	**11.63**	**96%**
2016	PY2016	**159**	**99.2%**	**158,640**	**77.98**	**98%**
GRAND TOTAL		**704**	**98.5%**	**444,125**	**111.21**	**92%**

4.1.6 PORTFOLIO NET VERIFIED SAVINGS RESULTS

Table 11 includes a summary of net verified savings by program and framework from the PY2017 evaluation. Net savings for the industrial portfolio evaluated in PY2017 are 85.3% of gross verified savings, indicating low levels of free-ridership, on average, across the programs. PSUP has the highest NTG ratio at 91.3%. The Energy Manager program has the lowest NTG ratio at 75.8%. The CFF is clearly meeting is goal of creating long-lasting energy savings, as 85% of the PY2017 industrial portfolio's first year energy savings verified in this evaluation persist through 2020. This is typical of programs in the industrial sector, where projects tend to have longer effective useful lives. There is no spillover attributed to the industrial programs across the portfolio.

Table 11: PY2017 Net Verified Savings Detail

Program/Year	# of Projects Evaluated & Reported	NTG Ratio (%)[12]	Net Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
Process & Systems Upgrades (PSUP)					
2017	16	95.0%	14,774	2.64	100%
2016 Adjustments	14	90.5%	46,647	6.57	100%
2015 Legacy Adjustments	1	93.0%	9,013	0.73	100%
PSUP TOTAL	**31**	**91.3%**	**70,433**	**9.95**	**100%**
Program Enabled Savings (PES)					
2017	2	100.0%	428	-	100%
2016 Adjustments	1	100.0%	18,491	-	100%
2015 Legacy Adjustments	1	100.0%	17,265	-	13%
PES PSUP Total	**4**	**100.0%**	**36,185**	**-**	**59%**
Energy Manager Non-Incented (EM)					
2017	281	71.6%	21,099	2.85	56%
2016 Adjustments	157	86.0%	10,343	1.78	81%
EM TOTAL	**438**	**75.8%**	**31,442**	**4.63**	**63%**
IAP Capital Incentives					
2017	4	83.9%	80,066	9.16	100%
IAP CI Total	**4**	**83.9%**	**80,066**	**9.16**	**100%**
IAP Retrofit					
2017	12	88.4%	6,032	0.70	100%
2016 Adjustments	5	88.4%	1,275	0.31	100%
2015 Legacy Adjustments	2	88.4%	5,347	0.79	100%
IAP Retrofit Total	**19**	**88.4%**	**12,654**	**1.80**	**100%**
IAP Energy Manager Non-Incented					
2017	42	71.6%	26,800	2.22	55%
2016 Adjustments	11	86.0%	14,182	1.55	91%
IAP EM Total	**53**	**76.0%**	**40,982**	**3.77**	**66%**

[12] Program-level NTG ratios are for illustration purposes only. NTG ratios are calculated each program year for the evaluation sample and applied to the population of each program. For the PSU and IAP CI programs, each project received its own NTG ratio.

GRAND TOTAL	549	85.3%	271,762	29.31	85%

4.1.6.1 Total CFF Net Savings Results

The total verified net savings for the industrial portfolio under the CFF (PY2017 and PY2016) are summarized in Table 12 below.

Table 12: CFF Net Savings Detail

Implementation Year	Evaluation Year	# of Projects Evaluated & Reported	NTG Ratio (%)[13]	Net Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)[14]	Persistence of Savings in 2020
Process & Systems Upgrades (PSUP)						
2017	PY2017	16	94.8%	14,774	2.64	100%
2016	PY2017	14	89.9%	46,647	6.57	100%
2016	PY2016	4	81.3%	11,397	1.63	100%
PSU TOTAL		**34**	**89.4%**	**72,818**	**10.85**	**100%**
Program Enabled Savings (PES)						
2017	PY2017	2	100.0%	428	-	100%
2016	PY2017	1	100.0%	18,491	-	100%
2016	PY2016	1	100.0%	339	-	100%
PES PSU Total		**4**	**100.0%**	**19,259**	**-**	**100%**
Energy Manager Non-Incented (EM)						
2017	PY2017	281	71.6%	21,099	2.85	56%
2016	PY2017	157	86.0%	10,343	1.78	81%
2016	PY2016	123	86.0%	16,363	1.51	82%
EM Total		**561**	**79.0%**	**47,804**	**6.14**	**69%**
IAP Capital Incentives						
2017	PY2017	4	83.9%	80,066	9.16	100%
2016	PY2017	0	-	0	0.00	-
2016	PY2016	10	98.3%	110,042	16.07	100%

[13] NTG ratios are calculated each program year for the evaluation sample and applied to the population of each program. For the PSU and IAP CI programs, Program-level NTG ratios are for illustration purposes only, each project received its own NTG ratio.
[14] No demand savings are reported for the PES initiative because demand savings were not verified by the technical reviewer.

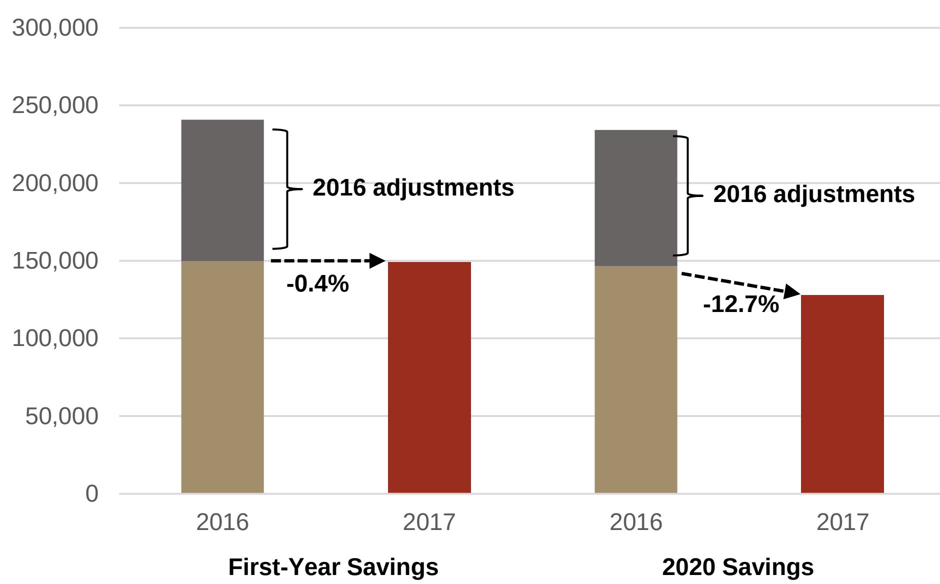
Implementation Year	Evaluation Year	# of Projects Evaluated & Reported	NTG Ratio (%)[13]	Net Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)[14]	Persistence of Savings in 2020
IAP CI Total		**14**	**91.7%**	**190,108**	**25.23**	**100%**
IAP Retrofit						
2017	PY2017	12	88.4%	6,032	0.70	100%
2016	PY2017	5	88.4%	1,275	0.31	100%
2016	PY2016	10	77.0%	1,293	0.11	100%
IAP Retrofit Total		**27**	**90.0%**	**8,600**	**1.12**	**100%**
IAP Energy Manager Non-Incented						
2017	PY2017	42	71.6%	26,800	2.22	55%
2016	PY2017	11	86.0%	14,182	1.55	91%
2016	PY2016	11	86.0%	10,363	67.60	100%
IAP EM Total		**64**	**77.9%**	**51,345**	**71.3.7**	**72%**
Industrial Portfolio Total						
2017	PY2017	**357**	**80.6%**	**149,199**	**17.57**	**84%**
2016	PY2017	**188**	**90.7%**	**90,939**	**10.21**	**96%**
2016	PY2016	**159**	**94.2%**	**149,797**	**86.92**	**98%**
GRAND TOTAL		**704**	**87.8%**	**389,935**	**114.70**	**92%**

As part of the CFF framework, **the industrial portfolio has achieved 389,935 MWh of net first-year energy savings, representing 87.8% of gross verified first-year energy savings during PY2016 and PY2017 and indicating relatively low levels of free-ridership overall**. Growth in the portfolio's net first-year energy savings was relatively flat in PY2017 compared to the 149,797 MWh net first-year energy savings achieved and evaluated in PY2016.

Figure 4 below depicts the CFF industrial portfolio net first-year and persistent energy savings. **Total net first-year energy savings decreased just 0.4% YOY in PY2017, compared to PY2016 results without 2016 adjustment savings.** 2016 adjustment projects, those that were implemented in 2016 but evaluated in PY2017, account for 90,939 MWh of net first-year energy savings—23% of the total portfolio net energy savings achieved through the CFF to date.

In total, 362,153 MWh of industrial portfolio net energy savings achieved under the CFF persist to 2020—93% of net first-year energy savings. The industrial portfolio projects implemented in PY2017 and evaluated in PY2017 had 127,945 MWh of net 2020 energy savings—84% of net first-year energy savings. Compared to PY2016 projects without 2016 adjustments from the PY2017 evaluation, total portfolio net 2020 energy savings decreased 12.7% YOY. The main driver for this decline in savings persistence was the decrease in persistent savings from the IAP Energy Manager non-incented and Energy Manager non-incented programs which experienced an uptick in PY2017 of Operations and Maintenance (O&M) measures that have shorter Effective Useful Lives (EULs).

Figure 4: CFF Industrial Portfolio Total First-Year and 2020 Net Energy Savings (MWh)



4.1.7 COST EFFECTIVENESS RESULTS

EcoMetric utilized the IESO Conservation and Demand Management (CDM) Energy Efficiency Cost-Effectiveness Tool to calculate multiple measures of cost-effectiveness, including the Total Resource Cost Test, the Program Administrator Test, and levelized cost per kWh.

Table 13 includes select program and portfolio cost effectiveness results. Cost-benefit assumptions by program are included in *Appendix D*.

Table 13: PY2017 Cost Effectiveness Results

Admin	Program	TRC Costs	TRC Benefits	TRC Ratio	PAC Costs	PAC Benefits	PAC Ratio	LC $/kWh
LDCs	PSUP	$18,945,012	$10,213,369	0.54	$7,951,054	$12,518,751	1.57	0.05
	PES[15]	-	$51,335	-	-	$818,153	-	-
	EM	$8,492,766	$7,518,719	0.89	$2,459,290	$6,538,017	2.66	0.02
	M&T	$213,180	$0	-	$213,180	$0	-	-
	Total LDCs	**$27,650,959**	**$17,783,422**	**0.64**	**$10,623,524**	**$19,874,920**	**1.87**	**0.04**
IESO	IAP (CI)	$28,022,350	$103,850,375	3.71	$23,516,402	$66,699,817	2.84	0.03
	IAP (Retrofit)	$1,319,671	$4,264,297	3.23	$470,445	$3,708,085	7.88	0.01
	IAP (EM)	$1,856,058	$7,979,385	4.30	$0	$6,938,596	-	-
	Total IESO	**$31,198,079**	**$116,094,058**	**3.72**	**$23,986,847**	**$77,346,497**	**3.22**	**0.02**
PORTFOLIO TOTAL		**$58,849,038**	**$133,877,481**	**2.27**	**$34,610,371**	**$97,221,417**	**2.81**	**0.03**

Overall the Industrial Portfolio was cost effective in PY2017 according to program administrator cost (PAC) test and the total resource cost (TRC) test using a threshold of 1.0. IESO-administered industrial programs in PY2017 had a TRC ratio of 3.72 while LDC-administered Industrial Programs had a TRC ratio of just 0.64. The TRC ratio for LDC-administered industrial programs was brought down by the high natural gas costs of the CHP projects prevalent in PSUP.

Only 2 of 22 CHP projects met the TRC threshold of 1.0 at the project-level. The vast majority of CHP units evaluated in PY2017 resulted in net increased natural gas consumption. The cost of supply for natural gas outweighed the avoided cost of electricity generated by the units.

Finding 4: The cost of natural gas used to calculate avoided costs of natural gas consumption in the IESO's Cost Effectiveness Tool is not frequently updated to reflect current market conditions, resulting in inaccurate calculations that do not account for actual natural gas costs incurred in the fuel market.

- The cost of avoided gas is set at $8.80/MMBtu in the CE Tool, which was first used in 2014 and developed leveraging data from 2007. Since January 1, 2017, the spot market price of natural gas (Henry Hub) has fallen 10%. Market prices for natural gas are extremely sensitive to ever-changing

[15] PES claims' costs and benefits are included in their respective programs. PES PSUP CE analysis is included in the PSUP CE results in Section 5.1.4.

supply and demand dynamics, as well as unpredictable weather events. The fuel's price volatility is depicted below in Figure 5.

Figure 5: Henry Hub Spot Price for Natural Gas[16]

***Recommendation 4:** Update the avoided cost of natural gas used in the CDM Cost Effectiveness Tool on an annual basis to reflect current market conditions. A comparison study of marginal natural gas costs in Ontario and other provinces with similar markets is recommended to ensure the avoided costs used reflect industry practices.*

- The price of natural gas is seasonal, increasing in the winter in the Northern Hemisphere when demand is high for heating. Using just one avoided natural gas cost across the whole year does not account for this seasonality, penalizing projects that create natural gas savings during winter when prices are higher and projects that result in increased natural gas consumption during the summer when prices are lower.

***Recommendation 5:** Develop functionality in the Cost Effectiveness tool to account for the seasonality of natural gas prices. Seasonal avoided cost prices of electricity are utilized in the CDM CE tool by leveraging hourly electric load profiles, which should serve as an example for seasonal avoided cost of natural gas.*

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[16] Source: EIA; https://www.eia.gov/dnav/ng/hist/rngwhhdM.htm

4.1.8 PORTFOLIO GREENHOUSE GAS EMISSIONS RESULTS

Net greenhouse gas (GHG) emissions impacts of the industrial portfolio in PY2017 are positive, resulting in net first year emissions reductions of approximately 27,018 metric tonnes (t) of CO_2 equivalent (CO_2e). The largest contributor to GHG reductions is IAP Capital Incentives, resulting first-year GHG reduction of 28,591 tonnes. However, the PSUP and PES PSUP projects in PY2017 increase first-year GHG emissions by a total of 16,083 tonnes due to the considerable increase in natural gas consumption attributable to combined heat and power (CHP) installations.

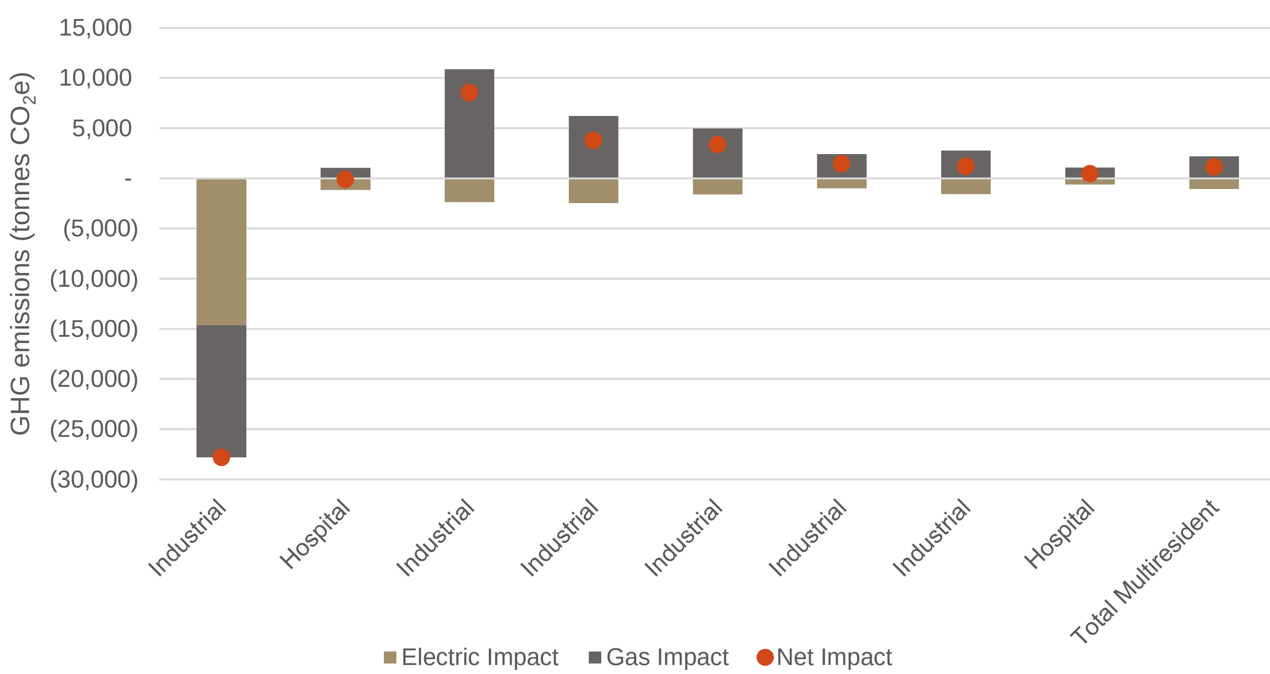
The entire portfolio resulted in a reduction of 45,351 tonnes of GHG emissions from electric savings but increased natural gas consumption created 18,333 tonnes of GHG emissions. As the IESO stopped accepting applications for natural gas-powered CHP units in July 2018, emissions impacts for the industrial portfolio will likely improve through the remainder of the CFF. Cost per tonne of avoided emissions varies significantly among programs, as show in Table 14. The costs presented here are TRC, including both the participants' and the administrator's costs.

Table 14: PY2017 Greenhouse Gas Emissions Impacts

Administrator	Program	First Year GHG Impacts (tonnes CO_2e)			First Year GHG Reduction Costs ($/tonne CO_2e) (Total Resource Costs)
		Electric	Gas	**Total**	
LDCs	PSU	10,551	-14,342	**-3,790**	(15,156)
	PES PSU	4,894	-17,187	**-12,293**	-
	EM	5,476	0	**5,476**	2,277
	M&T	0	0	**0**	-
	Total LDCs	20,922	-31,529	-10,607	(6,592)
IESO	IAP (CI)	15,395	13,196	**28,591**	1,013
	IAP (Retrofit)	2,141	0	**2,141**	1,303
	IAP (EM)	6,894	0	**6,894**	279
	Total IESO	24,430	13,196	37,626	895
PORTFOLIO TOTAL		**45,351**	**-18,333**	**27,018**	**3,835**

As shown in Figure 6, behind-the-meter generation (BMG) projects have complex emissions impacts, where avoided GHG emissions from electric savings are often counteracted by increased GHG emissions resulting from more natural gas consumption. Out of 39 total PSUP, PES PSUP and IAP Capital Incentive projects evaluated in PY2017, 22 are BMG—specifically CHP units. CHP units typically reduce electric consumption at the expense of increased consumption of natural gas. The negative numbers in the "Gas" column of Table 14 show these increases.[17] Due to the prevalence of CHP units in the LDC-administered programs and their increased natural gas consumption, the 31,529 tonnes of GHG emissions created by the natural gas consumption outweigh the 20,922 tonnes of GHG emissions reduced by electric savings.

Figure 6: BMG Project GHG Emissions



Out of 22 CHP units evaluated, only two resulted in a net decrease in GHG emissions. One of these units was implemented through the IAP CI program at a large industrial refining facility, resulting in major GHG reductions of 27,809 tonnes from both electric and natural gas savings. This project was the only CHP unit in the PY2017 evaluation that resulted in natural gas savings, as it was designed to offset a highly inefficient natural gas-fired steam generation supply. The other CHP that resulted in a net decrease of GHG emissions was implemented at a hospital where the unit's electric savings resulted in enough GHG reductions to outweigh the GHG emissions created by the increased natural gas consumption.

The most common implementation of CHP units in the PY2017 evaluation was at multiresident housing to generate electricity and offset loads for space and water heating. All 14 of the CHP units implemented at multiresident facilities resulted in increased natural gas consumption and increased net GHG

[17] The Conservation and Demand Management Energy Efficiency Cost Effectiveness Tool calculates the GHG emissions of projects as "impacts" where a positive number represents savings or reduced emissions in tonnes and a negative number represents emissions increases in tonnes.

emissions. However, these units are much smaller than industrial and hospital applications and the combined net emissions increased only 16 tonnes.

4.2 INDUSTRIAL PORTFOLIO PROCESS EVALUATION RESULTS OVERVIEW

There are structures, procedures, and components that exist across all programs in the IESO portfolio and are most efficient to view as cross-cutting elements. This includes the broader environment – such as policy drivers or LDC delivery strategies – or components like data tracking or marketing. There are four findings for this section related to four topics:

- Variation in LDC implementation
- Program awareness
- Portfolio customer experience
- Program overlap and competition

Each of these are described in more detail below.

4.2.1 VARIATION IN LDC IMPLEMENTATION

Smaller LDCs with fewer resources and less experience with the complex industrial programs often feel less comfortable explaining them to customers. They often rely heavily on the Technical Reviewer to help them understand the rules. LDCs vary in the size of their customer base, internal resources, and time spent with the industrial programs, all of which impact how they promote and deliver these offerings:

- Customer base: LDCs can have as few as one or as many as several hundred customers eligible to participate in the industrial programs. Nearly 80% of the LDCs surveyed had fewer than 50 customers, but there were many at the extremes: 13% had over 100 customers, and 18% had just one to four.
- Internal resources: LDCs tend to have small teams focused on the industrial programs. Roughly 30% of respondents fell in each of the three smallest categories: less than one employee (i.e., shared with other commercial programs or even with other LDCs), one employee, or two to three employees. Only one LDC had more than five people on their industrial team.
- Time spent on industrial programs: While 82% of LDC respondents had an industrial program participant in the last year, such large projects may be few and far between for some LDCs.
- Role in the CDM portfolio: Since industrial projects tend to be quite large, they also play a key role for many of the LDCs. Nearly a third of the respondents stated that the industrial programs are extremely important to meeting their CDM goals (a 10 rating on a 0–10 scale). A total of 57% said they were important (eight and above). This leaves 43% of LDCs for whom the industrial programs

do not represent a major focus due to their customer base, assessment of savings potential, or internal resources.

These inherent differences in population and resources inevitably lead to some variations in implementation practices as well, mostly to match the LDCs' effort around the programs to their abilities:

- Management: LDCs use a variety of internal data tracking systems and processes to track leads, projects, and savings, ranging from large Customer Resource Management (CRM) tools to internally developed databases, or Excel or Google Drive spreadsheets. Many rely on receiving project data directly from the Technical Reviewer or IESO.
- Marketing: Availability of internal resources plays a big role into how proactive the LDC can be in reaching out to customers to explain the program. In addition, just over a third of LDCs have some form of channel partner network to assist in bringing in projects. The LDC's ability to offer value-added services like trainings or technical advice and support are also dependent on staff time and funding.
- Program understanding: Smaller LDCs that do not have as much experience with customers participating in the industrial programs tended to feel less comfortable with their ability to walk customers through the rules and process. They often rely heavily on the Technical Reviewer to provide education on the program rules to both the LDC staff and to the customer, and they appreciate the support. Over a third of LDCs mentioned the high quality of their communication with the Technical Reviewer, particularly when there was a question on program rules. Four small LDCs requested additional materials and training that would help them more quickly get up to speed on the programs when a customer became interested. Though these LDCs are small, they still represent roughly 20-40 industrial customers between them and two had industrial program participants in the last year. Two of the four considered the industrial programs very important (a 9 on a scale of 10) to hitting their CDM goals (the others were a 5 and a 1). Program rules "refresher" training was also mentioned by two of the ten LDCs (one medium, one small) interviewed during the Phase 1 evaluation in PY2016.

Process Finding 1: Smaller LDCs are often less confident in their understanding of the complex industrial programs.

Process Recommendation 1: Develop training for the PSUP, EM, and M&T programs, given to the LDCs, that cover their rules, processes, and the LDC responsibilities.

- Smaller LDCs with less experience in the industrial programs – generally because they have fewer large customers and thus less chance to go through the participation process – requested resources that would help them quickly become acquainted with the program and help customers who might be interested. This is also helpful for LDCs with recent turnover.

- The LDCs requesting materials are small and have a smaller impact on the program portfolio; however, they still represent a not insignificant number of customers and potential participants.
- Given the recent PSUP redesign, the timing is good to ensure that all LDCs understand the program, the changes, and the LDC's role in customer projects. Likewise, the EM program was the least recognized of the industrial offerings (see Process Finding #2, below) and may be less promoted than PSUP. Finally, depending on what is decided for the M&T program, IESO should either provide a training that explains how customers can use alternative programs to achieve similar ends or a training after the program is redesigned.

Although the programs are intended to be largely identical in terms of the rules and incentives across LDCs, there were two examples of places where the LDCs had some discretion in how they provide funding: engineering studies and EMs. The motivating factor behind these was the shift in program fiscal responsibility from the IESO to the LDCs at the start of the CFF, and some LDCs wanted to ensure that their funding for these enabling initiatives would result in actual energy savings. As a result, they increased the level of upfront screening and/or modified the incentives to promote additional project work.

When asked if they were aware of other LDCs implementing the programs differently from them, the most common response was around funding the engineering studies. Interestingly, there were a total of nine different funding mechanisms mentioned, from 0% funded to 100% funded:

- Do not fund engineering studies
- Do not fund engineering studies for CHP
- Rarely fund studies – case-by-case basis only
- Determination of study funding is on a case-by-case assessment
- Do not accept studies for the maximum incentive amounts, as consultants often try to max out the incentive regardless of need
- 50% funded
- 50% funded when the study is complete, and the rest is funded once the project is complete
- 100% funded but only once project is complete
- 100% funded (this is the original funding mechanism; the incentive amount would be deducted from the project incentive)

The recent PSUP redesign process adopted the "50% funded after the study, 50% funded after the project" mechanism for engineering studies and did away with the incentive deduction in the original rules. The evaluators will continue to monitor the impact of the PSUP redesign and whether the new funding mechanism eliminates most differences in how studies are funded.

There is also some evidence that a few LDCs have eliminated the salary-based option for EMs and only offer the performance-based option, similar to how IAP incentivizes its EM facilities. This does not represent a concern; other LDCs seem to use the salary-based option as a way to give more unsure facilities a taste of the program before encouraging them to move to the potentially more lucrative performance-based option.

Although LDCs may have unique considerations that they tailor their efforts to, they often run into similar challenges and successes implementing the CFF programs. Many LDCs are part of joint CDM plans, where several LDCs pool their goals and funding to more efficiently offer the programs and receive additional collaboration funding. These joint plans are particularly attractive for small LDCs. Some LDCs also have formed consortiums where they can meet to discuss the programs or meet through other industry organizations such as AESP. Since the LDCs are not competing and have similar experiences, the LDCs will often share findings; the smaller LDCs often rely on the largest LDCs for their expertise in running less-used, more complex offerings like the Industrial programs.

LDC program differences tend to reflect healthy functional tailoring of the programs to needs and resource constraints rather than unintended disconnects between them. Most variations in how the LDCs implement the programs stem from their unique characteristics, including the size of their customer base, internal resources, and time spent with the industrial programs. The two examples of LDCs tailoring the programs themselves come from places where they were given discretion to determine how to handle funding.

4.2.2 PROGRAM AWARENESS

Before a customer can participate in a program, a key contact at the business must become aware of the program and be motivated to pursue it for his or her facility. Due to the complex nature of the facilities and the projects that could fit into the industrial programs, both the LDCs and IAP use direct outreach to customers through calls, emails, and in-person meetings. This is both effective and appreciated, with many participants commenting in interviews on the level of support they received. The long-term upkeep of those relationships is very important to both LDCs and IAP – all 10 LDCs interviewed in Phase 1 stated they try to meet with their largest accounts at least once a year, and the IAP staff likewise try to meet with their far-flung customers in-person whenever possible. This helps the program staff gain rapport as an energy advisor to the customer. **Direct outreach is the primary method for raising awareness of the program offerings.** The overwhelming majority of LDCs use direct outreach to connect with their industrial customers – 95% of LDCs stated that they use direct outreach, and 68% said it was their primary technique. However, this is not the only technique used. Channel partners and events/trade shows were the next most commonly used techniques by 76% and 71% of LDCs, respectively. For primary methods, it was LDC general account managers (13%), followed by channel partners (11%).

The importance of channel partners, and how engaged the LDC is with them, varies widely. Also known as trade allies, channel partners are energy technology vendors that sell the efficient products or study services that can receive incentives. Since they are already meeting with customers and trying to close deals, they are often valuable in educating customers about programs and helping them through the process. While 76% of LDCs use channel partners to help drive projects, only 37% have some form of channel partner/trade ally network to engage these vendors. These networks range from formalized efforts with training sessions and an annual awards ceremony to an infrequent email distribution list and are used to increase vendor awareness and engagement (and therefore participation) through information sharing, training, and recognition. While larger LDCs were more likely to have a channel partner network, there is still room for network building at all LDC size ranges as shown in Table 15.

Table 15: LDCs with Channel Partner Networks by Size

Size - number of eligible customers[18]	Number of LDCs	Number with channel partner networks	Percentage with channel partners
100+	5	4	80%
50-99	2	1	50%
20-49	11	5	45%
10-19	8	2	25%
5-9	5	1	20%
1-4	7	1	14%
Total	**38**	**14**	

A few LDCs noted that their channel partner networks were focused on the Retrofit program; three had even observed their channel partners trying to steer customers away from PSUP to Retrofit so that they didn't have to deal with the complex requirements. Interestingly, two LDCs said they did not have a channel partner network because they wanted to remain impartial with vendors in their territory – this may represent an education opportunity, as such networks are generally open to all interested vendors.

[18] LDCs were asked to estimate the number of customers that would likely be large enough to be eligible for one of the industrial programs.

Process Finding 2: Only a little over a third of LDCs have some form of channel partner network, and several commented that their vendors tend to focus on either CHP or Retrofit projects.

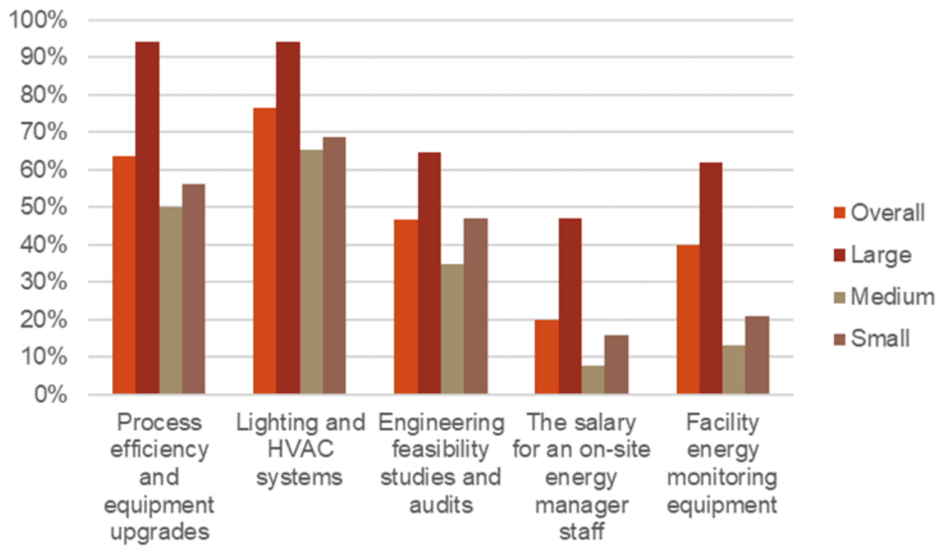
Process Recommendation 2: Encourage and help LDCs without channel partner networks to develop them. Conduct further research to identify the appropriate channel partner networks to develop and leverage into increased program participation. Compare with trade ally networks established in other markets.

- Some LDCs already have robust networks and utilize regular email updates, meetings, events, and even awards to build relationships with channel partners. Highlighting existing successes from those LDCs or giving them the opportunity to briefly explain their structure as part of a presentation would provide good examples for other LDCs to implement and more motivation to do so.
- As a related effort, the LDCs and IESO IAP staff should collaborate on developing a list of channel partners with demonstrated experience and knowledge with process efficiency projects for PSUP/IAP. Some LDCs commented that their trade ally networks tend to have vendors focused on Retrofit; most vendors with PSUP experience are CHP vendors and can no longer bring those projects to the program. LDCs and the IESO IAP staff should make a concerted effort to engage the vendors who can still participate in PSUP/Process & Systems with large efficiency projects, which may also help in meeting savings goals after the phase-out of natural gas fired CHP.

Most LDCs believed that their outreach efforts were working: 79% of LDCs said that 70% or more of their industrial customers were aware of the program offerings. That was backed up by the nonparticipant surveys, where 75% of respondents had heard of the Save on Energy programs. When asked about specific offerings, 76% knew about Retrofit options (lighting, HVAC) and 64% knew about process efficiency/equipment upgrades through PSUP.[19] Nonparticipants were also segmented into three groups by their savings potential – large, medium, and small – and perhaps unsurprisingly, the large group had the greatest awareness of all five Save on Energy offerings, as shown in Figure 7 below.

[19] Seven nonparticipants said they hadn't heard of Save on Energy, but later stated that they were aware of incentives available for particular measures, which explains how the overall awareness for measures could be higher than for the umbrella program. Other respondents who had heard of Save on Energy were unaware of the specific offerings.

Figure 7: Nonparticipant Awareness of Save on Energy Industrial Program Offerings



Almost all large facilities are aware of the PSUP and Retrofit offerings; over 60% are also aware of the incentives for studies and monitoring equipment. Overall, the EM program had the lowest awareness from all three segments - only 20% of respondents knew about it, half as many as the next category. The large segment, which would be best suited for the EM program, still only had a 47% awareness of it. This dropped dramatically to 8% and 16% for the medium and small facilities, respectively. As only half of large nonparticipants, and just two of 26 medium nonparticipants, knew about the EM program, this represents an opportunity for additional promotion of the offering.

Interestingly, the medium category had lower awareness than the small facilities for all offerings. It is unclear what is driving this discrepancy.

Process Finding 3: Nonparticipants are generally aware of the Save on Energy programs and offerings with the exception of the EM program.

Process Recommendation 3: Increase nonparticipant awareness of the EM program by raising the profile of the program.

- Despite the EM program's excellent satisfaction scores and role as an enabling program, only 50% of large nonparticipants and much smaller percentages of medium and small nonparticipants know about the Energy Manager program. This could be due to fewer marketing materials, less attention paid to it in LDC outreach to potential customers, less of an understanding/interest of the program for some smaller LDCs resulting in little outreach, and/or facilities not knowing to look for an incentive (it's plausible that a customer might think, "I'm performing this project – I wonder if any rebates are available?" due to the prevalence of equipment rebates, but it is far more unlikely they would think, "I'm hiring a facility manager – I wonder if any incentives are available?") There are many ways to go after increasing awareness; here are two suggestions:

- Include more EM case studies and success stories on the Save on Energy website, and make it very clear which facilities have EMs, what the EM's role is, and the successes they worked to bring about. While six case studies on the Save on Energy website list "Energy Management" as one of the facility's efforts, few describe the EM's role beyond their involvement in the main project that the brief highlights. LDCs should also host case studies from their customers on their own websites where possible.
- Many LDCs do not have EMs and/or do not appear to actively promote the program (at least four small LDCs did not offer it to customers). Some of that is due to a lack of understanding or experience with the program, which should be helped by Process Recommendation #1. IESO – or LDC collaboration groups – might also consider creating a "toolkit" on best practices on promoting and managing the program based on successful LDC experiences (i.e. a factsheet, one-page printable case studies, even outreach talking points).

4.2.3 PORTFOLIO CUSTOMER EXPERIENCE

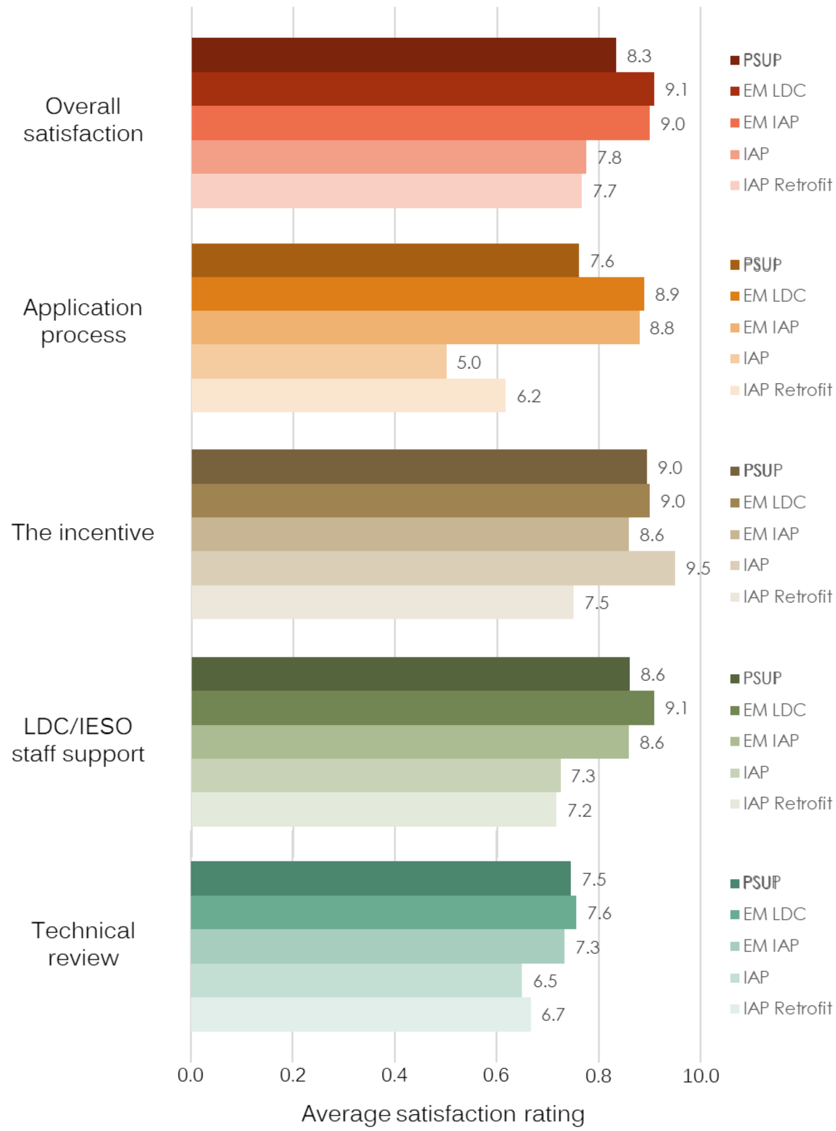
The participant interviews conducted with the NTG evaluation include a short battery of satisfaction questions regarding the customer's experience with the program. In PY2017, a total of 48 interviews were conducted, as shown in Table 16 below.

Table 16: Completed Participant Interviews by Program

Participant interviews	Interviews
PSUP	23
EM - LDC	10
IAP	4
IAP Retrofit	6
EM - IAP	5
Total	**48**

The questions asked on a scale of 0 to 10, with 0 as very unsatisfied and 10 as very satisfied, how satisfied customers were with various aspects of the program (overall, the application process, the incentive, IESO/LDC support, and the technical review). Figure 8 shows the average satisfaction scores for each program and aspect from the participant interviews.

Figure 8: Satisfaction Ratings by Program and Aspect



These scores are fairly similar to the ones seen in the PY2016 evaluation; the evaluators will continue to monitor satisfaction ratings to look for longer-term trends. Some of the key takeaways:

- **Participants generally were satisfied with their experiences with the industrial programs.**
- The EM program received the highest satisfaction scores for almost all program aspects, including overall (see discussion, Section 5.2.6.1).
- IAP participants reported the highest satisfaction of any of the programs for the IAP Process & Systems incentive (referred to in this report as IAP Capital Incentive or IAP CI); however, in all other

aspects, IAP CI and IAP Retrofit received lower satisfaction ratings than other programs (see discussion, Section 5.3.6.1 and 5.3.6.2).

- The aspects generally receiving the highest satisfaction scores were the incentive, IESO/LDC support for PSUP and EM, and the application process for the two EM programs.
- The aspects receiving the lowest satisfaction scores were the technical review, the application process for IAP CI and IAP Retrofit, and the IESO support for IAP CI and IAP Retrofit (see discussion, Section 5.3.6.1 and 5.3.6.2).

Each program section features a callout box with the satisfaction scores for that program.

4.2.4 PROGRAM OVERLAP AND COMPETITION

The Save on Energy and IAP offerings operate within a larger environment of incentive programs to optimize customers' energy choices. Arguably, these programs are all variations on a theme to make Ontario's energy systems more efficient, but they can overlap and even compete with each other for customer attention and funding. This topic has been elevated in the past year, with both IESO and LDC staff requesting research into the impact the program overlap has on the CFF industrial programs.

There are three sets of programs that significantly overlap with the CFF industrial programs:

1. **Gas utility incentive programs**: Some of the major natural gas utilities in Ontario (such as Union Gas and Enbridge Gas) also offer conservation funding for energy efficiency projects, overseen by the Ontario Energy Board (OEB).
2. **The Industrial Conservation Initiative (ICI)**: ICI is a program developed by the Ontario government in 2010 to allow Class A customers (those above 1 MW of demand) to pay their portion of the Global Adjustment (GA) – part of the electricity commodity price – based on their load contribution to the five days with highest peak load rather than as a flat rate. The intent was to encourage conservation from the largest energy users on those days, and users have the ability to decrease the amount they pay on an annual basis by reducing their load. Customers over 5 MW are automatically enrolled and can choose to opt out; all customers between 1 and 5 MW and industrial customers between 500 kW and 1 MW can choose to opt in.
3. **Greenhouse gas (GHG) reduction programs**: In addition to cap-and-trade, which many industrial customers participated in, there were several programs funded primarily from cap-and-trade proceeds offering incentives for GHG reductions. GreenON Industries and TargetGHG were two of these programs. Cap-and-trade, GreenON, and several other initiatives were disbanded as of early July 2018.

The gas utility incentive programs have long existed in the same space. The competition here is generally seen as minor, and some LDCs and IESO staff have expressed a desire to work together more frequently. Currently, there is little formal collaboration with the gas utilities and the CFF programs, though individual LDCs may do joint pilot programs or joint site visits for CHP projects. To be able to collaborate on a project, the entities must figure out how to stack incentives without allowing double-counting, and without muddying the attribution evaluation results.

The ICI and GHG reduction programs, on the other hand, had become a subject of concern for program managers by the start of the PY2017 evaluation. While overlap with the GHG programs were included in the research, interview/survey questions, and analysis, the data collected is now out-of-date and is not included here. The remainder of this section focuses on overlap with the ICI.

Industrial Conservation Initiative

At least one question on ICI was included on every interview and survey conducted for the process evaluation this year, for a total of 189 open-ended data points. Just over a third had an opinion on whether ICI affected conservation projects for their customers or facilities. Their opinions fell into four groups: positive, negative, neutral, or no impact, as shown in Table 17.

Table 17: Viewpoints on ICI's Impact on Conservation Projects

Arguments	Proponents
Positive: ICI helps conservation projects.	
1. Conservation projects often reduce demand, so the GA reduction provides an added motivating factor to the project. 2. Conversely, customers looking to reduce on the 5 peaks often look to conservation projects - it's a reason for them to start considering efficiency. (This was especially true as an interest in CHP drove many to PSUP). 3. Some customers prefer permanent demand reductions caused by conservation projects over short-term curtailments to meet the 5 peaks for several reasons: a. They cannot interfere with operations (such as for hospitals) b. They realize that permanent demand reductions are more sustainable for the business than production curtailment c. They are wary of the difficulties in forecasting the peaks: ICI was recently opened to a smaller class of customers and the influx of new participants contributing to the peaks have made them harder to forecast. d. They are concerned that ICI may not be continued in the future 4. One customer noted that having someone to go after GA avoidance projects was the primary reason they got an EM.	LDCs: 10 (37%) Participants: 2 (15%)
Negative: ICI hurts conservation projects.	
1. Conservation is competing for limited capital funding and staff time at a facility, and often loses because ICI is more lucrative and requires less paperwork. 2. Customers that are successful in reducing their GA have much lower electricity costs – this hurts the payback for conservation measures and weakens the business case. 3. Many customers curtail production or shut down parts of their operations to avoid the 5 peaks. This reduces run hours for energy/demand savings calculations and weakens the business case. This also means that if the equipment will be off during the 5 peaks, the customer will be less interested in upgrading it. 4. Customers that are close to the size cutoff for ICI eligibility don't want to drop below the cutoff, as their electricity bills could increase substantially.[20] 5. Many customers came to PSUP looking for incentives for CHP to reduce their GA contribution. Now that CHP has been phased out, there will be fewer customers driven to PSUP. 6. Projects that are explicitly to reduce peak demand are not eligible for PSUP incentives.	LDCs: 12 (44%) IAP staff: 2 (67%)
Neutral: ICI has an impact on conservation projects, but how much is not clear.	
1. Participants, partial participants, and nonparticipants tended to note that the ICI was very important to them and that it had an impact on their decision-making/project selection but provided no evidence on whether the projects were conservation (i.e. process upgrades) or non-conservation (i.e. batteries, demand response).	Participants: 9 (69%) Partial participants: 3 (60%) Nonparticipants: 4 (31%)
No impact: ICI is not related to conservation projects.	

[20] There was an example of this in the participant interviews: one PSUP participant managed to reduce their facility's load from 5 MW to 2.5 MW, dropping them from Class A and costing the facility an additional $300,000 in electricity costs. Five LDCs listed the ICI eligibility threshold as a barrier for conservation projects.

1. ICI is not a big motivating factor for some facilities, even ones that are required to go through it – they would rather pay the bill than impact operations or prioritize avoidance over other efforts. 2. ICI is not the reason conservation projects don't go through – other barriers are far more important.	LDCs: 5 (19%) IAP staff: 1 (33%) Participants: 2 (15%) Partial Participants: 2 (40%) Nonparticipants: 9 (69%)

The LDCs had mixed opinions on whether ICI helped promote conservation projects or hindered them, with a plurality (44%) voting that the effect was negative. IESO IAP staff (the program manager and business advisors) likewise tended to believe the impact of ICI on their project pipeline was negative. Customers – participants, partial participants, and nonparticipants – mostly conveyed that ICI was very important and had made a big impact on their decision-making and the types of projects they were looking into. However, it was impossible to tell from most responses whether they would eventually support conservation projects or divert resources elsewhere, such as to batteries or demand response.

The customer interviews/surveys also yielded robust statistics that provide a sense of the magnitude of ICI participation:

- 73% of LDC participants and 100% of IAP participants participate in ICI. 95% of LDC EMs are also in ICI.
- 31% of nonparticipants participate in ICI (this could be skewed by the fact that the nonparticipant survey population likely included smaller industrial facilities than the participant population).
- Out of the 68 participant and nonparticipant facilities in ICI, 57% curtail at least part of their production to avoid the 5 peaks. This could support the “negative” view, as curtailment could hurt the value proposition for a conservation measure.
- 55% of LDC participants in ICI and 69% of IAP participants in ICI responded that the project included in the NTG interviews was part of their strategy for ICI. This could support the “positive” view, as there appears to be substantial overlap between the projects, or the “negative” view if those projects were CHP.

While there was no consensus on how much ICI was impacting the CFF programs, it was clear that ICI participation is prevalent and important to most customers. This is an area that the evaluators will continue to monitor in future years.

Process Finding 4: Administrators described significant overlap between IESO energy conservation programs and the Industrial Conservation Initiative (ICI).

- Program staff and participants report mixed opinions on whether the ICI helps or hinders Save on Energy/IAP projects; some believe that the ICI helps prompt conversations on conservation projects, while others feel that the ICI is prioritized for funding and effort within facilities.

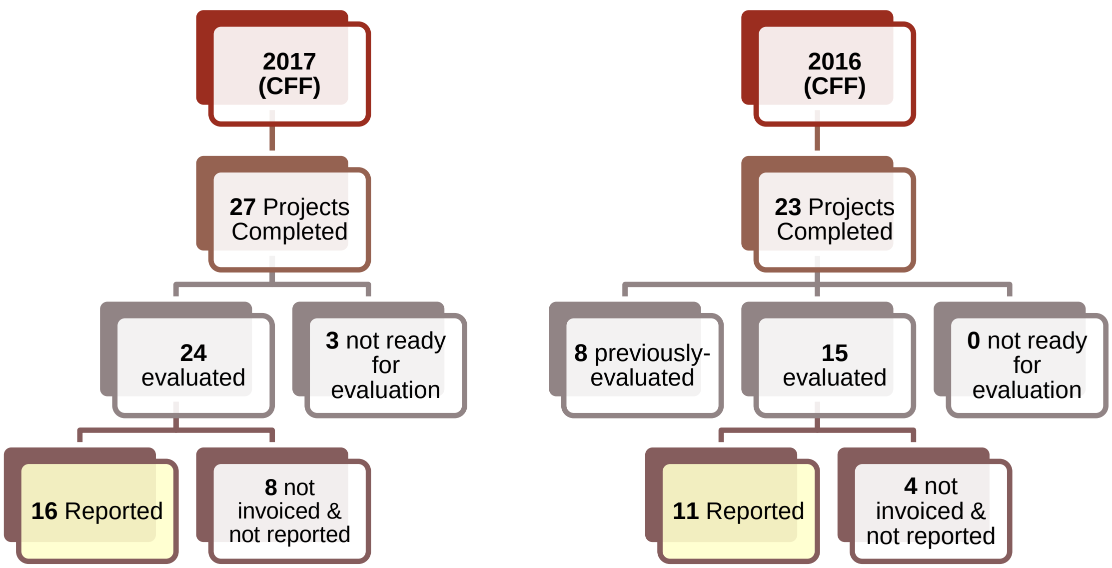
Process Recommendation 4: Leverage the ICI to spur conversations with customers and use it to market to their priorities without making the project explicitly about demand reduction.

- For example, the permanent reductions in demand caused by an energy efficiency project could reduce their load during the peaks, help the facility even if the ICI program changes, and enable the facility to spend less effort trying to forecast the peaks. An EM could also be used to identify other load-reducing projects.

5.1 PROCESS AND SYSTEMS UPGRADES PROGRAM (PSUP) RESULTS

The Process & Systems Upgrades Program (PSUP) provides financial support for the implementation of energy efficiency projects and system optimization projects for facilities that are intrinsically complex and capital-intensive. Twenty-seven industrial customers completed PSUP projects in PY2017. Twenty-four of these projects had undergone technical review and were ready for evaluation when the sample frame for this evaluation was established on April 1, 2018. Eight of these 24 projects are not included in this report because they have not been invoiced to IESO by the LDCs. Completing the invoicing process for a project is a requirement for savings to be reported. Projects completed and evaluated in PY2017 but did not get invoiced will be reported in the PY2018 results once invoiced. Another 11 projects from PY2016 and one from PY2015 have been carried over to this year's evaluation. In this report, these PY2017 projects and PY2016 and PY2015 adjustment projects are collectively referred to as the PY2017 sample frame. Figure 9 below shows how the PSUP sample frame comprises projects from PY2015 through PY2017.

Figure 9: PY2017 PSUP Sample Frame



5.1.1 PSUP PROGRAM EVALUATION APPROACH

5.1.1.1 PSUP Sampling

A census of all projects was conducted for PSUP. This program warrants the census approach because of the relatively small number of projects, each with high reported contribution to overall Industrial portfolio savings. However, participation in PSUP has continued to grow throughout the CFF and the increasing number of projects will likely require the gross and net evaluation to utilize sampling in future evaluations.

Figure 10 illustrates the process of defining the PY2017 sample frame for the PSUP Program.

Figure 10: Process for Process & Systems Upgrades Sampling & Program Year Cutoff

December 2017

- Program snapshot defines initial PY2017 sample frame: projects with reported savings that were in service starting in 2017 and have at least one quarter of completed technical review.
- PY2016 and PY2015 adjustment projects are added: projects in service starting in 2016 or 2015 that did not make the prior evaluation cutoff.
- Data collection & analysis activities commence.

March 31, 2018

- PY2017 cutoff is enacted.
- On April 1, current program snapshot is collected. Any projects where technical review has been completed since preliminary are added to the sample frame.

April 2018

- EcoMetric submits a draft LDC project list to IESO for IESO and LDC review. This list contains all projects for inclusion in the PY2017 and PY2016 and PY2015 adjustment results.
- Final LDC project list confirmed with IESO

June 2018

- Projects in service starting in 2017 that did not make the March 31 cutoff are considered PY2017 adjustments, and are expected to be evaluated later in 2018.
- Verified impacts of PY2016 adjustment projects are used to true up PY2016 results.

When projects receive annual M&V only (instead of quarterly), an in-service date late in calendar year 2017 resulted in M&V being unavailable until after the evaluation sample frame was finalized on April 1, 2018, as illustrated in the graphic above. These projects are scheduled for PY2017 adjustment evaluation in Q4 2018.

5.1.1.2 PSUP Data Collection

The primary data source for Process & Systems Upgrades projects was M&V reports, equipment logs, analysis workbooks, and other data and documentation submitted by the technical reviewer in support of reported savings estimates. EcoMetric carefully reviewed the application and annual and/or quarterly M&V reports prepared for each project and facility. This review of project documentation provided an initial understanding of the efficiency upgrades implemented, and just as importantly, how savings from these upgrades have been estimated.

A thorough review of the measurement and verification completed by IESO's technical reviewer enabled EcoMetric to assess the key assumptions and potential areas of uncertainty for each PSUP project. In the rare instances where assumptions were undocumented or appeared inconsistent, EcoMetric flagged them for further investigation. Similarly, if key parameters that would affect the observed savings of the project were not included in established savings estimates, EcoMetric gathered these values and incorporated them into the gross verified savings calculation.

5.1.1.3 PSUP Gross Savings Verification

Gross savings verification methods largely depended on the technology types included in the PSUP efficiency project and were customized on a project-by-project basis. EcoMetric first determined if the savings claim was valid based on information gathered during the data collection stage, including on-site visits. EcoMetric re-calculated savings using the parameter inputs validated or adjusted during the data collection phase. For projects where less than a full year of M&V had been conducted at the time of analysis, EcoMetric annualized savings according to the project parameters and available M&V data.

5.1.1.3.1 Gross Savings Verification for CHP projects

The CHP projects had a fairly consistent approach to the analyses. It was established whether the installation of the CHP offset the electrical consumption of any equipment. In almost all cases, the baseline was zero due to there being no difference in the facility operation after the installation. There were a few instances of the baseline being positive due to a piece of equipment being taken offline or replaced due to the CHP installation. Such was the case for a project that replaced a standard mechanical chiller with an adsorption chiller which ran its vapor compression cycle off waste heat produced by the CHP instead of an electric compressor. There was at least a full quarter of data for each of the CHP projects, oftentimes more. For projects that did not have a full year of M&V data, the quarterly data was extrapolated into an annual year, and then adjustments were made based on planned shutdowns.

5.1.1.3.2 Gross Savings Verification for other projects

PSUP projects evaluated outside of CHPs included: compressed air, air conditioners, controls, and VFD projects. Most projects contained at least a quarter of baseline measurement data, and a quarter of post retrofit metered data. Non-routine adjustments included making changes to the power consumption based on changes in production, changes in occupancy, or building additions that would affect the load. Oftentimes metered data was already collected as a power measurement, negating the necessity of applying an average power factor and voltage to the interval data. Metered power measurements are preferential to interval amperage measurements given their higher accuracy of true interval power consumption of a piece of equipment. The process of applying equations to convert amperage to power can be seen in Figure 11 below, a screenshot of one of EcoMetric's custom project calculators. This specific calculator was taken from the evaluation of a PSUP project that installed new compressors and updated sequences of operations for existing compressors.

Figure 11: EcoMetric Custom Project Calculator

EcoMetric Consulting IESO Industrial Verification - Custom Project Calculator

RAW DATA & ANALYSIS

AC single phase kilowatts to amps calculation

The phase current *I* in amps (A) is equal to 1000 times the power *P* in kilowatts (kW), divided by the power factor *PF* times the RMS voltage *V* in volts (V):

$$I_{(A)} = 1000 \times P_{(kW)} / (PF \times V_{(V)})$$

AC three phase kilowatts to amps calculation

V_{L-L}

Calculation with line to line voltage

The phase current *I* in amps (A) is equal to 1000 times the power *P* in kilowatts (kW), divided by square root of 3 times the power factor *PF* times the line to line RMS voltage V_{L-L} in volts (V):

$$I_{(A)} = 1000 \times P_{(kW)} / (\sqrt{3} \times PF \times V_{L-L(V)})$$

Variable	Description	Units
I	Phase current	Amps
1000	W to kw conversion	W/kw
P	Power	kW
PF	Power Factor	unitless
V	Voltage	Volts
	Line to Line Voltage	Volts

	Voltage	Power Factor
Comp 1	339.55	0.74
Comp 2	337.73	0.84
Comp 3	333.98	0.87
Comp 4	348.01	0.81
Comp 5	346.46	0.94
Dryer 1	346.46	0.94
Dryer 2	345.67	0.86

Single Phase Power Calculation

$I = 1000 * P/(PF * V)$

$P = (I * PF * V)/1000$

Three Phase Power Calculation

$I = 1000 * P/(\sqrt{3} * PF * V_{L-L})$

$P = (I * \sqrt{3} * PF * V)/1000$

Date	Hour	Comp 1 Usage (kw)	Comp 2 Usage (kw)	Comp 3 usage (kw)	Total (kw)
3/9/2016	11	23.19	51.01	9.36	83.55
3/9/2016	12	30.85	38.70	13.50	83.04
3/9/2016	13	31.48	64.98	13.64	110.10
3/9/2016	14	30.51	46.16	13.53	90.20
3/9/2016	15	30.88	62.61	13.46	106.95
3/9/2016	16	31.48	64.59	13.41	109.48
3/9/2016	17	31.08	64.32	13.45	108.85
3/9/2016	18	31.37	64.48	13.41	109.25
3/9/2016	19	31.34	64.43	13.34	109.11
3/9/2016	20	30.96	63.20	13.49	107.65
3/9/2016	21	31.41	64.21	13.38	109.00
3/9/2016	22	30.38	59.10	13.51	102.99
3/9/2016	23	31.29	17.62	13.38	62.29
3/10/2016	0	16.39	61.58	13.42	91.40
3/10/2016	1	0.25	64.66	13.25	78.17
3/10/2016	2	0.25	65.06	13.32	78.62
3/10/2016	3	0.25	64.85	13.25	78.35

Date	Hour	Comp 1 Avg Amps	Comp 1 - kw	Comp 2 Avg Amps
4/5/2017	0	2.70	1.18	64.70
4/5/2017	1	2.72	1.19	58.87
4/5/2017	2	2.73	1.19	67.03
4/5/2017	3	2.72	1.19	68.51
4/5/2017	4	2.72	1.19	63.89
4/5/2017	5	2.73	1.19	49.26
4/5/2017	6	2.72	1.19	5.20
4/5/2017	7	0.56	0.24	62.54
4/5/2017	8	0.48	0.21	70.78
4/5/2017	9	0.47	0.21	69.72
4/5/2017	10	0.47	0.21	72.12
4/5/2017	11	0.48	0.21	71.65
4/5/2017	12	0.47	0.21	69.83
4/5/2017	13	0.47	0.21	63.42
4/5/2017	14	0.47	0.21	52.29
4/5/2017	15	0.47	0.21	53.83
4/5/2017	16	0.21	0.09	4.48

In this example, the compressors were metered for a year prior to the installation of new variable speed compressors, and a year after the new compressors were installed. Spot measurements were taken to determine the instantaneous power factors and voltages. The metering data was collected in amps, and using the average power factor and voltage, converted to hourly power consumption.

5.1.2 PSUP TRACKING SYSTEM & PROGRAM DOCUMENTATION REVIEW RESULTS

Tracking system data and program/project documentation for the PSUP program was provided by the Technical Reviewer. In general, the documentation was thorough and allowed for a robust verification of energy and summer peak demand savings.

5.1.3 PSUP GROSS VERIFIED SAVINGS RESULTS

PSUP projects can be divided into two general categories: behind-the-meter generation (BMG) projects and energy efficiency (EE) projects. **Realization rates across PSUP project categories are relatively close to 100%, ranging between 98.8% (2016 BMG) and 111.2% (2017 EE).** PSUP project-level energy RRs range from 168.5% to 93.5%. PSUP project-level peak demand RRs range from 283.8% to -379.0%. The project with the -379% demand realization rate was reported to have a demand increase but was verified to have significant demand savings.

Table 18: PY2017 PSUP Gross Verified Savings Results

Framework/Project Type	# of Projects Evaluated	Energy Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
2017					
BMG	10	99.2%	4,749	0.57	100%
EE	6	111.2%	10,837	2.25	100%
2017 Total	**16**	**107.2%**	**15,586**	**2.81**	**100%**
2016 Adjustments					
BMG	7	98.8%	37,034	4.98	100%
EE	7	102.7%	14,829	2.42	100%
2016 Adj. Total	**14**	**99.9%**	**51,863**	**7.40**	**100%**
2015 Legacy Adjustments					
BMG	1	104.8%	9,691	0.79	100%
EE	0	n/a	-	-	n/a
2015 Adj. Total	**1**	**104.8%**	**9,691**	**0.79**	**100%**
GRAND TOTAL	**31**	**101.9%**	**77,140**	**11.00**	**100%**

PY2017 PSUP gross verified energy savings are 101.9% of reported savings. Measurement and verification activities and technical reviews are generally resulting in highly accurate estimates of energy savings.

Finding 5: Two PSUP projects were reported to have summer peak demand *increases* following the technical review stage but were verified to have summer peak demand *savings* in the savings audit.

- It was unclear how the technical reviewer reached the conclusion of a summer peak demand increase for these projects.

Recommendation 6: Ensure the technical reviewer accurately calculates and reports summer peak demand savings as defined by the IESO for all PSUP projects.

- While the focus of the CFF is on energy savings more so than demand savings, accurate demand savings are integral for cost effectiveness analyses, as well as bulk system and local planning.

Finding 6: Several PSUP projects relied on spot measurements as short as 90 minutes to extrapolate a year of data.

- Spot measurements were a program requirement on equipment that used current transducers instead of kw meters to collect the instantaneous power factors and voltages. There were instances throughout the program where a piece of equipment did not have a metering period and spot measurements were used. A day or less of spot measurement data can be insufficient as a basis of extrapolation if the equipment being metered would have a seasonal or even daily variations such as a chiller pump.

Recommendation 7: In the case where measurement data is unavailable, interviews with the participant should be conducted and nameplate data should be recorded to inform the technical reviewer and allow the development of an annual profile with inputs from the spot measurements, in lieu of extrapolation of brief spot measurement data.

Recommendation 8: The implementer should always meter equipment using kW meters.

- KW meters would save both the implementers and evaluators time in converting amperage reading into power readings and would be more accurate as the power factor and voltage for a piece of equipment will vary with different modes of operation. Applying an average voltage and average power factor to interval amperage data will not have the same reliability as true power measurements.

BMG projects are typically larger in size, and account for 94% of verified gross energy savings in the PSUP program. The average energy RR for PSUP BMG projects (99.5%) is slightly lower than for EE projects (106.1%), as shown in Table 19 below. For demand savings, EE projects have a significantly higher average RR (1,196.8%) where BMG projects have an average RR of (99.6%). The average demand RR for EE PSUP projects is extremely high due to two projects that had reported demand increases that were verified to have demand savings.

Table 19: PSUP Realization Rates by Project Type

Project Type	Average Energy RR	Average Demand RR
BMG	99.9%	96.6%
EE	106.1%	1,196.8%

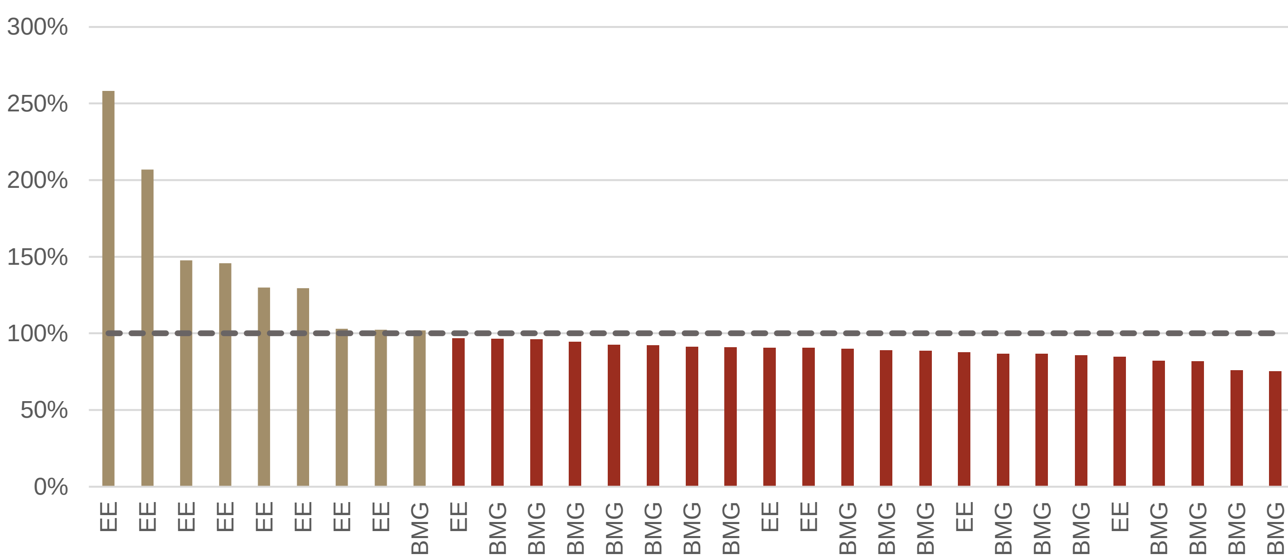
5.1.3.1 PSUP Performance against Anticipated Savings

PSUP program rules specify that project incentives are recalculated following the project's actual performance after one year of M&V against anticipated savings calculated before the project is installed. As shown in Figure 12, **9 out of 31 PSUP projects exceeded or met their anticipated savings**. **Of the 18 BMG projects in the PSUP program, only one project exceeded its anticipated savings.** Meanwhile, eight of the 13 PSUP EE projects exceeded anticipated savings, with several far exceeding anticipated savings. **Overall, the PSUP projects evaluated in PY2017 achieved 91% of their combined anticipated savings**. This suggests success in calculating anticipated savings, as well as strong performance of the projects once in service.

BMG PSUP projects that failed to meet anticipated savings fell short for reasons including:

- Lower than expected facility electrical demand for a CHP system in the performance period, resulting in much lower than expected operational hours at peak capacity; and
- Several unexpected shut-down periods after the in-service date for a CHP system

Figure 12: PSUP Savings Performance Results



5.1.4 PSUP NET VERIFIED SAVINGS RESULTS

Total net first-year energy savings for PSUP projects evaluated in PY2017 are 70,433 MWh, 91.7% of gross verified savings. Net demand savings for PSUP total 9.95 MW. Free-ridership is 8.3% and spillover directly attributable to the program is 0%. These components of NTG are described below Table 20.

Table 20: PY2017 PSUP Net Verified Savings Results

Framework/Project Type	# of Projects Evaluated	NTG Ratio[21]	Net First-Year Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)
2017				
BMG	10	94.0%	4,458	0.53
EE	6	95.5%	10,316	2.11
2017 Total	**16**	**95.0%**	**14,774**	**2.64**
2016 Adjustments				
BMG	7	94.3%	34,916	4.70
EE	7	76.0%	11,731	1.87
2016 Adj. Total	**14**	**90.5%**	**46,647**	**6.57**
2015 Legacy Adjustments				
BMG	1	93.0%	9,013	0.73
EE	0	n/a	-	n/a
2015 Adj. Total	**1**	**93.0%**	**9,013**	**0.73**
GRAND TOTAL	**31**	**91.7%**	**70,433**	**9.95**

Free-ridership - BMG projects on the whole had larger average savings than EE projects, but they varied widely from small multifamily projects to large-scale installations in excess of 10,000 MWh. Especially for the larger BMG projects, interviews revealed that the decision-making is more likely to be made independent of IESO/LDC program incentives. While the energy cost reductions and program benefits were viewed favourably by the BMG project interviewees, these large projects were, on average, more likely to be implemented without program incentives.

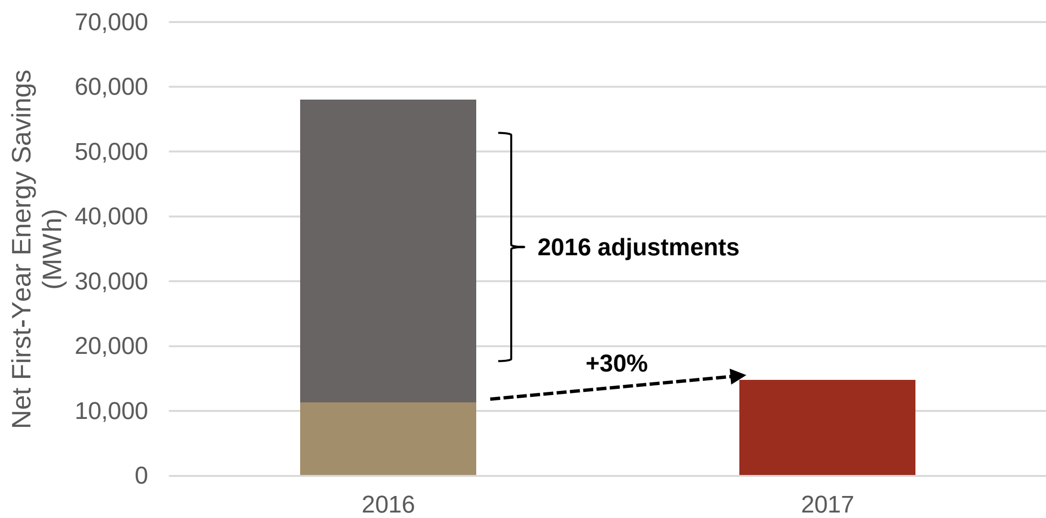
Spillover – While there was no spillover credited to PSUP through the interviews, there was significant spillover identified during the PSUP interviews. Overall, 30 out of the 31 PSU interviewees indicated that they have completed or plan to complete additional projects through the PSU or other LDC programs. However, in all cases the customers expect to receive program incentives from their LDCs for these

[21] BMG and EE ratios are for illustration purposes only. NTG ratios are calculated each program year for the evaluation sample and applied to the population of each program. For the PSU program, each project received its own NTG ratio.

projects. While this cannot be counted as spillover for PSUP, it shows the value that PSUP plays in encouraging continued project activity for its customers.

5.1.4.1 Total CFF PSUP Net Savings

Figure 13: Total CFF PSUP Net First-Year Energy Savings



As part of the CFF framework, the PSUP program has achieved 72,818 MWh of net first-year energy savings, representing 89.4% of gross verified first-year energy savings. Eighteen PSUP projects that were implemented in 2016 have been evaluated and reported through PY2017, totaling 58,044 MWh net first-year energy savings. 2016 adjustment projects, those that were implemented in 2016 but evaluated in PY2017, account for 46,647 MWh of net energy savings—80% of the total PSUP net energy savings achieved through the CFF to date. PSUP projects tend to be large and complex, often demanding more time to be technically reviewed and made ready for evaluation than projects in the rest of the industrial portfolio.

The 16 PSUP projects implemented in PY2017 and evaluated in PY2017 had 14,774 MWh of net first-year energy savings. **PSUP net first-year energy savings increased 30% YOY in PY2017 compared to the 11,397 MWh net first-year energy savings achieved and evaluated in PY2016.** Only 4 PSUP projects were implemented and evaluated in PY2016, compared to 16 in PY2017. While the net savings per project has declined YOY, participation in the program has increased.

100% of energy savings achieved through the PSUP under the CFF persist through 2020.

5.1.5 PSUP COST EFFECTIVENESS RESULTS

As shown in Table 21, PSUP is cost effective in PY2017 from the PAC test perspective using a benefit/cost threshold of 1.0[22]. However, the PSUP program fails to meet the benefit/cost threshold of 1.0 under the TRC test. Cost-benefit assumptions are included in *Appendix F: Cost-Effectiveness Assumptions.*

Table 21: PY2017 PSUP Cost Effectiveness Results

TRC Costs	TRC Benefits	TRC Ratio	PAC Costs	PAC Benefits	PAC Ratio	LC $/kWh
$18,945,012	$10,264,703	**0.54**	$7,951,054	$12,775,809	**1.61**	0.05

At the project-level, the average TRC of BMG projects in the PY2017 PSUP was just 0.16. Fourteen of the 21 CHP projects that were installed through the PSUP were in multifamily residential apartments. The CHPs in these apartments were mainly installed to offset the domestic hot water thermal load. This is not an ideal situation to utilize a CHP system. Ideally, a CHP by nature of the system increases in usefulness when there is a large thermal and power load to fulfill. Such was the case for the lone CHP project in IAP described in *Section 5.3.5*.

The total present value of avoided natural gas benefits for PSUP BMG projects implemented in PY2017 is -$4.05M. CHP projects, which made up the majority of the program's energy savings, resulted in increased natural gas consumption and the high cost of supply for the gas outweighed the avoided cost of electricity generated by the units. As such, "avoided natural gas benefits" were actually negative, representing the additional costs incurred to power the CHP units with natural gas. The cost of natural gas supplied to these units proved detrimental to the TRC ratio of PSUP. These costs are inflated due to the out of date avoided costs of natural gas in the current CE Tool. (See Recommendation #4).

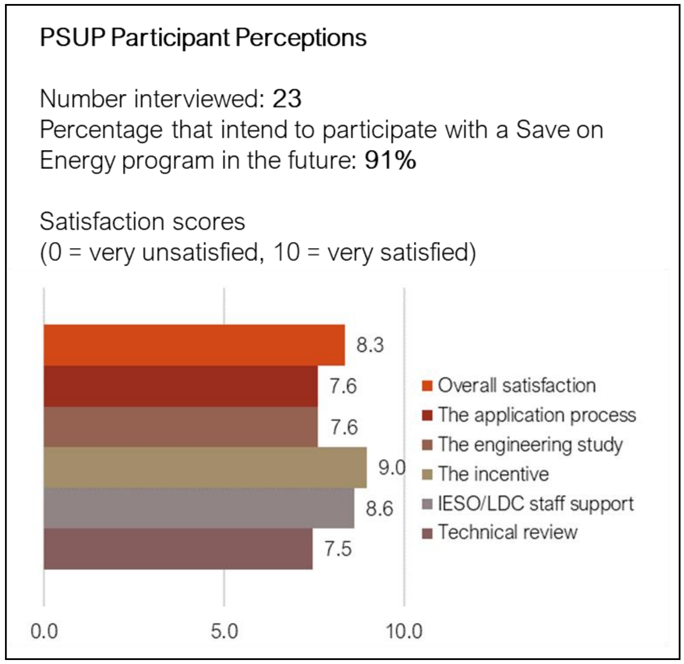
[22] PSUP cost effectiveness analysis includes benefits and costs from PY2017 PES PSUP claims.

5.1.6 PSUP PROCESS EVALUATION RESULTS

EcoMetric observed two findings for this program, related to two topics:

- Program redesign
- CHP phase-out

Each of these are described in more detail below.



5.1.6.1 Program Redesign

The LDCs and IESO recently completed a program redesign process through the Business Working Group, which made a number of changes to PSUP in order to streamline and simplify it in response to LDC and customer feedback. The revised rules were posted on April 6, 2018 and went into effect one month later.

Major changes from the program redesign include:

1. The project type was simplified to either energy efficiency or generation, and small capital projects were eliminated. Projects must deliver 300 MWh of savings (revised from 100 MWh for small and 350 MWh for standard projects). This increase is due in part to the acknowledgement that many EE projects can go through Retrofit – this keeps PSUP to the largest projects.

2. An opportunity for overperformance was added – the incentive is the lower of 70% of eligible costs or "the product of the Electricity Savings multiplied by $200/MWh *capped at 120% of the Approved Amount*." The Approved Amount is the estimated participant incentive when the application is approved.

3. The preliminary and detailed engineering studies are collapsed to a single Engineering Feasibility Study, which is still required to do a project.

4. The contract length is shortened to four years for energy efficiency, four years for generation worth less than $1M in incentives and kept at 10 years for generation more than $1M in incentives.

5. The M&V period is shortened to one year, but the customer must maintain data for the duration of their contract for the LDCs' right to audit.

6. The engineering study funding is revised so that 50% of the incentive is paid when the study is completed, and the remaining 50% (up to $50,000) is paid if the project is submitted for implementation within 12 months of the study being approved.
7. The upfront process for calculating incentives is revised. Originally, the savings and the incentive were estimated upfront during the application review process; as long as the project kept within 80% of the estimate, it received the incentive. Now, while savings and the incentive are estimated upfront, the actual incentive amount is determined based on the first year of M&V.

The rules were also reorganized to be easier to follow; the overall effort had the effect of reducing the rules document from 50 pages to 25. In addition to the program rules, there were several periphery documents also revised after the redesign, including:

- The customer contract (called the participation agreement), which was revised with the new rules and streamlined substantially, bringing the page count from over 70 to around 20.
- The application workbook
- Several LDC-facing materials, including a program guide and customer selling points.

Several of these adjustments were also discussed in the Phase 1 process evaluation[23], including revising the engineering study funding mechanism (Preliminary Recommendation #2), adding an overperformance incentive, and shortening the participation agreement (Preliminary Recommendation #4).

Since this evaluation covers projects completed in PY2017, the customers did not experience the effects of the redesign, and thus the interviews and satisfaction represent perspectives on the original set of program rules. IESO is allowing existing PSUP applications (either submitted or approved, but before contracting) to be converted to the new program rules.[24] After May 7, 2018, all new studies or projects followed the new program rules. While it is possible that the PY2018 evaluation will start to see the effects of the redesign – particularly with the two-step NTG surveys, which will interview the customer shortly after contracting – projects submitted in mid-2018 are unlikely to complete the required M&V to be

[23] Please find the Phase 1 Process Evaluation Results in the PY2016 IESO Industrial Evaluation Report here: http://www.ieso.ca/-/media/files/ieso/document-library/conservation/emv/2016/2016-industrial-programs-evaluation-report.pdf?la=en

[24] "Program and Systems Upgrades Program Rules Implementation Update," Conservation E-Blast, April 18, 2018. Accessed at: http://www.ieso.ca/en/sector-participants/conservation-delivery-and-tools/conservation-e-blasts/2018/04/program--systems-upgrades-program-rules-implementation-update

included in the evaluation until PY2019. As a result, it may be several years before the full effects can be felt.

Some of the indicators IESO expects to see and the evaluators can study in future work include:

- An increase in large efficiency PSUP applications relative to pre-redesign
- Decreased administrative costs for the LDCs
- An increase in study-to-project conversion rates
- An increase in customer satisfaction

The evaluators will continue to monitor the effects of the redesign throughout the remaining years of the CFF. The redesign is intended to remove or reduce several major customer pain points, such as with the participation agreement. One of the largest customer complaints is around the application review process, and it is not yet clear to what extent this process has been streamlined by the changes (particularly #7 in the list above). The crux of the issue is not the application requirements themselves – those seem to be at least mostly understood and accepted – but the amount of time and effort spent with information requests (IRs) to provide the Technical Reviewer with enough data. If an application does not have enough data for the Technical Reviewer to estimate savings within a certain degree of confidence, the reviewer will request additional data in the form of IRs. This could be because an application itself was deficient, or the project is unique enough that the data was not included as a requirement on the application.

The subsequent back-and-forth can take a substantial amount of time; anecdotes from interviews suggest that a fair number of PES claims originate from projects where the customer pulled out if the application process was taking too long. The application review barrier is an even larger source of customer complaints for IAP, where the projects may be more complex, there are fewer CHP projects, and the facility is more likely to put together the application rather than relying on a consultant or vendor. This is covered in more detail in *Section 5.3.6.2*.

Process Finding 5: The application review process remains a major customer pain point for PSUP.

Process Recommendation 5 (PSUP/IAP): Develop measure-specific applications or accompanying guidance to limit the number of information requests (See also Recommendation 13, Section 5.3.6.2, for IAP).

- The technical reviewer should determine what types of data they often request in IRs and whether the data was missing or not requested in the application.

- IESO should then consider revising the application, developing an application amendment, or including more detailed guidance as an accompaniment to the application based on this review. Making the applications or guidance measure-specific for the most common 4-5 measures would also ensure that relevant information is captured upfront for each. This would ultimately save both Technical Reviewer and customer time from having to track down additional unexpected information.
- The PSUP and IAP application processes are similar; this recommendation is repeated for IAP in *Section 5.3.6.2*.

5.1.6.2 CHP Phase-Out

Natural gas-fired CHP was phased out as an eligible measure for PSUP and IAP incentives on July 1, 2018. The definition of BMG was adjusted to exclude fossil fuel-fired CHP, leaving BMG based on by-product heat of fuel from the facility, in a ministry directive released October 26, 2017.[25] The motivation was the increase in GHG emissions due to increased natural gas use at facilities implementing CHP; the PY2016 impact evaluation found that PSUP resulted in a net increase of 20,322 tonnes CO2e from its CHP projects.

Interviews from the Phase 1 process evaluation, which occurred before the phase-out was announced, revealed that IESO and the LDCs were already aware of rumors that CHP would no longer be incentivized. At the time, four LDCs stated that the majority or entirety of their industrial pipelines were CHP and losing that as a measure would effectively eliminate their chances of hitting their goals. When the announcement was made, the evaluators added a question to this year's LDC survey that assessed how concerned the LDC was with hitting their CDM goals without CHP. The wide range of responses is shown in Figure 14; an answer of one meant that the phase-out was not a concern at all, and 10 meant that it was a large concern.

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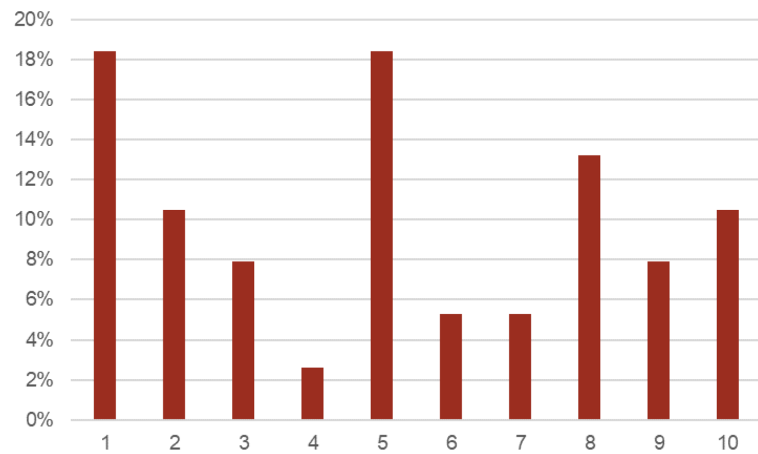
[25] "Amendments to Ministerial Directions Arising from the Long-Term Energy Plan 2017," October 26, 2017. Accessible at: http://www.ieso.ca/corporate-ieso/ministerial-directives

Figure 14: Degree of Concern from CHP Phase-Out to Hitting LDC Goals



Looking at the responses in rough thirds – not much of a concern (1–3), somewhat of a concern (4–7), and a large concern (8–10) – there are slightly more respondents in the first category (37%) than the other two (31%–32%). While the LDCs less concerned about CHP tended to be the smaller ones that either have little opportunity for CHP or are already ahead on their goals, those stating it was a moderate or large concern were a mix of small, medium, and large LDCs.

LDCs for which the phase-out did represent a concern must develop alternative strategies to meet their goals. When asked about their strategies, doing more projects through Retrofit was the most common response followed by efforts to promote specific measures (i.e., compressed air, refrigeration, and other energy-intensive equipment). Other responses included focusing more on the EM or M&T programs, promoting non-gas behind-the-meter generation, or accelerating the timelines for CHP projects to get them in while still eligible. Although only two LDCs mentioned accelerating CHP as a key strategy, the massive uptick in applications just before the July 1, 2018, deadline indicates that this was a tool employed by more.

A small number of program participants mentioned the phase-out during their interviews this year. Four asked that the deadline be extended when asked "how could the program improve"; one respondent said their company did not plan to participate again in the future (compared to 92% of their PSUP peers) because CHP was no longer eligible. Two participants seemed to think that the entire PSU program was being terminated, not just the natural gas-fired CHP. One nonparticipant also mentioned the CHP phase-out.

The CHP phase-out affected LDCs differently; some are taking steps to make up an anticipated savings shortfall, while others did not view it as a challenge. Several participants – and even nonparticipants –

mentioned the phase-out; however, a small number of participants seemed to think that the entire PSUP was being terminated.

5.2 ENERGY MANAGER NON-INCENTED MEASURES (EM) RESULTS

5.2.1 EM NON-INCENTED MEASURES DESCRIPTION AND EVALUATION APPROACH

The Energy Manager program subsidizes the salary of a trained energy manager to work directly with participating facilities to find energy savings, identify smart energy investments, secure financial incentives, and unleash competitive advantage. Energy managers can identify capital improvements that are eligible for incentive payments through PSUP, IAP Retrofit, or IAP Capital Incentives. Savings from these projects accrue to, and are evaluated in, the program that incents the improvement.

Energy managers are also expected to identify and implement *non-incented* improvements for the organizations they support. Since 2016, Energy Manager contracts require that 10% of the savings goal be achieved through non-incented improvements. This is a reduction from the 30% requirement in place previously. These non-incented projects are the focus of the Energy Manager evaluation conducted by the EcoMetric team. Non-incented Energy Manager projects from commercial LDC accounts, industrial LDC accounts, and transmission-connected accounts were evaluated together. This section of the report discusses the evaluation methodology and findings across all types of accounts because the EcoMetric team did not calculate separate realization rates for LDC participants and transmission-connected accounts. The gross and net verified savings values presented in this section of the report focus on LDC accounts.

5.2.1.1 EM Program Observations

The number of Energy Managers with non-incented savings claims and the aggregate energy savings claimed both increased significantly from PY2016 to PY2017. Many of the Energy Managers added in 2017 did not record any non-incented savings in PY2017 because of the timing of their contract start date so we expect program volume will continue to increase in PY2018. The measures implemented in PY2017 were as diverse as the industry across the province and included upgrades to compressed air systems, mining equipment, chilled water plants, fans, pumps, lighting, and refrigeration. Energy Managers and the program technical reviewer classify non-incented measures into different category types. Table 22 shows the distribution of projects and reported energy savings by measure type. The prevalence of operation and maintenance (O&M) and optimization measures is an important theme in the gross verified savings calculations and estimates of measure life.

Table 22: Distribution of Non-Incented EM Projects and Savings by Measure Type

Measure Type	Measure Quantity[26]	Reported Savings (%)
Optimization	98	50%
Equipment Upgrade	105	28%
O&M	47	14%
Other	13	5%
Behavioural	59	2%
Missing (Unclassified)	13	1%
Conservation	1	1%
2017 EM TOTAL	**336**	**100%**

The evaluation team noted an increase in the level of complexity of the non-incented projects completed by Energy Managers in 2017. The 2016 non-incented projects included a fair amount of "low-hanging fruit" measures such as conversion of High-Intensity Discharge (HID) lighting to LED or changing schedules to avoid lighting and ventilating empty areas. In 2017, we observed an increase in optimization and O&M projects where EMs made adjustments to the core business process to reduce energy intensity.

5.2.1.2 EM Sampling

The sample frame for the 2017 impact was all participating organizations with reported kWh savings in the implementer program tracking data on April 1st (n=58). EcoMetric used the participating organization as the sampling unit for the non-incented Energy Manager gross impact evaluation. EcoMetric selected a sample of 17 participating organizations for the impact evaluation. Each of the organizations with over 1,000 MWh of reported savings (n=14) were placed into a certainty stratum and a random sample (n=3) of the remaining organizations (n=44) with reported savings less than 1,000 MWh were selected to complete the sample. For each sampled organization, EcoMetric reviewed all completed non-incented measures with reported kWh savings – both those that received a technical review and ones that did not receive a technical review. The reviewed measures in the sample accounted for 68.2% of the first-year energy savings in the sample frame and the measures that did not receive a technical review accounted for the remaining 31.8% of the reported energy savings in the sample. The evaluation sample included

[26] Includes all measures completed in PY2017. Measures that were not technically reviewed or invoiced before the sample cutoff date are not included in the savings reported in this evaluation report.

79.4% of all reported PY2017 non-incented savings. Because such a large share of the program savings was evaluated the sampling error was limited. The reported and verified gross energy savings were also well-aligned so the relative precision of the energy realization rate was just ±0.6% at the 90% confidence level.

5.2.1.3 EM Data Collection

The primary data source for non-incented Energy Manager projects in the gross impact evaluation sample were the program tracking data, calculation workbooks, and other supporting documentation submitted by the participating organization's energy manager. This information was supplemented with interviews and supplemental data requests to the energy managers in the sample. No site inspections were conducted for the PY2017 evaluation.

IESO retains an independent implementer to perform technical reviews of a subset of non-incented savings claims and track the progress of Energy Managers towards their goals. The implementer reviews at least 30% of the non-incented projects submitted by each Energy Manager annually and typically focuses their reviews on projects with the largest energy savings. For projects receiving a technical review, the technical reviewer's calculations, notes, and adjustments were also key inputs as they are the source of the reported savings estimates. EcoMetric also reviewed the quarterly and annual term reports prepared by the implementer for each sampled participant. The intent of this initial review is to gain a detailed understanding of each upgrade and how it saves the facility energy.

For projects that were not technically reviewed, no supporting calculations or documentation had been submitted to the implementer, the LDC, or to IESO. In these cases, EcoMetric requested the supporting documents directly from the Energy Manager for review. For the most part, energy managers were able to provide the requested information and were very responsive to technical questions about project details. In a few cases, supporting documentation from the technical review was not available until very late in the evaluation period. This left only a matter of days for the EcoMetric team to interface with the energy managers and limited the depth of review possible by the evaluation team.

The EcoMetric team noted a definite improvement in the quality and transparency of the energy manager and technical reviewer savings calculations. Compared to PY2016, more projects utilized data driven methods in the spirit of IPMVP Options A, B, or C and fewer projects relied on engineering calculations based on equipment sizes and estimated operating conditions. Billing analysis projects were almost all completed using the RETScreen software packages as opposed to the mixture of Excel models observed in PY2016.

For many projects in the evaluation sample, the fact that the verified savings analysis occurred 3-6 months after the technical review afforded the EcoMetric team with additional consumption and trend data that was not available to the implementer during the technical review (because it hadn't happened yet). EcoMetric worked with Energy Managers and LDC representatives to gather the latest billing data, production data, and other key parameters measured by facility energy management systems for use in the savings analysis. In some cases, EcoMetric could gather more granular data (hourly or daily) than was used in the EM or technical reviewer calculations, which allowed for more accurate estimates of the summer and winter peak demand impacts.

5.2.1.4 EM Gross Savings Verification

Each of the 144 measures completed by the 17 participating organizations in the non-incented sample were analyzed separately. The level of rigour of the EcoMetric analysis was consistent with project size. Many of the larger projects were completed using regression analysis to compare the facility loads or loads from a specific process within the facility. Weather was used as an independent variable for several upgrades to military and educational organizations.

5.2.2 EM TRACKING SYSTEM & PROGRAM DOCUMENTATION REVIEW RESULTS

The establishment of ex-ante savings for the non-incented Energy Manager projects required careful communication between EcoMetric, IESO, the implementer, and the LDCs. *Section 5.2.1.2* discusses the development of the sample frame for the impact evaluation activities. EcoMetric relied on the program tracking data maintained by the implementer as the system of record for the reported savings on a project basis. Key elements of the program tracking data are listed below along with observations and recommendations. It's important to note that the intended purpose of the technical review and tracking process is to assess each Energy Manager's performance towards their contractual obligations, which does not perfectly align with programmatic reporting needs of IESO.

Finding 7: Energy Manager program tracking data for PY2017 was very similar to PY2016. It is somewhat less reliable than the data tracked for the other Industrial programs and showed minimal improvements in PY2017.

- The reported kWh savings values for non-incented Energy Manager projects were generally reasonable. In some cases, EcoMetric interviews with EMs and technical reviewers revealed that the savings claims were deliberately conservative to ensure that estimates were not over-stated.
- Peak demand savings claims were less reliable. For many projects with kWh savings, the peak demand impact was reported as 0 kW. For some projects, the savings profile of the measure was exclusively off-peak so zero was the correct value. More often, it appears that peak demand savings just was not calculated by the EM or the technical reviewer. For other EM projects, the peak demand savings estimate stored in the tracking data was equal to the change in the connected load and was not discounted to reflect coincidence with the system peak.

- The 'Project Costs' field in the program tracking data was populated inconsistently. Some projects involved capital upgrades but were assigned $0 of project cost. Other projects were just changes to equipment settings, so the only real cost was the Energy Manager salary, which is tracked elsewhere. The difference between zero and missing is important because participant cost is included as cost in the TRC test. If participant cost is not recorded it can't be included in the TRC costs and the TRC ratio for the program will be overstated. For some projects in the evaluation sample, EcoMetric obtained more accurate cost information, but this data collection really needs to be a point of emphasis for energy managers and technical reviewers
- Several issues were identified with unique identifiers (iConID) for participating organizations. Measures were recorded twice under both Alectra and EnerSource due to the acquisition. We also found energy managers with measures recorded under different iConID values because of transposed digits.
- Measures were recorded as non-incented, but also showed incentive amounts.

Recommendation 9: *Energy Managers and technical reviewers should include participant cost information as this information is critical for program tracking and evaluation purposes. This information should be entered into tracking databases and supported with invoices and other documentation.*

Recommendation 10: *Require that all key tracking parameters (in-service date, project cost, kWh, kW, and EUL) are completed for all measures and that zero values actually reflect the absence of participant cost or peak demand savings.*

5.2.3 EM GROSS VERIFIED SAVINGS RESULTS

EcoMetric reviewed the available documentation and prepared questions prior to reaching out to the Energy Managers in the sample. For 16 of the 17 organizations in the evaluation sample, EcoMetric conducted an engineering phone interview with the Energy Manager – or Energy Managers in the case of organizations who had different EMs across different facilities. For one organization the original Energy Manager had left the company and no new Energy Manager yet hired so the discussion was with a supervisor in the organization who was familiar with the measures. These meetings were used to ask questions about the savings calculations and request updated or additional trend data for the verified savings analysis.

Table 23 shows gross verified energy savings for the LDC Energy Manager non-incented measures in PY2017. **Overall the measures achieved an energy realization rate of 95.3% and resulted in 41,503 MWh of first-year energy savings.** Measurement and verification activities and technical reviews are generally resulting in highly accurate estimates of energy savings in the program. **About 63% of these savings had** an EUL of enough years for the measure to persist to 2020. The sections below include detailed descriptions of verified results.

Table 23: Energy Manager Gross Verified Savings Results

Program Year	# of Measures Evaluated	Realization Rate (%)[27]	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
Energy Manager Non-Incented (EM)					
2017	281	94.3%	29,476	3.98	56%
2016 Adjustments	157	97.8%	12,027	2.07	81%
EM TOTAL	**438**	**95.3%**	**41,503**	**6.05**	**63%**

Table 24 provides the realization rates by stratum for the non-incented Energy Manager projects completed in PY2017.

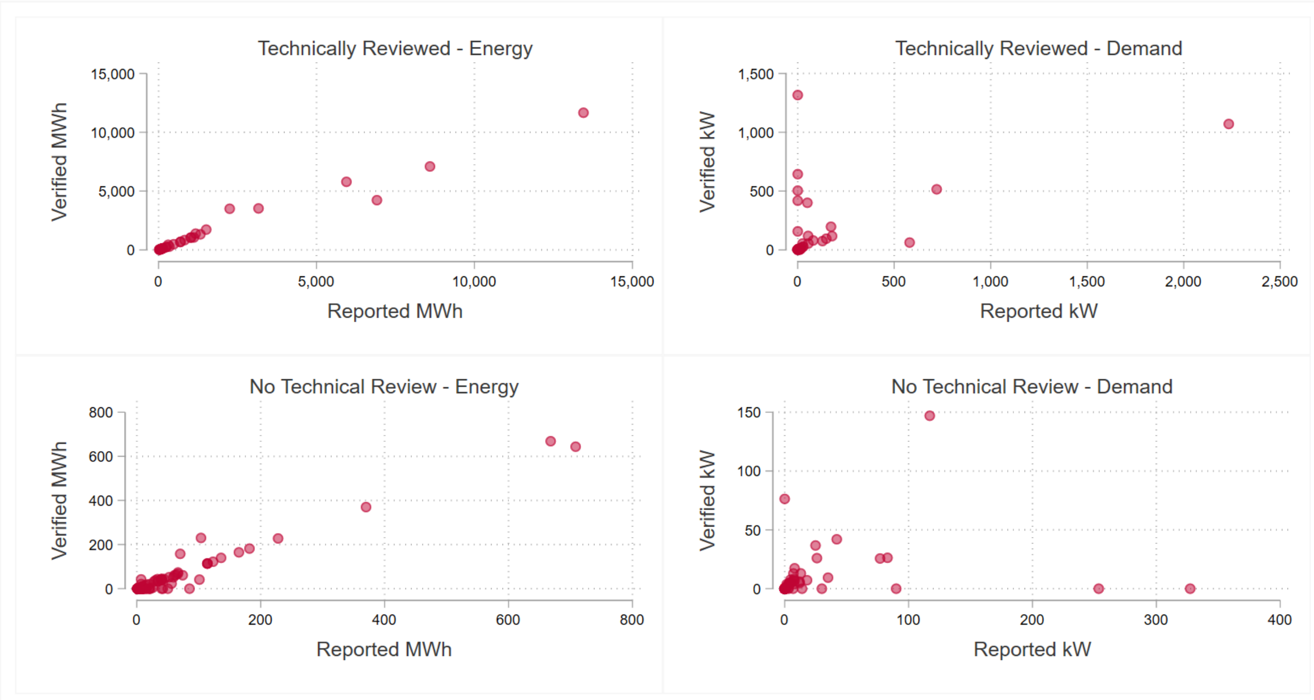
Table 24: PY2017 Non-Incented Energy Manager Realization Rates by Stratum

Stratum	Energy RR	Demand RR
No Technical Review	91.2%	129.9%
Technically Reviewed	95.3%	92.1%

Figure 15 shows the project-level savings results for the two strata of non-incented Energy Manager projects. The reported savings estimate from the program tracking data is on the x-axis and the verified savings estimate is on the y-axis. The plots on the left side of the figure look at energy and the plots on the right look at summer peak demand. The realization rate can be thought of as the slope of a fitted line through these points. Figure 15 shows that that the correlation between reported and verified energy savings were generally quite good for non-incented Energy Manager projects. The peak demand impacts exhibited significantly more variation between the measure-level reported and verified savings estimates. Peak demand savings from technically reviewed measures showed the same poor correlation as measures that were not technically reviewed.

[27] RR is reported at a confidence interval of +/- 2%

Figure 15: Scatter Plot of Reported and Verified LDC Energy Manager Savings Estimates by Stratum



The energy realization rates by stratum were applied to the reported gross savings for each LDC project to calculate the verified gross savings shown in Table 23. Projects that are expected to reach the end of their effective useful life before December 31, 2020 are assigned first-year kWh savings, but no 2020 persistent savings.

Embedded Energy Managers continue to identify and implement successful improvements. The evaluation team observed a transition from "low-hanging fruit" projects to more complex projects in PY2017 compared to PY2016.

Finding 8: The annual energy savings estimates produced by Energy Managers are generally very accurate. There is a tendency for Energy Managers to be overly conservative in their estimates once they have met their contractual obligations.

Recommendation 11: Consider a mechanism to reward Energy Managers for exceeding their required amount of non-incented energy savings. One possibility would be a "carry-over" calculation whereby savings more than the contractually required minimum could be applied to future years in the event of a shortfall. Designing a proper incentive would eliminate the conservative behavior of EMs to target the required minimum savings.

Finding 9: The peak demand savings estimates for non-incented Energy Manager projects are inconsistent or non-existent. Projects are often submitted without peak demand savings estimates. When projects have demand impacts recorded, they are

frequently the change in connected load rather than an estimate of demand reduction coincident with the system peak.

Recommendation 12: Make the quality and completeness of peak demand tracking and reporting a performance metric for technical reviewers. Although goals are based on energy savings, peak demand impacts are a key factor in system planning and cost-effectiveness.

Finding 10: The evaluation team observed Energy Managers using LDC meter data in savings calculations that was adjusted for transmission and distribution losses.

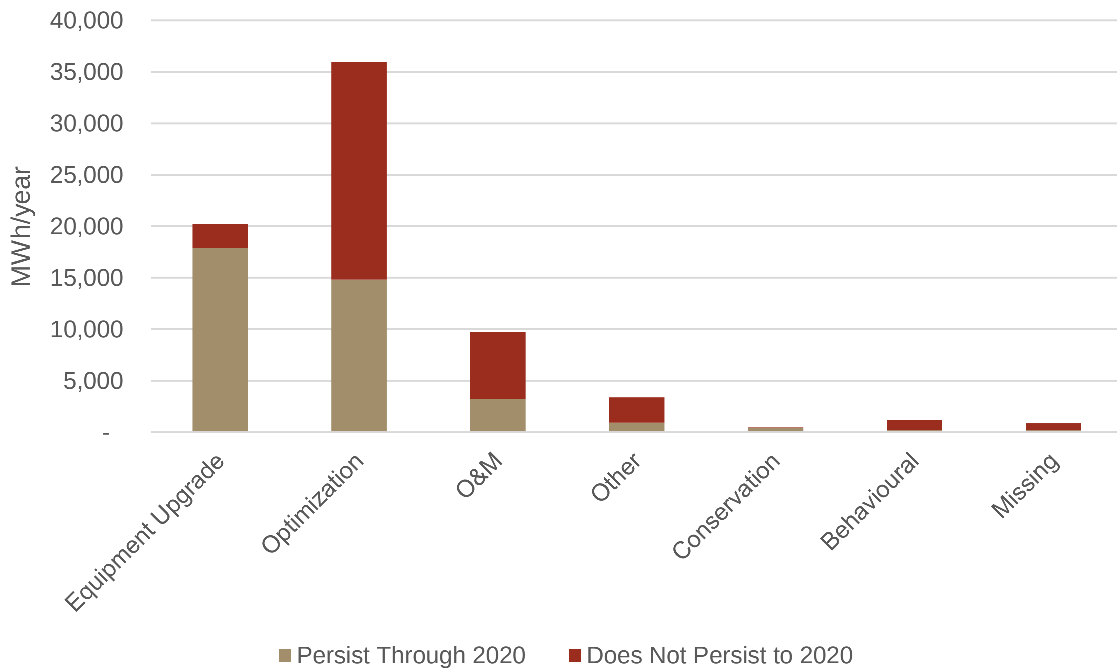
Recommendation 13: All project savings calculations should be performed at the meter-level for goal assessment. Impacts are grossed up for T&D losses as part of cost-effectiveness calculations.

5.2.3.1 EM Savings Persistence to 2020

The persistence of non-incented Energy Manager savings to 2020 varied by LDC. The policy decision to assess progress towards goals via the measurement of 2020 persistent savings places a lot of importance on the estimated measure life of non-incented Energy Manager projects. Consider a project with an in-service date of July 2017 with a three-year EUL. That project would reach the end of its useful life in July 2020 and contribute no savings towards goals. If the same project were installed in July 2018, the savings would persist to July 2021 and savings would count towards goals. The two hypothetical projects would save the same number of kWh, and have virtually the same cost-effectiveness ratio, but have vastly different contribution towards goals. Measuring goals via persistent savings is designed to encourage the installation of long-lasting measures but can have an unintended consequence of discouraging the installation of short-lived options like O&M or behavioural measures early in a program cycle. Some jurisdictions have moved away from persistent savings goals to avoid creating a disincentive for program administrators to install efficiency measures with shorter measure lives.

Figure 16 shows the share of first-year energy savings that persist to 2020 across the 2017 Energy Manager population (LDC and transmission-connected) by measure type. Overall 52.4% of the 2017 non-incented Energy Manager savings will persist to 2020 and the other 47.6% will expired before 2020. A large share of the non-incented Energy Manager projects would be categorized as behavioral, process optimization, or retro-commissioning. While successful and low-cost, these types of projects have limited persistence. Persistence considerations will have less impact in 2018 when measures with a 3-year EUL are persistent to 2020. The default EUL assumption of O&M measures is three years.

Figure 16: Energy Manager Non-Incented Measure Persistence through 2020



For projects outside of the sample, the EcoMetric team largely relied on the measure life assumptions supplied by the Energy Managers and technical reviewers. For a small number of projects where equipment was installed, EcoMetric increased the EUL from less than four years to greater than or equal to four years. Similarly, EcoMetric reduced the measure life assumption from greater than or equal to four years to less than four years for a handful of projects where the upgrades consisted of changes to equipment settings or re-commissioning of equipment controls. Where no measure life was reported in the tracking data, EcoMetric estimated an EUL based on the type of project implemented. EcoMetric provides the following findings and recommendations regarding measure life assumptions for non-incented Energy Manager projects.

5.2.4 EM NET VERIFIED SAVINGS RESULTS

Table 25 summarizes the EM non-incented net savings below. **The program-level NTG for the EM non-incented measures was 71.6% for 2017 projects, comprised of a free-ridership score of 28.4% and spillover of 0%.** Total net first-year energy savings for EM projects evaluated in PY2017 was 31,442 MWh and net peak demand savings were 4.63 MW.

Table 25: EM Non-Incented Net Savings

Program/Status/ Framework	# of Measures Evaluated	NTG Ratio (%)[28]	Net Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)
Energy Manager Non-Incented (EM)				
2017	281	71.6%	21,099	2.85
2016 Adjustments	157	86.0%	10,343	1.78
EM TOTAL	**438**	**75.8%**	**31,442**	**4.63**

Free-ridership – Generally, energy managers were perceived by customers as key players in project identification, analysis, and documentation. While in some cases the customers indicated they would likely have pursued the projects in question regardless of whether they had an energy manager, in most cases the interviewees felt that energy managers were instrumental in speeding up project implementation and ensuring that all required documentation and savings estimates were accounted for.

Spillover – While there was no spillover credited to the EM program through the interviews, there was significant spillover identified during the energy manager interviews. All except one interviewee indicated that they have completed or plan to complete additional projects through the energy manager or other LDC programs. However, in all cases the customer expects that the program-supported energy manager will continue to have an instrumental role in project identification, savings estimation, and implementation either as non-incented energy manager projects or incented under Retrofit or PSU. While this cannot be counted as spillover for the program, it is a testament to the overall strength of the Energy Manager program.

[28] The EM total NTG ratio is for illustrative purposes only, representing total net verified savings divided by total gross verified savings.

5.2.4.1 Total CFF EM Net Savings Results

Figure 17: Total CFF EM Net First-Year Energy Savings (MWh)

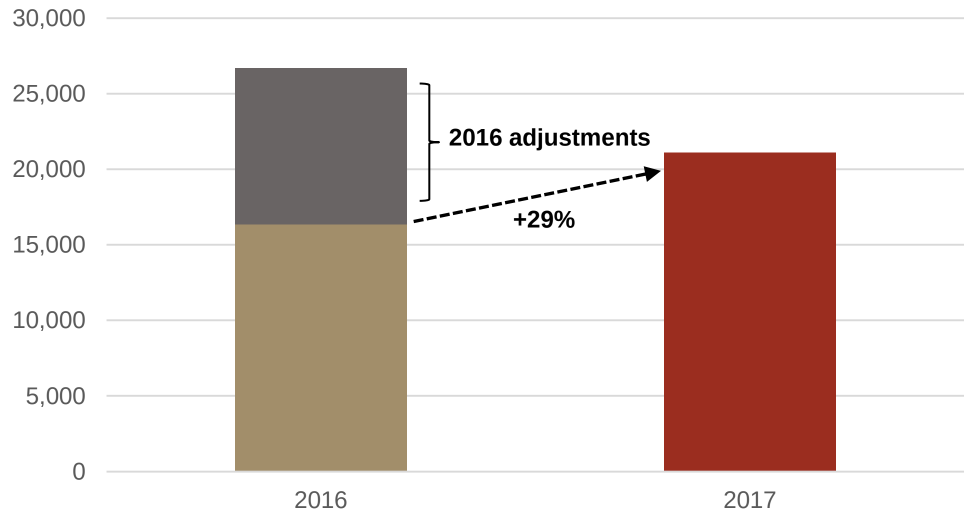


Figure 17 above depicts the EM program's total CFF net first-year energy savings achieved through non-incented projects. **As part of the CFF framework, the EM non-incented program has achieved 47,804 MWh of net first-year energy savings, representing 79.0% of gross verified first-year energy savings.** EM projects that were implemented in 2016 and have been evaluated and reported through PY2017 total 26,705 MWh of net first-year energy savings. 2016 adjustment projects, those that were implemented in 2016 but evaluated in PY2017, account for 10,343 MWh of net energy savings—22% of the total EM net energy savings achieved through the CFF to date.

The EM projects implemented in PY2017 and evaluated in PY2017 had 21,099 MWh of net first-year energy savings. **EM net first-year energy savings increased 29% YOY in PY2017 compared to the 16,363 MWh net first-year energy savings achieved and evaluated in PY2016.** Only 123 EM measures were implemented and evaluated in PY2016, compared to 281 in PY2017.

5.2.5 EM COST EFFECTIVENESS RESULTS

As shown in Table 26, the EM program is cost effective in PY2017 from the PAC test perspective using a benefit/cost threshold of 1.0. However, the EM program fails to meet the benefit/cost threshold of 1.0 under the TRC test. Cost-benefit assumptions are included in *Appendix D.*

Table 26: EM Non-Incented Cost Effectiveness Results

TRC Costs	TRC Benefits	TRC Ratio	PAC Costs	PAC Benefits	PAC Ratio	LC $/kWh
$8,492,766	$7,518,719	**0.89**	$2,459,290	$6,538,017	**2.66**	0.02

Average incremental cost of EM measures increased 97% YOY in PY2017. The average incremental life cycle cost of the EM measures evaluated in PY2017 was $29,997, nearly twice as much as the $15,175 average for PY2016 EM measures. Projects implemented in PY2017 tended to be larger and slightly more complex, resulting in higher per project savings as well as costs.

5.2.6 EM PROCESS EVALUATION RESULTS

There are three key findings for this section, related to three topics:

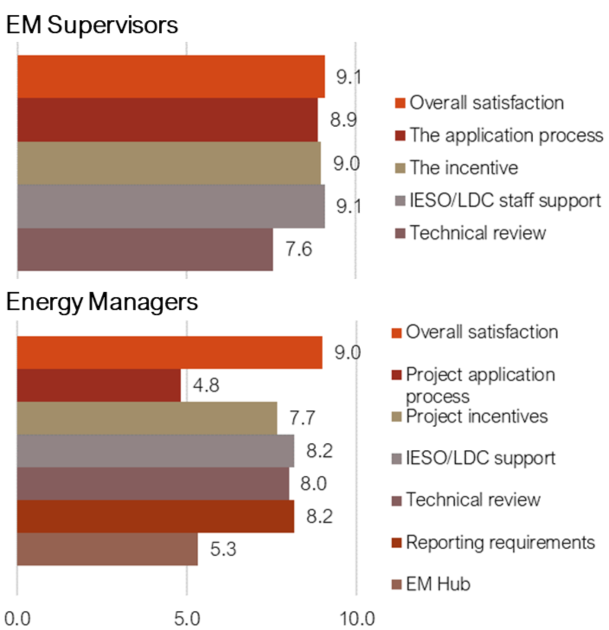
- Role in the industrial portfolio
- EM success factors
- Program support & resources

Each of these are described in more detail below.

EM Participant Perceptions (LDC)

Number interviewed: **10 supervisors, 6 participants**
Percentage that intend to participate with a Save on Energy program in the future: **90%**

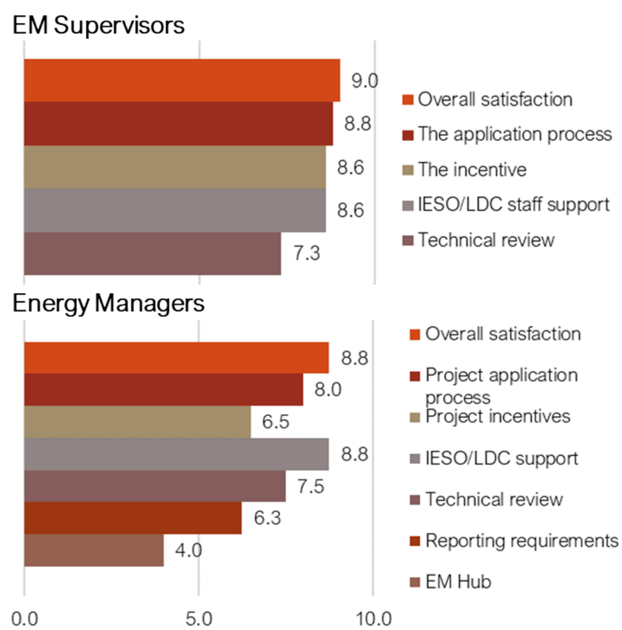
Satisfaction scores – supervisors
(0 = very unsatisfied, 10 = very satisfied)



EM Participant Perceptions (IAP)

Number interviewed: **5 supervisors, 4 participants**
Percentage that intend to participate with a Save on Energy program in the future: **100%**

Satisfaction scores – supervisors
(0 = very unsatisfied, 10 = very satisfied)



5.2.6.1 Role in the Industrial Portfolio

The EM program inhabits a unique role in the industrial portfolio. Rather than providing an incentive for a piece of equipment, it provides an incentive for a person – a dedicated, embedded resource at a customer facility. The program, in turn, receives the savings from the projects that each EM identifies and implements. The savings that accrue directly to the program result from any non-incented projects, which must account for at least 10% of each EM's annual savings goal. Most of each EM's savings result from projects performed through Retrofit, PSUP, M&T, IAP, or other programs, and those savings are counted as part of the relevant program. As a result, the EM program provides a small portion of the industrial portfolio savings directly. However, as an enabling initiative, it drives savings in other programs; there are also a variety of non-energy benefits that the EM program provides.

EM-Driven Savings and Projects

EMs drive measurable impacts at their sites in the form of energy savings and cost reductions. Their influence can also be assessed at the portfolio level. The EcoMetric team performed two separate analyses to determine the proportion of portfolio savings and projects attributable to facilities with EMs. The first used verified net savings data from several programs to assess the percentage that could be attributed to EM activities. The second used industrial program and Retrofit application trackers from PY2015-2017 to determine whether EMs submitted more projects than their non-EM counterparts during these three years. Both of these analyses are described in detail in *Appendix C.*

Facilities with EMs represent about 6% of the estimated industrial population and 15% of facilities that have submitted an application for any of the industrial programs (referred to as the "active" population).[29] This small group has an outsized effect on the portfolios in terms of savings, as shown in Table 27. In PY2017, EMs contributed a total of 56,733 MWh of net first-year energy savings in the Retrofit, PSUP and PUMPsaver programs—accounting for 8.4% of the total net energy savings in those programs. The clear majority of EM-enabled savings were in the Retrofit program where EMs contributed nearly 75,000 measures resulting in 50,264 MWh of net first-year energy savings (7.8% of the program total). The magnitude of savings from EMs is much lower in the PSUP and PUMPsaver programs; however, the EMs contribution to the programs' total net energy savings is greater at 17.2% and 24.6%, respectively. The

[29] For the nonparticipant surveys, the evaluators developed a list of facilities that were likely to be large enough to participate in the industrial programs from a list of all commercial facilities in Ontario. The possible participant list was then segmented into large, medium, and small groups based on their estimated energy usage (calculated from their square footage and industry). The estimated industrial population mentioned here only includes the large and medium facilities; adding the small facilities doubles the population and puts EMs at 3% of the total.

PSUP projects enabled by EMs were major upgrades to a compressed air system and chiller, with just two projects accounting for over 17% of the net savings achieved by all PSUP projects completed in 2017.

Table 27: PY2017 Energy Manager Incented Savings Results

Program	Measures Evaluated and Reported	Net First-Year Energy Savings (MWh)	% of Total Energy Savings	Net Summer Peak Demand Savings (MW)	% of Total Peak Demand Savings
Retrofit					
EM Incented	74,938	50,264	7.8%	7.50	7.1%
Other	1,680,918	598,235	92.2%	98.74	92.9%
Total	**1,755,856**	**648,500**		**106.24**	
PSUP					
EM Incented	2	2,544	17.2%	0.70	26.6%
Other	14	12,229	82.8%	1.94	73.4%
Total	**16**	**14,774**		**2.64**	
PUMPSaver					
EM Incented	41	3,924	24.6%	0.51	25.1%
Other	245	12,024	75.4%	1.51	74.9%
Total	**286**	**15,948**		**2.02**	
Portfolio Total					
EM Incented	**74,981**	**56,733**	**8.4%**	**8.71**	**7.9%**
Other	**1,681,177**	**622,489**	**91.6%**	**102.19**	**92.1%**
Grand Total	**1,756,158**	**679,221**		**110.90**	

The second analysis revealed that EM facilities overall submitted just slightly more projects per facility as their non-EM counterparts, which also suggests that EMs were responsible for larger projects. Other findings from this 2015-2017 project analysis include the following:

- **EMs represent a substantial number of facilities**. There have been 98 facilities with EMs over the past three years – 76 LDC ones and 22 IAP ones. LDC EMs represent 15% of the active population of distribution-connected industrial facilities submitting projects, whereas the IAP EMs represent an impressive 48% of transmission-connected ones.
- **EM facilities overall submitted roughly the same number of projects as their non-EM counterparts**. LDC EM facilities represent 15% of the active population and 15% of its submitted projects (studies, PSUP, M&T, Retrofit). IAP EM facilities represent 48% of the population and 49% of its submitted projects (studies, P&S, Retrofit).
- **EM facilities were better at leveraging Retrofit than non-EM counterparts**. Both the LDC and IAP EM populations completed more Retrofit projects per facility, as shown in Table 28 below.

- **EM facilities completed fewer studies than non-EM counterparts**. LDC EMs also completed fewer industrial projects through PSUP projects, but IAP EMs completed more through Process & Systems.
- **EM facilities cancelled fewer projects**. This was especially true for the LDC participants, where non-EM facilities cancelled five times more projects than facilities with EMs.
- **The M&T program was more favored by facilities with EMs**. This stands to reason as having an EM is a program requisite.[30] There were no M&T projects submitted by EM facilities in either 2015 or 2016, but in 2017, that jumped to nearly half of all M&T applications. No EM facility cancelled any of its M&T projects; however, fully half of non-EM M&T projects were cancelled within the three years of this analysis.

Table 28: Average Projects Per Facility for EM and Non-EM Participants

Average Projects per Facility	LDC (Distribution-Connected)		IAP (Transmission-Connected)	
	EM	Non-EM	EM	Non-EM
Completed/In Progress Projects				
Avg successful projects per facility	20.21	20.07	4.72	4.50
Avg studies per facility	0.44	0.79	1.00	1.15
Avg PSUP/IAP P&S per facility	0.30	0.45	0.61	0.45
Avg M&T per facility	0.09	0.03	N/A	N/A
Avg Retrofit per facility	19.38	18.81	3.11	2.90
Cancelled Projects				
Avg cancelled projects per facility	0.04	0.22	0.86	1.00
Avg cancelled PSUP per facility	0.04	0.19	0.14	0.13
Avg cancelled M&T per facility	0.00	0.03	N/A	N/A
Avg cancelled Retrofit per facility	N/A	N/A	0.73	0.88

It's also very possible that this facility-level analysis understates EM achievements, as the data is segmented by calendar year, but EMs must submit projects within one year of their start date. As a result, some 2017 EMs starting later in the year may not have submitted any projects since they have until mid-2018 to plan and implement them. This phenomenon is clear when looking at EMs that did not submit any projects: 13% of EM facilities had no projects between 2015–2017; focusing just on 2017, this number jumps to 26%. While it's possible that some EM facilities were ultimately unable to conduct any

[30] The M&T program requires a designated on-site EM to participate, but it is not necessary that EM be IESO-sponsored.

incented projects (about 11% of non-EM active facilities have submitted projects but never completed one), at least a few of those facilities just have not needed to comply with their deadline yet.

In addition to the savings driven by participation in other programs, each EM must meet at least 10% of their annual goal through non-incented savings projects. In PY2017, these non-incented projects represented 21,009 MW of net verified savings (see Section 5.2.4), or about 27% of the savings EMs contribute to the portfolio. These projects tend to be ones with very low payback periods, operations and maintenance adjustments, behavioral programs for other employees, and corporate policy changes (such as influencing purchasing). However, there are two paradoxes with non-incented projects:

- **While non-incented savings are more cost-effective for IESO and LDCs, the EM has no incentive to overachieve the 10% limit.** Because the customer cannot apply for additional incentive money for these savings, they generally try to minimize the amount of non-incented projects. Projects that go over the savings threshold do not provide any additional value to the customer for the purposes of complying with program requirements. The impact evaluation team noticed this from the tracking data: once targets had been met, participants became extremely conservative in their savings estimates so that the technical reviewer did not ask questions. One participant told the evaluator in PY2016 that if they'd known that they would have to do extra work to gather data for the evaluation, they wouldn't have submitted an extra non-incented project in the first place.
- **While the EM can use short-term behavioral or maintenance projects to meet their goals, the LDCs/IAP often cannot.** Persistence is often an issue with these types of projects. Although the EM can utilize those projects to meet their goal based on reported-first year savings, the LDCs can only claim savings persisting to 2020.

Future process evaluation work could be used to explore non-incented projects and the data behind them in more detail.

Process Finding 6: The EM program is seen as an enabling program and drives participation and savings in other Save on Energy/IAP programs.

- Although only non-incented savings accrue directly to the EM program for reporting, EMs are also responsible for a good percentage of savings and projects in other programs, such as PSUP and Retrofit.

Process Recommendation 6: *Consider ways to reward EMs for overachieving the 10% non-incented target, provided that they submit enough documentation for the technical reviewer to fully review and the savings persist to 2020.*

- Future evaluation work could consider ways of motivating EMs to perform projects where the savings will persist, including program tweaks where the EM could be encouraged to create a long-term plan for maintenance or behavioral programs that states how often the effort will be refreshed and in what format. The effort could also explore the types of non-measure projects done by EMs, how the savings are estimated, and the benefits they have on their facilities.
- This is based on a preliminary recommendation from the PY2016/Phase 1: Process Evaluation Recommendation #7.

While the above discussion focuses on the portfolio-level, there is a large variation in how much each EM contributes. Although this evaluation did not focus on performance on an EM level, each EM does have a built-in key performance indicator in the form of their annual savings goal.[31] Technical Reviewer data from the legacy framework suggests that two-thirds of EMs were successful in hitting their targets in their first year; EMs that stayed on for subsequent years were more likely to meet their goals.[32] LDCs likewise reported a range of success levels for their EMs. Out of the ten LDCs surveyed with active EMs, five stated that 100% of their EMs had met their goals, another four estimated that between 60 and 90% of their EMs did, and one that 0% had. This does not take into account the number of EMs each LDC had, however.

Assessing individual EM performance has not historically been included within the evaluation because the data does not readily overlap (EMs are assessed based on their reported savings one year from the contract start date; the evaluation uses calendar year data and evaluates a sample of EM non-incented projects). However, understanding how many and under what circumstances EMs meet their targets is a topic of interest to program stakeholders and may be included in future targeted evaluation studies.

Process Finding 7: EMs vary considerably on their achievement of annual goals, though further research is needed to understand the factors involved.

Process Recommendation 7: Consider including further research of EM goal achievement as a targeted study item for the PY2018 process evaluation.

- In addition to establishing a percentage of EMs that achieve their goals, which may or may not already be determined by the Technical Reviewer, the evaluation team can also look at EM

[31] This annual savings goal is 2,000 MWh for salary-based EMs and 1,000 MWh for performance-based EMs, though they can receive incentives for up to 3,750 MWh of savings. If a salary-based EM does not meet their goal, the shortfall is added to their subsequent year target.

[32] "Energy Manager Initiative Review," prepared by the implementer for IESO, April 17, 2017.

performance by incentive type (salary-based vs. performance-based), the EM's term, the LDC, the industry, the facility size, or other key factors.

EM Non-Energy Benefits

Table 29 lists the key benefits to the implementers and to the participants of the EM program.

Table 29: Benefits of the Energy Manager Program

Benefits to IESO/the LDCs	Benefits to the EM's facility
Direct savings from non-incented measures	A dedicated resource to help optimize energy use and drive projects forward
Indirect savings due to EM participation in other incented programs	Energy and bill savings from EM-implemented projects
A key contact and energy champion inside the customer's facility that helps in building and maintaining a relationship	An internal champion to educate others, lobby management for projects, and orchestrate campaigns
Appreciation and goodwill from customers	Technical expertise from the EM
Perception of the program staff as an advisor or even partner to the EM	Additional capacity on staff
"Market transformation" – helping promote the concept that having an EM is a vital resource to a company	Credibility from the LDC involvement
	The incentive itself[33]

The EM program continues to have the highest satisfaction of all SaveONenergy/IAP programs.

While the savings aspect of the program is critical, it is hard to overstate how important the non-energy benefits of the EM program are, especially as culture shifts and market transformation can in turn lead to more energy savings. The EM program receives consistently high satisfaction scores from both LDC and IAP participants, much higher than any other program in the industrial portfolio (see *Section 4.2.1.3*).

This is due to a variety of factors: the program process is straightforward, there are many resources from the LDCs and IESO available to the EM to support them, and the incentive is good. Beyond that, it's clear from the responses that the participants can see the positive impacts (energy, cost, effort, etc.) from having their EM on-site – and from having them on the team. There is a personal aspect to this program that does not exist with any other. This helps both the customer and the LDC or IAP staff, who now have a contact and energy champion to work with at the facility.

[33] Note: the incentive was not mentioned by participants as a benefit of the program. The perceived benefit is what the incentive allows for.

Having a dedicated resource or additional capacity on staff to worry about energy use was mentioned frequently as a key benefit of the program. Supervisors saw the EM as a key force on-site to oversee projects and do all the associated work to get them done, including pitches to get approval. They were clear about the value of the program:

- "Most people [here] are not worried about energy. The EM does a great job of working with the personnel and convincing them that the energy conservation is the best thing to do."
- "Without the EM [program], we would have moved our EM to a different engineering role, and we wouldn't be getting nearly as much done."
- "Without the EM you don't optimize your benefits. He keeps this organized, gets us incentives to do studies and projects, and works with internal staff. It's critical."

It's fair to say that these managers would also view the EM program as an enabling initiative – it enables them to complete work that would not have been done otherwise.

5.2.6.2 EM Success Factors

Although the EM is a single individual, it is clear that to be successful they must involve and motivate many others around, above, and below them. This is important when identifying projects, pitching ideas to and seeking approval from upper management, implementing measures, promoting behavior changes, and going beyond to change company culture. The EM's ability to gain the company's support – through their own actions and depending on whether the company is truly committed to taking action – is seen by EMs, their supervisors, and the LDCs as the single largest determinant of the EM's success. Some of the findings from interviews include the following:

- It takes time for the EM to build rapport at his or her company. All the EM supervisors interviewed for this evaluation had their EMs on staff for at least two years; most of the interviewed EMs had been there for between one and two years, with some as long as four. Several LDCs commented that newly hired EMs often take a while to start implementing projects as they must get to know the facility or facilities, understand the company policies, and start identifying efforts (the IAP version of the EM program has a two-year contract, recognizing that it can be challenging for some EMs to hit their first-year goals if the project lead times are long).
- Having an internal network is often key to identify projects and support for the project through the approval process. This could come in the form of multiple EMs or other internal networks. About seven to eight distribution-connected facilities have multiple IESO-sponsored EMs, depending on the year (only one transmission-connected facility has multiple). This could be split by administrative unit – i.e., EMs at different facilities or divisions – or EMs working in teams. For example, one EM interviewed noted that he did most of the on-site work since he was an

electrician, and his partner did most of the reporting. However, this support may not come from another company-designated EM. Three other EMs mentioned during the interviews that they instead have internal networks that are key to their work:

  - One formed an EM working group with experts from each sector of the company. The company allows him to utilize up to a certain portion of their hours to help with energy projects.
  - One noted there is a voluntary energy champion in every department and around 50 embedded EMs at other locations worldwide. The EMs meet monthly to discuss progress, best practices, and savings goals; the energy champions help identify projects at their facility.
  - One was part of an energy management committee and mentioned that the company also had 24 designated energy champions.

- The approval process is one of the biggest hurdles EMs face and a key place to have allies. Companies that can participate in the industrial programs tend to be very large – often multinational – and have complex internal processes. Seven of the ten EMs interviewed discussed the need to send projects through the corporate management offices; five mentioned that this process was at best long and at worst a project-killer. One EM said that they must plan all projects one to two years in advance given the need to set aside a budget in the capital plan, get a designated PM, and get approval from the corporate office outside of Canada. This process becomes easier if the company is on board and committed to saving energy, and if they have key stakeholders involved and engaged.

Overall, his ability to get the company to "buy in" to the EM's projects is seen as the biggest success factor for EMs hitting their goals and changing company culture, and also the biggest barrier. Said simply, EMs that do well have the support of upper management and colleagues at their facilities; EMs that do poorly often do not. This cause and effect is bidirectional – the EM must be able to earn respect within the facility, and the company must also be willing to engage with them on projects. Both are needed to be successful. There are at least two examples of LDCs revoking EM contracts when the EM was unable to gain the support of his or her company:

- The company was not focused on energy reductions and would not approve any projects
- The EM had excellent technical credentials but lacked the ability to sell the projects internally.

Four of the ten EMs interviewed said that getting company buy-in was the biggest challenge they faced on a daily basis; however, when they did, they were able to accomplish much more.

One EM provided a striking example of this phenomenon at work. Their company won an external award for the efforts of the EM and their energy champion network; the award was prestigious enough to lead to a major shift in the company. "It became a lot easier to get corporate approval for projects since everyone wants to be part of the success story," the EM said. It also helped provide a motivator for the energy champions at the facility, though the EM wishes s/he could do more for the champions – the success wouldn't have been possible without them.

Process Finding 8: The ability to get buy-in and commitment from the rest of the company is one of the most important determining factors of an EM's success.

- This is bidirectional: the EM must win the respect and support of others, and the company must be willing to commit to energy-saving projects. The two recommendations below correspond to each piece of this equation.

Process Recommendation 8: On a regular basis, offer training sessions on the communication skills that allow EMs to pitch projects, network internally, and convince both facility and corporate staff of the benefits of conservation projects.

- One example of a popular "soft skills" training mentioned several times in Phase 1 interviews was Mark Jewell's "Learning to Sell Efficiency Effectively" training, offered through IESO to the LDCs and then in turn to the EMs.
- If not already performed, a basic primer on pitching projects to upper management should be included in the onboarding training for all new EMs.
- Archive past trainings and resources so that EMs that start between training offerings can still access the information.

Process Recommendation 9: Continue to highlight the successes of EMs in case studies, presentations, and awards, and consider additional venues or methods to do so.

- This is important not only to market to facilities without EMs that might be considering it, but also to create positive feedback loops in the facilities with EMs. Apart from the striking example of an EM award changing company culture as explained above, multiple EMs commented on the semi-annual workshops IESO hosts to bring the EMs together. This method is clearly working and appreciated by attendees and should be continued.
- Requests for more case studies or success stories are also common (see also Process Recommendation #8).

5.2.6.3 Program Support & Resources

The EM program continues to be the highest rated of all Save on Energy/IAP programs. Apart from the overall program, support from the LDC/IESO was the program aspect that consistently receives the highest satisfaction ratings. EMs and their supervisors are appreciative of the support provided by the EM program implementer, the LDCs, and IESO in the form of frequent training opportunities and check-ins. Two EMs noted that they spoke with their IESO/LDC contact as much as once per week; most others were monthly or quarterly, though all felt well-connected to their contacts. "[Our LDC contact] is a fantastic resource," one said. "They offer all the support we need and are very proactive in reaching out." Some LDCs with many EMs in their territories may hold quarterly or semi-annual events to gather their local EMs together.

There are ample opportunities for trainings provided to EMs through the program implementer and sometimes IESO or the LDCs. The program onboarding trainings were seen as particularly valuable by the EMs, as were the workshops offering opportunities for sharing successes with other EMs. The implementer offers trainings to the EMs on a quarterly basis, usually held in three to four locations around the province and featuring a mix of technical and sales/business topics. Most of the interviewed EMs indicated that they attended these trainings whenever they could, and they provided a few suggestions on how future trainings could be more beneficial:

- Industry-specific trainings: Nearly 40% of the EMs interviewed thought that some of the trainings could be too general and would like to see more presentations targeted to their most common measures, even if it meant some were not applicable to them and others were. For example, one EM noted that there are multiple EMs in the mining sector (especially in IAP), where the key measures are ventilation, compressed air, and dewatering.
- Regional meetings: While far-flung EMs realize the difficulty in scheduling in-person events that attract the greatest number of EMs, they are appreciative of attempts to include them. For example, one mentioned an upcoming training that was conducted several times in different areas of Ontario. The EM also asked if there was a way to create smaller regional groups, so s/he could find more local EMs for possible collaboration.
- Scheduling: One EM asked that the program implementer be more mindful of scheduling the presentations – the next quarterly training was on the same day that a government report was due, a Northern Industrial Electricity Rate (NIER) Program report was due, and an industry energy group was meeting.

Some LDCs also offer trainings about technologies or other topics for energy professionals that EMs can attend; there were examples of EMs attending presentations or events by other nearby LDCs if the topics were relevant.

Process Finding 9: EMs and their supervisors are appreciative of the support provided by the program implementer, the LDCs, and IESO in the form of frequent training opportunities and check-ins.

Process Recommendation 10: Conduct industry-specific training sessions that cover relevant technology measures for that industry.

- Around 40% of the EMs interviewed thought that some of the trainings are too general. Since the quarterly trainings are designed to be applicable to as many EMs as possible, this could either be done as industry-specific applications within a training or separately.
- If done separately, the implementer should consider partnering with the LDCs and/or IAP with customers in that industry to put on the trainings.

Process Recommendation 11: Develop an online schedule listing all relevant training sessions and events.

- Coordinating a calendar between the implementer, the LDCs, and IESO would minimize any duplicative or conflicting trainings and allow customers to see all relevant trainings and events. This should also contain, to the extent possible, information on major government report deadlines and events from other key energy industry groups that would affect participation from multiple EMs.
- This could be hosted on the EM Hub, the Save on Energy website, or a more informal, publicly-available calendar linked from the other sites if preferred.

One resource frequently discussed as part of the support offered to EMs is the EM Hub, an online portal run by the program implementer. This website, open to all EMs, contains a monthly newsletter archive, project lists, a forum for EMs to discuss various topics, and other resources. In addition, there is a dashboard for each EM that shows progress against their annual goals. Although the concept is excellent, the EM Hub was generally seen as time-consuming to sort through and was not widely used by the EMs interviewed. This was also reflected in the satisfaction ratings, where the average rating was 5.3 for LDC EMs, and 4.0 for IAP EMs (see the callout box at the beginning of *Section 5.2.6*). Of the ten EMs interviewed, six use it infrequently and four do not use it at all. Those who do visit the site mentioned using it to get training notifications, ask industry-specific questions of the other EMs via the forum, and read some of the articles. One of the more frequent comments was that the articles and resources could be difficult to navigate and thus not a widely used resource. Two EMs suggested that grouping the topics by industry would be very helpful, so they could quickly see the information relevant to them. Another EM asked for more success stories and case studies. There was also some confusion regarding the dashboard; one EM noted that none of their projects for the year were showing up on the portal.

Process Finding 10: The EM Hub was not widely used by the EMs interviewed.

Process Recommendation 12: Survey all EMs on their use of the EM Hub and use the responses to update its functionalities.

- The EM Hub provides data and a valuable platform to exchange information between EMs and between the program implementer and EMs. Nonetheless the survey responses were clear that it is underutilized by EMs.
- While a sample of EMs were interviewed in this evaluation, a short survey for all EMs that focuses primarily on the EM Hub, how often they use it, and what functions they use would provide better information on how to curate it.
- The program implementer should use the results of the survey to assess what changes could be made to the EM Hub to better engage the EMs and decrease time spent on functionalities that do not provide as much benefit to EMs.
- In the meantime, the program implementer could consider adding industry tags to articles or making those industry groupings more prominent if they already exist, per one of the most common comments.

Finally, when asked what kinds of support would be most valuable, many EMs took the opportunity to ask for a replacement for the iCon system used to submit applications. The shortfalls of the iCon system – it is very slow and can often crash – are widely recognized by IESO, the LDCs, and participants; it was brought to the attention of the evaluators last year and mentioned an additional seven times by EMs, EM supervisors, and EM partial participants this year. For EMs, this challenge comes mainly in submitting Retrofit projects, as LDCs must manually upload PSUP applications on the back end of the system. One EM stated he sometimes would wake up at 5am to submit the application before any others would be on the system. Another three stated that they had sometimes skipped incentives because of the difficulty of submitting the application and implemented the project anyway.

5.3 INDUSTRIAL ACCELERATOR PROGRAM (IAP) RESULTS

5.3.1 IAP PROGRAM DESCRIPTION AND EVALUATION APPROACH

The Industrial Accelerator Program is administered directly by the IESO, offered to transmission-connected customers, and provides incentives through three program streams or initiatives: Capital Incentives (referred to interchangeably as IAP Process & Systems), Retrofit, and Energy Manager. Program delivery for each of these initiatives closely mimics the respective LDC-administered programs.

Between the three initiatives, 58 IAP projects were completed in 2017. 12 IAP projects were evaluated as 2016 adjustments and another two were evaluated as 2015 adjustment projects. While the IAP Retrofit and IAP Energy Manager initiatives account for the largest number of projects, these projects are typically smaller in size and comprise a smaller portion of the IAP savings. The IAP Capital Incentives initiative is responsible for the majority (67%) of the IAP reported energy savings included in this evaluation. 42 IAP Energy Manager non-incented measures with 2017 in-service dates were included in this evaluation and seven measures with 2016 in-service dates were included as adjustments. The IAP Retrofit program had 12 projects with 2017 in-service dates ready for evaluation and five projects completed in 2016 and two completed in 2015 were included as adjustments. The IAP Retrofit program, consisting of smaller projects, accounted for just 5% of PY2017 IAP reported energy savings.

5.3.2 IAP TRACKING SYSTEM & PROGRAM DOCUMENTATION REVIEW RESULTS

IAP Capital Incentives projects and savings are tracked in tandem with PSUP and are scarcely differentiated from the perspective of the technical reviewer. This is generally appropriate given the similarity between these program streams: they comprise a small number of large, capital-intensive, complex energy savings projects that commonly involve generation components. Tracking for IAP Capital Incentives is slightly simpler given the lack of LDC involvement in invoicing and other program tracking functions.

IAP Retrofit and IAP Energy Manager Non-Incented Measures are also tracked by the technical reviewer and tended to very accurately represent project statuses and estimated savings.

5.3.3 IAP GROSS VERIFIED SAVINGS RESULTS

Table 30 shows gross verified savings for the IAP Capital Incentives, Retrofit, and Energy Manager Non-Incented Measures. All energy realization rates are very close to 100%, apart from the IAP Energy Manager Non-incented measures (90.8%). The overall large amount of savings coming from IAP Capital Incentives with an energy RR of 100.7% results in a combined IAP/IESO-administered RR of 97.5%. Most IAP savings (93%) persist through 2020, reflective of the longer measure lives typical of these projects.

Table 30: PY2017 IAP Gross Verified Savings Results

Program/Project Type	# of Projects Evaluated & Reported	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
IAP Capital Incentives*					
BMG	1	101.2%	90,581	10.35	100%
EE	3	92.1%	4,834	0.57	100%
IAP CI Total	**4**	**100.7%**	**95,415**	**10.92**	**100%**
IAP Retrofit					
2017	12	103.8%	6,824	0.79	100%
2016 Adj.	5	103.8%	1,443	0.35	100%
2015 Legacy Adj.	2	103.8%	6,049	0.90	100%
IAP Retrofit Total	**19**	**103.8%**	**14,316**	**2.04**	**100%**
IAP Energy Manager Non-Incented					
2017	42	93.7%	37,442	3.10	55%
2016 Adj.	11	84.9%	16,491	1.80	91%
IAP EM Total	**53**	**90.8%**	**53,932**	**4.90**	**66%**
GRAND TOTAL	**76**	**97.5%**	**163,663**	**17.86**	**93%**

Total PY2017 IESO-administered program gross verified energy savings are 97.5% of reported savings. Among the three IAP initiatives, energy RRs range from 90.8% (IAP EM non-incented) to 103.8% (IAP Retrofit). Measurement and verification activities and technical reviews are generally resulting in highly accurate estimates of energy savings. However, several of the technical reviews for IAP Retrofit prescriptive lighting measures used baseline and post-retrofit wattages instead of IESO's prescriptive savings to calculate energy and demand savings.

Finding 11: Baseline assumptions for behind-the-meter generation projects are typically poorly documented.

Recommendation 14: Require that measurement and verification plans for BMG projects include a discussion of the assumed baseline condition and explain the technical alternatives participants had other than installing generation equipment.

- The information on baseline alternatives will provide a cleaner audit trail for the NTG evaluation.

Average energy realization rates by project type vary only slightly across the IAP program, as shown below in Table 31. The one BMG projects had an RR of 101.2%, while EE projects are lower at 93.2%. Average peak demand RRs follow a similar pattern, averaging 100.4% for BMG projects and 94.8% for EE Projects.

Table 31: IAP Realization Rates by Project Type

Project Type	Average Energy RR	Average Demand RR
BMG	101.2%	100.4%
EE	93.2%	94.8%

The single CHP project in the IAP CI program was the only CHP unit out of the 22 evaluated in the Industrial Portfolio in PY2017 that resulted in net natural gas savings. The CHP unit was installed at a large industrial corn refining plant. The corn refining process involves energy intensive (electricity and steam) equipment, which include cleaning, soaking and milling of corn using cyclone separators, grinders, and centrifuges. The facility on average used 80,000 pounds of steam per hour. The participant's total steam supply was delivered by a neighboring plant operated by a third-party. A 15 MW natural gas turbine generator was designed to offset over 96% of the electricity purchased from the grid, while a heat recovery steam generator, would supply an unfired full load steam output of 62,000 pounds of steam per hour supplementing when needed with a gas fired duct burner. The factors that contributed the high cost effectiveness of this project were the steep steam consumption of the facility and the inefficiency of the boiler used by the third-party plant to supply steam to the participant. A non-condensing 80% efficient boiler was supplying steam to the facility before the project. With the installation of the CHP system, steam generation was a byproduct of electrical generation, and line losses were avoided with steam now being generated onsite. **This particular CHP represents an ideal BMG project with high potential for cost-effective energy and natural gas savings meeting the main criteria of high thermal loads and inefficient thermal production.**

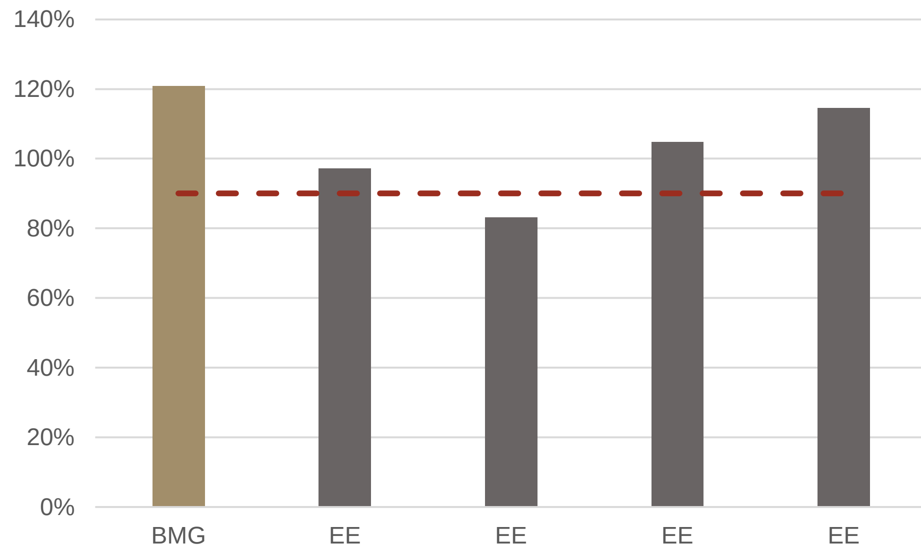
5.3.3.1 IAP CI Anticipated Savings Threshold

As shown in Figure 18, **four out of five IAP Capital Incentives measures meet the 90% actual-to-anticipated savings threshold as required in the IAP program rules.**[34] Two of the EE measures occurred at the same facility with the same in-service date, so they are counted as one project. The one EE IAP CI project that did not meet the savings threshold fell short by 7% due to lower than expected utilization of the VFD-controlled fan units that were upgraded through the program. The annual gross savings for this

[34] http://www.ieso.ca/en/sector-participants/energy-efficiency-for-large-consumers/industrial-accelerator-program

project relied on an extrapolation of one quarter of M&V data, which could also contribute to the project's failure to meet the anticipated savings threshold.

Figure 18: IAP Savings Threshold Results



5.3.4 IAP NET VERIFIED SAVINGS RESULTS

The average NTG for the IAP programs was 81.7%, as shown in Table 32 below**. IAP projects demonstrated low levels of free-ridership and no attributed spillover.** The IAP Retrofit had the highest NTG ratio (88.4%), followed by IAP Capital Incentives (83.9%) and IAP Energy Manager non-incented (76.0%). The IAP Energy Managers non-incented net-to-gross analysis was assessed in tandem with the LDC-administered Energy Managers and comprises two components: 2017 projects with an NTG ratio of 71.6%, and 2016 true-up projects that were given the 2016 result of 86%.

Table 32: IAP Net Verified Savings Results

Program/Project Type	# of Projects Evaluated	NTG Ratio[35]	Net Energy Savings (MWh)	Net Summer Peak Demand Savings (MW)
IAP Capital Incentives*				
BMG	1	83.9%	76,009	8.69
EE	3	83.9%	4,057	0.48
IAP CI Total	**4**	**83.9%**	**80,066**	**9.16**
IAP Retrofit				
2017	12	88.4%	6,032	0.70
2016 Adj.	5	88.4%	1,275	0.31
2015 Adj.	2	88.4%	5,347	0.79
IAP Retrofit Total	**19**	**88.4%**	**12,654**	**1.80**
IAP Energy Manager Non-Incented				
2017	42	71.6%	26,800	2.22
2016 Adj.	11	86.0%	14,182	1.55
IAP EM Total	**53**	**76.0%**	**40,982**	**3.77**
GRAND TOTAL	**76**	**81.7%**	**133,702**	**14.74**

As shown in Table 33 below, **energy NTG ratios for the IAP programs are high for both BMG (101.2%) and EE (93.2%) projects.** Demand NTG ratios, on the other hand, were lower for both BMG (84.2%) and EE (76.4%) projects.

Table 33: IAP NTGs by Project Type

Project Type	Energy NTG[36]	Demand NTG
BMG	101.2%	84.2%
EE	93.2%	76.4%

Free-ridership – The free-ridership score for the IAP CI and Retrofit programs was largely influenced by the IAP projects' high savings numbers and the interviewees indications that IESO was instrumental in assisting project implementation and timing.

[35] BMG, EE and Program Total NTG Ratios are for illustrative purposes only.

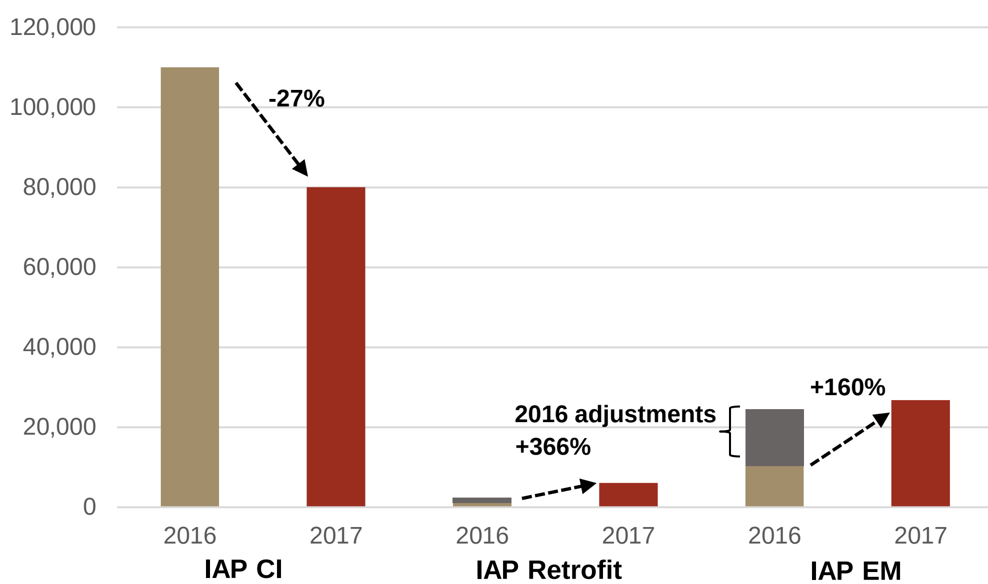
[36] BMG and EE NTG ratios are for illustrative purposes only, representing total net verified savings divided by total gross verified savings.

Spillover – No spillover was attributable to the program, but 22 of the 23 interviewees indicated that they have pursued or are pursuing additional projects influenced by the specific projects under review during the interview. In all cases, these customers plan to or already have submitted these projects for IESO incentives.

5.3.4.1 Total CFF IAP Net Verified Savings Results

Total net first-year energy savings for the CFF IAP programs are 250,054 MWh, 88.4% of gross verified savings. Net demand savings for IAP projects under the CFF total 97.7 MW. **Overall, total net first-year energy savings for IAP programs decreased 13% YOY in PY2017, compared to IAP projects implemented and evaluated in PY2016.** Net verified results for the CFF IAP programs are summarized in Figure 19 below.

Figure 19: Total CFF IAP Net First-Year Energy Savings (MWh)



The IAP CI program has achieved 190,108 MWh of net first-year energy savings in the CFF, accounting for 76% of total IAP net savings and 49% of the industrial portfolio. Compared to projects implemented and evaluated in PY2016, net first-year energy savings declined 27% YOY. The IAP CI program is characterized by a small number of very large projects resulting in major energy savings. As such, a few projects can make a major impact on total savings from year to year. While the participation in the program has remained fairly steady since PY2016, projects completed in the IAP CI program in PY2016 averaged over 18,600 MWh of net first-year energy savings compared to just over 16,000 MWh in PY2017.

IAP Retrofit accounts for just 8,303 MWh of net first-year energy savings—3% of total IAP net energy savings achieved during the CFF. However, net energy savings increased over 500% YOY, due to a greater number of non-lighting projects implemented in PY2017 that generally result in higher energy savings. Generally, IAP Retrofit projects mostly consist of engineered and custom lighting retrofit measures and tend to be smaller in size and savings when compared to those of IAP CI and IAP EM.

Net first-year energy savings are 51,300 MWh for the IAP EM program in the CFF, representing 21% of total IAP net savings. In PY2017, net energy savings totaled 26,800 MWh for IAP EM projects implemented in PY2017, a 160% increase YOY compared to the net energy savings achieved and implemented in PY2016. IAP EM net savings increased YOY due to increased participation in the program.

5.3.5 IAP COST EFFECTIVENESS RESULTS

As shown in Table 34, the IESO-administered IAP programs are cost effective in PY2017 from the TRC and PAC test perspectives using a benefit/cost threshold of 1.0. Cost-benefit assumptions are included in *Appendix D*.

Table 34: IAP Cost-Effectiveness Results

Program	TRC Costs	TRC Benefits	TRC Ratio	PAC Costs	PAC Benefits	PAC Ratio	LC $/ kWh
IAP (CI)	$28,022,350	$103,850,375	3.71	$23,516,402	$66,699,817	2.84	0.03
IAP (Retrofit)	$1,319,671	$4,264,297	3.23	$470,445	$3,708,085	7.88	0.01
IAP (EM)	$1,856,058	$7,979,385	4.30	$0	$6,938,596	-	-
Total IAP	**$31,198,079**	**$116,094,058**	**3.72**	**$23,986,847**	**$77,346,497**	**3.22**	**0.02**

The CHP project in the IAP CI program, an example of a highly cost-effective BMG project, contributed $102M TRC benefits to the program and had a project-level TRC ratio of 4.10. The project resulted in 76,099 MWh net first-year energy savings that persist to 2020, as well as 235,280 MMBtu of natural gas savings. These strong savings results provide a massive amount of benefits from the avoided costs for electricity and natural gas.

5.3.6 IAP PROCESS EVALUATION RESULTS

There are two key findings for this section, related to two topics:

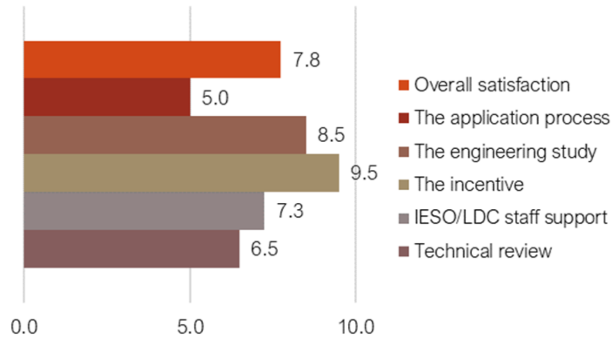
- Program updates
- Customer experience and pain points

Each of these are described in more detail below.

IAP Process & Systems Participant Perceptions

Number interviewed: **4**
Percentage that intend to participate with a Save on Energy program in the future: **100%**

Satisfaction scores
(0 = very unsatisfied, 10 = very satisfied)



5.3.6.1 Program Updates

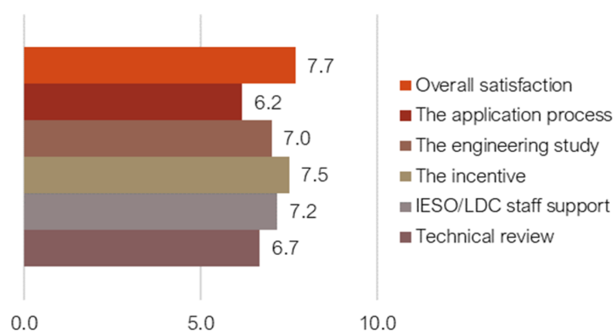
IAP has undergone several changes since last year, some of which are policy-driven and some internal:

1. The IAP CFF target was reduced to 1.3 TWh (from its original goal of 1.7 TWh).[37]
2. As with the LDC programs, CHP has been phased out as of July 1, 2018.
3. Per a Ministry directive in December 2016, transmission-connected customers were allowed to use IAP for all of their projects (including at distribution-connected facilities) to create a one-stop shop; PY2017 was the first year that customers could choose this option.
4. A new, streamlined contract was introduced in August 2017.

IAP Retrofit Participant Perceptions

Number interviewed: **6**
Percentage that intend to participate with a Save on Energy program in the future: **100%**

Satisfaction scores
(0 = very unsatisfied, 10 = very satisfied)



[37] This 0.4 TWh target was transferred from IAP to other IESO-delivered programs ("centrally-delivered programs and province-wide distributor CDM programs delivered by the IESO.") In the same ministerial directive, IESO was directed to establish a new budget for IAP and these programs without increasing the overall IESO budget. See "Reallocation of Targets from the Industrial Accelerator Program to the 2015-2020 Conservation First Framework and Delivery of Programs Targeted to On-Reserve First Nations Communities," February 8, 2018. Accessible at: http://www.ieso.ca/corporate-ieso/ministerial-directives

5. IESO added two sales support contractors to help customers scope projects, answer questions, and provide application support.
6. The number of IAP business advisors increased from one to three, with roughly a third of the 59 transmission-connected customer accounts apiece.
7. IAP will also make several adjustments to its Process & Systems subprogram to reflect the PSUP redesign, including reducing the M&V period to one year, but has not yet.

The IAP program manager and business advisors note that the effects of the CHP phase-out and the inclusion of some distribution facilities per the Ministry directive have been minimal to date and are expected to stay that way. Regarding the CHP phase-out, IAP Process & Systems has tended to have more process efficiency and less CHP than its LDC counterpart; moreover, IAP had already been focusing on waste energy recovery opportunities. The Ministry directive, likewise, did not dramatically change the program's implementation. To date, it has not created an increase in IAP applications from transmission customers bringing their distribution-connected facilities into the program. The IAP staff explained that they offered this option to streamline the process for customers that might be interested, but they do not actively target those distribution-connected customers. This is both out of deference to the LDC relationships and because savings from those distribution-connected customers accrue to the LDCs, rather than IAP.

Improving the customer experience has been a stated goal of the IAP staff for some time, and several of the program updates were done for this reason. In particular, they wanted to reach customers with poor experiences of older versions of the program and help change their perceptions. These customer experience challenges were demonstrated by the participant interviews, where IAP and IAP Retrofit received the lowest satisfaction ratings of all CFF programs. Customer complaints focused on the overall length of time it took to finish the project, the application process, and a lack of support from IESO.

The program took several major steps toward that goal of improving the customer experience with several of its revamps this year, including the streamlined contract, the sales support contractors, and increased business advisor staff. While the long lead times for project completion mean that the participants this year did not experience the new process, a few were already aware of the changes, especially with the sales support.

The IAP program manager explained that adding more resources in the form of the sales support team to be available for customers – to identify opportunities, fill out applications, or explain M&V – had been a customer request. The two contractors will also help the IAP team develop leads, provide weekly reports of the project pipeline, and even help identify opportunities for projects to go through PES (IAP submitted its first two PES claims this year). The two sales support contractors each have a specific geographic territory (roughly north and south Ontario) and work closely with the business advisors for their accounts in each area. One IAP customer that had not participated recently mentioned that he had been in touch with the IESO and knew about the third-party team to help prepare the application and technical review. Most notably, one EM used their interview to thank IAP for the sales support: "I want the IESO to know how excited I am to have the extra help and am thrilled that they considered my feedback. Less time reporting means more time to achieve savings."

Due to the long lead times for project completion, the full impact of these changes was not reflected in the participant interviews this year as many of them have not yet experienced the updated contract and process. The evaluators will continue to monitor how customers perceive the program process, the support they receive, the barriers they encounter, and their overall satisfaction with the process to see how the IAP team's efforts manifest themselves in future satisfaction scores.

IAP has undergone several changes in the past year to improve the customer experience, which will be monitored in subsequent evaluations.

- Other policy changes, such as the CHP phase-out or the Ministry Directive allowing transmission-connected customers with distribution-connected facilities to use IAP for all their projects, are not expected to substantially impact the program, but will likewise be monitored.

5.3.6.2 Customer Pain Points

Overall customer satisfaction for IAP CI and Retrofit participants rose slightly from the PY2016 data, though they still have the lowest satisfaction of the CFF industrial programs (they were also substantially lower than IAP EMs, who gave an overall satisfaction rating of 9.0, compared to IAP CI's 7.8 and Retrofit's 7.7).[38] As noted above, the program staff expects satisfaction to increase as more customers experience the program's updates. Perhaps unsurprisingly, the incentive was where participants most frequently praised their experience, especially for the more lucrative P&S program. Two participants said the incentives were the main enabler of their projects.

When asked to comment on barriers, places the program could improve, or why they were not satisfied with a particular program aspect, there was one thing that participants had in mind: the application process. Out of 19 comments made by the four IAP CI and six Retrofit participants, 13 were related to the application requirements or the review. Although the application review requirements are the same as for PSUP and participants raised similar comments, their IAP counterparts brought up the challenges more frequently and with stronger language. There are a few potential reasons for this:

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[38] IAP Process & Systems overall satisfaction rose by 0.1 points and Retrofit by 0.3 points.

- More IAP projects are focused around process efficiency or very customized measures, which are more challenging to review, and the TR will have less experience with them
- PSUP is currently dominated by CHP; CHP vendors tend to be better versed in the program requirements and may be more likely to complete the application on behalf of the customer
- PSUP is dominated by CHP, where the bigger headaches are likely to be around interconnection issues
- PSUP facilities are smaller and are less likely to have the resources to complete the application themselves; they may request the vendor to do it.

Whatever the reason, IAP customers seemed to be more frustrated with the application review process than their LDC counterparts. There were three main challenges brought up with the application review, all of which were also raised in the Phase 1 participant interviews:

- Time required: The number one complaint was simply on the amount of time and effort to wait for approval and/or answer information requests (IRs). As with the PSUP comments, the application itself did not appear to be a barrier, just what occurred after it was submitted. Comments were similar for both IAP CI and Retrofit participants, though Retrofit participants that had also participated in IAP seemed to think that Retrofit required an outsized amount of work compared to the incentive level. One Retrofit participant stated that the approval timeframe had prevented them for applying for incentives, as they needed to proceed faster than what the program could allow for. All three business advisors also commented on the amount of time it took to get applications completed and approved. Two noted that solid projects with submitted applications could get “shelved” as time wore on, and the third noted that if a customer was on the fence – if electricity costs were less of a priority – then the administrative time could tip them towards not going through with the incentive.
- Additional documentation required: Participants seemed particularly confused about the information requests, which often asked for information that was not in the application or was seemingly irrelevant.
- Explaining technical details: There were a few comments made by participants who felt that their technical reviewer lacked the technical understanding needed for a particular project and

required hand-holding. This would have to be repeated each time there was reviewer turnover (which four of the ten participants brought up as a frustration).[39]

The later-stage M&V can also be a challenge for some customers as the participants supply and calibrate their own metering equipment. While this can be very important for large IAP CI projects (leading to a disagreement between the participant and the technical reviewer in one case), it can also be a challenge for smaller Retrofit projects. Two participants brought up that Retrofit requires metering for lighting projects and are not sure why; one participant deliberately batches lighting projects so that they are under the M&V threshold.

On the other hand, not all participants had a poor experience; there was one IAP CI participant who stated they had been through the programs enough times now that they were familiar with the process, and an IAP Retrofit participant who thought it was well organized and not overly cumbersome.

Process Finding 11: The application review process is a major barrier for IAP and the long timeframe can cause customers to shelve projects.

- Although similar comments were raised in the PSUP interviews, they occur more frequently and with stronger language in the IAP interviews.

Process Recommendation 13 (PSUP/IAP): Develop measure-specific applications or accompanying guidance to limit the number of information requests.

- The Technical Reviewer should determine what types of data they often request in IRs and whether the data was missing or not requested in the application.
- IESO should then consider revising the application, developing an application amendment, or including more detailed guidance as an accompaniment to the application based on this review. Making the applications or guidance measure-specific for the most common 4-5 measures would also ensure that relevant information is captured upfront for each. This would ultimately save both Technical Reviewer and customer time from having to track down additional unexpected information.

5.4 PROGRAM-ENABLED/SPILLOVER SAVINGS (PES) RESULTS

5.4.1 PES DESCRIPTION AND EVALUATION APPROACH

[39] These two issues – regarding technical experience and staff turnover – were also raised in PSUP and EM interviews, though less frequently.

The Program Enabled Savings (PES) initiative provides an opportunity for LDCs to quantify savings generated through their customer interactions outside of the existing suite of efficiency programs. LDCs submit a PES claim form with substantiating documentation describing the project(s) and savings, which are credited to the appropriate conservation program (PSUP, Retrofit or High Performance New Construction). The PES initiative is unique and does not exist in any North American jurisdiction with greater than $30M per year in annual CDM spending.

In PY2017, PES claims were approved and were subject to an independent technical review process similar to other programs included in this evaluation. This is a change from PY2016, when PES claims did not go through an intermediate technical review; rather, the claims were directly verified by the EcoMetric Evaluation team.

Savings from PES claims are attributed to the Industrial Portfolio through the PSUP program. Four total PES claims were attributed to the PSUP program in the PY2017 evaluation, two going into service in 2017 and one going into service in 2016 and 2015. Meanwhile, savings from claims attributed to the Retrofit and High Performance New Construction (HPNC) are reported with their respective programs in the Business Portfolio. PES Retrofit claims were the most prevalent in the PY2017 evaluation with 46, while there were just three PES HPNC claims.

5.4.2 PES TRACKING SYSTEM & DOCUMENTATION REVIEW RESULTS

The evaluation team's review of the Program-Enabled Saving/Spillover (PES) tracking system and project documentation found that savings documentation and data for submitted claims is often incomplete and lacking key parameters to verify savings and/or spillover. Out of 142 PES claims submitted to IESO over the past two years, 24 claims continue to not include sufficient information to both a) substantiate the energy savings claims, and b) attribute the savings to a Save on Energy program. Many claims that were lacking sufficient documentation did not include adequate evidence of pre-project/baseline conditions, transparency in calculation of energy savings, and/or information on post-project equipment specifications and operating parameters. While several projects were able to provide the missing information following a request by the evaluator or technical reviewer, the process to request and obtain the missing data and information often took several months to resolve.

Finding 12: Tracking and technical review documentation data does not include project cost data.

- Project cost data for PES claims remains unverified, with the only cost data available coming from the participant in the PES claim application.

Recommendation 15: Engage the technical reviewer to track and verify the participant's project costs associated with their PES claim. Require that documentation supporting the project costs be provided by the participant at the application stage for the claim to be eligible.

5.4.3 PES GROSS VERIFIED SAVINGS RESULTS

The PES initiative had a total of 62,386 MWh of gross energy savings in PY2017. Over 58% of the verified spillover savings from the PES initiative (36,185 MWh) are attributed to the PSUP program from just four evaluated claims. Meanwhile, 46 claims for the Retrofit program, where projects tend to be smaller in scale, resulted in 22,757 MWh of gross verified energy savings. Just three claims attributable to the Business High Performance New Construction (HPNC) program were evaluated, accounting for 3,445 MWh of verified energy savings.

The technical reviewer did not verify demand savings, so no summer peak demand savings were reported. The evaluation team did calculate demand savings for all PES claims in the PY2017 evaluation, however.

Table 35: PES Gross Verified Savings

Program Claim Attributed To	# of Claims Evaluated	Realization Rate (%)	Gross Energy Savings (MWh)	Gross Summer Peak Demand Savings (MW)	Persistence of Savings in 2020
PSUP	4	99.59%	36,185	-	59%
Retrofit	46	99.59%	22,757	-	82%
HPNC	3	99.59%	3,445	-	100%
PES Total	**53**	**99.59%**	**62,386**	**-**	**69%**

Total PES Initiative gross verified energy savings are 99.6% of reported savings. Despite issues with a lack of documentation in the savings claims, the energy realization rate was nearly 100%. However, several large and complex projects would have greatly benefited from improved M&V data and supporting documentation to ensure accurate savings calculations.

69% of total first-year energy savings from the PES Initiative persist through 2020. Only 59% of energy savings from the PES claims attributed to the PSUP program persist through 2020. This is due to a large BMG CHP project that was verified to have reduced future savings following major operational changes at the facility.

Finding 13: The Evaluation Team was unable to evaluate demand savings as only energy savings were verified.

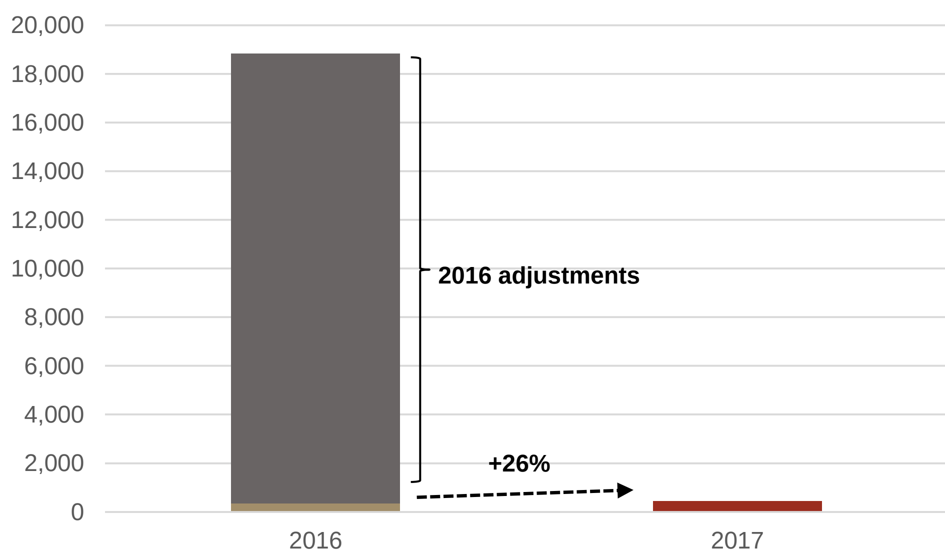
Recommendation 16: Require the technical reviewer to verify summer peak demand savings as is done in all other industrial programs.

5.4.4 PES NET VERIFIED SAVINGS RESULTS

The enabling nature of the PES initiative means that for savings to be verified, they must be clearly attributed to another program, therefore *net savings are equal to gross savings*. If a PES claim lacked attribution, more information was requested, or it was deemed ineligible.

Net verified results for the PES Initiative are summarized in Figure 20. **Total net first-year energy savings for the PES PSUP program in the CFF are 19,259 MWh. Overall, total net first-year energy savings for the PES PSUP program increased 26% YOY, compared to PES PSUP projects implemented and evaluated in PY2016.** 2016 adjustments, PES PSUP projects implemented in 2016 but evaluated in PY2017, represent 98% of PES PSUP net energy savings achieved in the CFF due to a very large CHP project.

Figure 20: Total CFF PES PSUP Net First-Year Energy Savings (MWh)



5.4.5 PES COST EFFECTIVENESS RESULTS

PES costs and benefits are included in the respective programs to which the spillover savings are attributed and are not estimated separately.

5.4.6 PES PROCESS EVALUATION RESULTS

As described above, the M&V guidelines for the PES initiative were revised in 2017, which the LDCs and the Technical Reviewer are now using. LDCs that had reviewed the revised guidance agreed that it provided more structure and certainty. Although a few LDCs reported challenges collecting the level of data required as if the customer was a standard program participant, only 17% of the 142 PES claims from 2016 and 2017 were stopped because they were unable to provide enough documentation to meet the level of rigor required.

The PES initiative is a unique offering, allowing very large projects to be claimed as program enabled spillover savings without direct participation in the IESO's conservation programs. However, this unique initiative does create several serious challenges. Participants in the PES initiative almost always participate in at least one of the IESO's other conservation programs that go through net-to-gross analysis. In the NTG surveys for these programs, participants are asked about spillover and are credited for completing EE projects beyond those being evaluated in the program. As such, this creates a challenge for the PES initiative to ensure that spillover credited to one program is not double-counted through a PES claim. To ensure spillover savings are not double-counted, technical reviewers and evaluators of IESO's programs must work together to review the PES claims and verify the savings from these claims have not already been counted as spillover in another program.

Process Finding 12: PES savings may accrue above and beyond spillover already captured by the NTG analysis conducted for other programs, but they could also be double counted if not calculated properly.

Process Recommendation 14: Investigate the potential for double-counting of spillover savings from PES claims. Consider providing the PES claims to each evaluation team (Retrofit Program, etc.) to reduce the possibility of double-counting spillover savings.

Another challenge the PES initiative creates is accounting for intention as part of free-ridership. There are two core components of free-ridership: 1) intention to implement the energy efficiency project(s) in the absence of program funds, and 2) influence of the program in the decision to carry out the energy efficiency project. For a PES claim to be approved, it must prove the project in the claim was influenced by an IESO program. Once a PES claim meets this standard of influence, 100% of the gross verified savings are considered net verified savings, giving the project a de facto NTG ratio of 100%. However, intention is not investigated as part of the PES claim review. Claims that are submitted to the PES initiative are for EE projects that the organization completed without receiving funds directly from the IESO program that was proven to influence the project. Although the initiative captures spillover, approved PES claims are rewarded 100% of their gross verified savings without taking into consideration the organization's intent—resulting in the reward for savings with an element of unknown free-ridership.

Process Recommendation 15: Investigate the potential for free-ridership in the PES initiative and how to account for participants intention scores in the calculation of net verified savings.

Projects of unprecedented sizes, including large industrial CHPs, have been counted as spillover through the initiative. Many projects of this size and complexity were completed several years before their claim was evaluated, creating a challenge for the technical reviewer and evaluator to obtain an accurate baseline to verify savings.

These serious challenges in administering the PES initiative create an opportunity for LDCs to be rewarded for energy savings that could possibly be double-counted or would have been achieved absent any IESO funds. **Considering the size of these claims and the complexities in verifying their savings, the IESO should seriously consider discontinuing the PES initiative**. The IESO should encourage LDCs and participants to leverage IESO support and funding through existing programs that historically influenced PES claims including: Retrofit, PSUP and HPNC.

Process Recommendation 16: Discontinue the PES initiative. Encourage LDCs and participants to leverage IESO support through existing programs that historically influenced PES claims.

5.5 MONITORING & TARGETING (M&T) PROGRAM RESULTS

The Monitoring and Targeting (M&T) Program encourages industrial distribution customers to install or upgrade M&T systems to relate a facility's energy consumption data to the weather, production schedule, or other measures in such a way as to provide a better understanding of how energy is being used. M&T systems are expected to identify signs of avoidable energy waste or other opportunities to reduce consumption. Project eligibility is partly contingent on achieving a savings goal within 24 months of installation and sustaining these savings for the terms of the participant agreement, five years from the date the M&T system is installed.

Monitoring & Targeting had no projects in service starting in 2017 and ready for evaluation, therefore no verified impacts from the M&T program are included in this report. The two-year implementation schedule of M&T projects described above leads to a somewhat longer technical review phase. M&T program costs incurred in 2017 are included in the cost-effectiveness analysis.

Only one M&T project was ready for evaluation in PY2017, but energy consumption and production data were outdated and unreliable. The EcoMetric team and the technical reviewer were not able to obtain updated information from the customer to support the savings calculations.

5.5.1 M&T PROCESS EVALUATION RESULTS

The M&T program pays for a facility to install energy monitoring equipment in its facility, with half of the incentive paid upfront and the remainder disbursed based on facility savings as documented through two years of M&V. As described above, although five M&T projects were completed in PY2017, none of them could be evaluated. The program's very low participation is caused by a variety of barriers, discussed more below.

5.5.1.1 Barriers to Participation

The M&T program remains a bit of an enigma to customers, LDCs, and the evaluators. There are few customers who can meet its requirements, a handful of successful participants, a small number of LDCs that understand the program rules, and scant projects for which the evaluators can study impacts and the customer processes. There have been 55 companies that have submitted 72 applications to the M&T program since 2012; about half were submitted since 2015 in the new framework. Only 5 of these M&T projects have completed the two years of M&V needed to receive the final incentive as of January 2018. Because of the long lead times, all 5 of these projects were submitted between 2012 and 2014, before the CFF started. To provide a sense of the magnitude of M&T, 338 engineering studies and 195 PSUP projects have been completed since 2015. Out of the 32 applications submitted since 2015, zero have finished the required M&V timeline. Twelve of these projects were supposed to have submitted the second-year report in either 2016 or 2017, but only 8 have; the remainder are listed as having outstanding information requests.

The NTG team did attempt to conduct interviews for those 5 projects, but since the projects had been started so long ago, none of the decisionmakers or site contacts could be reached for interviews. This was likewise true for the gross impact evaluation, where missing data and an inability to find good contacts hamstrung the team's ability to evaluate any of the projects. Although participants could not be reached, the evaluators were able to contact four M&T "partial" participants, or those who had stopped after their application had been approved. Only one said they had stopped – they found a better program but couldn't remember the name – two were still participating (and had missed a deadline by several months, placing them on the "partial participant" list), and one didn't know if they were still in the program or not. Their responses to follow-up questions about the program – any challenges or barriers, or ways that the M&T program could be improved – were very vague and referenced the general LDC programs rather than M&T, again possibly reflecting how long ago the projects had started.

The difficulty in reaching participants to learn about their experience or gather enough data to evaluate their projects illustrates some of the challenges in working with the program. The LDC interviews during the Phase 1 process evaluation provided an overview of the obstacles, so a question on the barriers to participation for M&T was added to the LDC survey this year. Only 59% of the LDCs were comfortable enough with the program to answer, but they managed to list eleven different barriers to participation, as shown in Table 36.

Table 36: Barriers to Participation in the M&T Program

#	Barrier	Description	Number of mentions
1	Savings requirements	Participants must meet two savings targets - 0.2 MW in peak demand reduction and the energy equivalent of that 0.2 MW based on the facility load factor. The savings target is very specific, ambitious, and some facilities might have difficulty meeting both metrics. One LDC suggested that a percentage reduction would be more beneficial than a specified one. Also, if the facility has an EM, the M&T target is added to their EM one.	5
2	Reporting	The facility must provide five years of annual reports on what opportunities have been identified and implemented. M&V is also required for 2 years with the facility providing the data for technical review.	4
3	Long-term commitment	There is a 5-year contract for the program. As stated above, there are also 2 years of M&V requirements before the incentive is paid, and 5 years of annual reporting.	4
4	Complexity	The program is limited to customers that are sophisticated enough to understand the many requirements and their implications.	4
5	Retrofit more attractive	While M&T offers a potentially higher incentive, Retrofit has none of the savings, reporting, or M&V requirements.	3
6	Obligation to implement	The customer must implement all capital measures identified that have less than a 1-year payback and may be uninterested or unable to commit to that.	2
7	Lack of LDC knowledge	Few LDCs have experience with the program. There is also little literature on the program; one LDC asked for a manual or training.	2
8	Uncertain outcome	Customers are skeptical that they can meet their savings targets through software.	2
9	Only works for large customers	The program is only set up for customers large enough to meet both savings metrics and the other requirements.	2
10	Services not supported	Costs of support and monitoring services by the consultant or vendor are not considered eligible costs under M&T.	1
11	Perception of costs	Historically the high cost of M&T equipment has been a barrier to the program. Although costs have dropped significantly, customers may still believe that costs are prohibitive.	1
12	EM required[40]	The facility must have a dedicated EM to participate in M&T, though they do not need to be incented through the EM program.	0

The key takeaway of this list is that there is a barrier for everyone. Even if some customers are large enough to meet the savings requirements, they may not be able to sign contracts longer than four years (a challenge for the automotive industry) or prefer to invest in capital projects with more certain paybacks than monitoring software. Even if there is a customer that would be a great fit for the program, their LDC

[40] Note: while no LDC mentioned having an onsite EM as a barrier, it's plausible that requirement could also prove challenging for some facilities and is included for the sake of comprehensiveness.

may not be able to identify them as a good use-case or be comfortable enough to promote the program more broadly. Over 40% of LDCs were not even able to comment on the barriers; even several that did mention that they did not advertise the program. As a result, the program continues to have low participation and low savings.

Process Finding 13: There are substantial barriers to participation for the current iteration of the M&T program, resulting in low participation and a small contribution to portfolio savings.

- The current iteration of the M&T program is seen as not workable for the vast majority of industrial customers.

Process Recommendation 17: Discontinue the M&T program and direct relevant new customers to other program offerings such as the Energy Performance Program (EPP) unless there is a compelling reason to redesign the program instead.

- EPP includes a whole-building performance aspect and pay-for-performance incentives and Retrofit offers incentives for the installation of energy management systems. Depending on the customer, they could be directed to either program in lieu of M&T.
- The evaluators did not get a clear sense of the original goal of the M&T program; it is possible that this goal cannot be fulfilled through a combination of other programs. IESO should convene a meeting with relevant stakeholders from the program design team and the LDCs to discuss the program's goals.

6 FINDINGS AND RECOMMENDATIONS

6.1 IMPACT EVALUATION FINDINGS AND RECOMMENDATIONS

Table 37: Impact Evaluation Findings and Recommendations

	Findings		Recommendations	Actionable Audience
Portfolio Tracking System & Program Documentation Review Results (Section 4.1.4)				
1	Tracking data and project documentation is generally accurate and comprehensive but can be improved to ensure precise estimations of verified savings.	1	Open a channel of communication between the evaluator and technical reviewer, facilitated by the IESO, to ensure tracking data and project documentation issues are understood and impactful and realistic solutions can be implemented.	IESO, Technical Reviewer
Portfolio Gross Verified Savings Results (Section 4.1.5)				
2	The technical review process generally yielded accurate energy savings calculations but could benefit from a more uniform methodology.	2	Create a standard procedure or similar guidance for the technical review process, including baseline classifications and calculations based on measure type. Require the technical reviewer to consider seasonal variations and other correlations when forecasting annual savings and encourage the technical reviewer to provide clear explanations of the methods used to extrapolate partial-year results to annual results.	IESO, Technical Reviewer
3	Behind-the-meter generation (BMG) projects account for 56% of gross verified energy savings and account for the majority of savings in both LDC-administered and IESO-administered programs evaluated in PY2017.	3	Create a standing committee with the IESO, LDCs and partners to develop a plan to sustain participation in the Industrial Portfolio following the removal of a popular energy efficiency measure. Investigate the potential for biogas-fueled CHPs in Ontario, as well as other projects that were overshadowed by CHPs.	IESO
Cost Effectiveness Results (Section 4.1.7)				

	Findings		Recommendations	Actionable Audience
4	The cost of natural gas used to calculate avoided costs of natural gas consumption in the IESO's Cost Effectiveness Tool is not frequently updated to reflect current market conditions, resulting in inaccurate calculations that do not account for actual natural gas costs incurred in the fuel market.	4	Update the avoided cost of natural gas used in the CDM Cost Effectiveness Tool on an annual basis to reflect current market conditions. A comparison study of marginal natural gas costs in Ontario and other provinces with similar markets is recommended to ensure the avoided costs used reflect industry practices.	IESO
		5	Develop functionality in the Cost Effectiveness tool to account for the seasonality of natural gas prices. Seasonal avoided cost prices of electricity are utilized in the CDM CE tool by leveraging hourly electric load profiles, which should serve as an example for seasonal avoided cost of natural gas.	IESO
PSUP Gross Verified Savings Results (Section 5.1.3)				
5	Two PSUP projects were reported to have summer peak demand increases following the technical review stage but were verified to have summer peak demand savings in the savings audit.	6	Ensure the technical reviewer accurately calculates and reports summer peak demand savings for all PSUP projects.	IESO, Technical Reviewer
6	Several PSUP projects relied on spot measurements as short as 90 minutes to extrapolate a year of data.	7	In the case where measurement data is unavailable, interviews with the participant should be conducted and nameplate data should be recorded to inform the technical reviewer and allow the development of an annual profile with inputs from the spot measurements, in lieu of extrapolation of brief spot measurement data.	Technical Reviewer
		8	The implementer should always meter equipment using kW meters.	Technical Reviewer
EM Tracking System & Program Documentation Review Results (Section 5.2.2)				
7	Energy Manager program tracking data for PY2017 was very similar to PY2016. It is somewhat less reliable than the data tracked for the other Industrial programs and showed minimal improvements in PY2017.	9	Energy Managers and technical reviewers should include participant cost information as this information is critical for program tracking and evaluation purposes. This information should be entered into tracking databases and supported with invoices and other documentation.	Technical Reviewer, Energy Managers

	Findings		Recommendations	Actionable Audience
		10	Require that all key tracking parameters (in-service date, project cost, kWh, kW, and EUL) are completed for all measures and that zero values actually reflect the absence of participant cost or peak demand savings.	Technical Reviewer
EM Gross Verified Savings Results (Section 5.2.3)				
8	The annual energy savings estimates produced by Energy Managers are generally very accurate. There is a tendency for Energy Managers to be overly conservative in their estimates once they have met their contractual obligations.	11	Consider a mechanism to reward Energy Managers for exceeding their required amount of non-incented energy savings. One possibility would be a "carry-over" calculation whereby savings more than the contractually required minimum could be applied to future years in the event of a shortfall. Designing a proper incentive would eliminate the conservative behavior of EMs to target the required minimum savings.	IESO
9	The peak demand savings estimates for non-incented Energy Manager projects are inconsistent or non-existent. Projects are often submitted without peak demand savings estimates. When projects have demand impacts recorded, they are frequently the change in connected load rather than an estimate of demand reduction coincident with the system peak.	12	Make the quality and completeness of peak demand tracking and reporting a performance metric for technical reviewers. Although goals are based on energy savings, peak demand impacts are a key factor in system planning and cost-effectiveness.	IESO, Technical Reviewer
10	The evaluation team observed Energy Managers using LDC meter data in savings calculations that was adjusted for transmission and distribution losses.	13	All project savings calculations should be performed at the meter-level for goal assessment. Impacts are grossed up for T&D losses as part of cost-effectiveness calculations.	Technical Reviewer
IAP Gross Verified Savings Results (Section 5.3.3)				
11	Baseline assumptions for behind-the-meter generation projects are typically poorly documented.	14	Require that measurement and verification plans for BMG projects include a discussion of the assumed baseline condition and explain the technical alternatives participants had other than installing generation equipment.	IESO, Technical Reviewer
PES Tracking System & Documentation Review Results (Section 5.4.2)				

Findings		Recommendations		Actionable Audience
12	Tracking and technical review documentation data does not include project cost data.	15	Engage the technical reviewer to track and verify the participant's project costs associated with their PES claim. Require that documentation supporting the project costs be provided by the participant at the application stage for the claim to be eligible.	IESO, Technical Reviewer
PES Gross Verified Savings Results (Section 5.4.3)				
13	The Evaluation Team was unable to evaluate demand savings as only energy savings were verified.	16	Require the technical reviewer to verify summer peak demand savings as is done in all other industrial programs.	IESO, Technical Reviewer

6.2 PROCESS EVALUATION FINDINGS AND RECOMMENDATIONS

Table 38: Process Evaluation Findings and Recommendations

	Findings		Recommendations	Actionable Audience
Variation in LDC Implementation (Section 4.2.1) Cross-cutting				
1	Smaller LDCs are often less confident in their understanding of the complex industrial programs.	1	Develop training for the PSUP, EM, and M&T programs, given to the LDCs, that cover their rules, processes, and the LDC responsibilities.	IESO, LDCs
Program Awareness (Section 4.2.2) Cross-cutting				
2	Only a little over a third of LDCs have some form of channel partner network, and several commented that their vendors tend to focus on either CHP or Retrofit projects.	2	Encourage and help LDCs without channel partner networks to develop them. Conduct further research to identify the appropriate channel partner networks to develop and leverage into increased program participation. Compare with trade ally networks established in other markets.	IESO, LDCs
3	Nonparticipants are generally aware of the Save on Energy programs and offerings with the exception of the EM program.	3	Increase nonparticipant awareness of the EM program by raising the profile of the program.	IESO
Program Overlap and Competition (Section 4.2.4) Cross-cutting				
4	Administrators described significant overlap between IESO energy conservation programs and the Industrial Conservation Initiative (ICI).	4	Leverage the ICI to spur conversations with customers and use it to market to their priorities without making the project explicitly about demand reduction.	IESO
PSUP Process Evaluation Results (Section 5.1.6)				
5	The application review process remains a major customer pain point for PSUP.	5	Develop measure-specific applications or accompanying guidance to limit the number of information requests (See also Recommendation 13, Section 5.3.6.2, for IAP).	IESO

	Findings		Recommendations	Actionable Audience
EM Process Evaluation Results (Section 5.2.6)				
6	The EM program is seen as an enabling program and drives participation and savings in other Save on Energy/IAP programs.	6	Consider ways to reward EMs for overachieving the 10% non-incented target, provided that they submit enough documentation for the technical reviewer to fully review and the savings persist to 2020.	IESO
7	EMs vary considerably on their achievement of annual goals, though further research is needed to understand the factors involved.	7	Consider including further research of EM goal achievement as a targeted study item for the PY2018 process evaluation.	IESO
8	The ability to get buy-in and commitment from the rest of the company is one of the most important determining factors of an EM's success.	8	On a regular basis, offer trainings on the communication skills that allow EMs to pitch projects, network internally, and convince both facility and corporate staff of the benefits of conservation projects.	IESO
		9	Continue to highlight the successes of EMs in case studies, presentations, and awards, and consider additional venues or methods to do so.	IESO
9	EMs and their supervisors are appreciative of the support provided by the program implementer, the LDCs, and IESO in the form of frequent training opportunities and check-ins.	10	Conduct industry-specific training sessions that cover relevant technology measures for that industry.	IESO
		11	Develop an online schedule listing all relevant trainings and events.	IESO
10	The EM Hub was not widely used by the EMs interviewed.	12	Survey all EMs on their use of the EM Hub and use the responses to update its functionalities.	IESO
IAP Process Evaluation Results (Section 5.3.6)				

	Findings		Recommendations	Actionable Audience
11	The application review process is a major barrier for IAP and the long timeframe can cause customers to shelve projects.	13	Develop measure-specific applications or accompanying guidance to limit the number of information requests.	IESO
PES Process Evaluation Results (Section 5.4.6)				
12	PES savings may accrue above and beyond spillover already captured by the NTG analysis conducted for other programs, but they could also be double counted if not calculated properly.	14	Investigate the potential for double-counting of spillover savings from PES claims. Consider providing the PES claims to each evaluation team (Retrofit Program, etc.) to reduce the possibility of double-counting spillover savings.	IESO
		15	Investigate the potential for free-ridership in the PES initiative and how to account for participants intention scores in the calculation of net verified savings.	IESO
		16	Discontinue the PES initiative. Encourage LDCs and participants to leverage IESO support through existing programs that historically influenced PES claims.	IESO
M&T Process Evaluation Results (Section 5.5.1)				
13	There are substantial barriers to participation for the current iteration of the M&T program, resulting in low participation and a small contribution to portfolio savings.	17	Discontinue the M&T program and direct relevant new customers to other program offerings such as the Energy Performance Program (EPP) unless there is a compelling reason to redesign the program instead.	IESO

APPENDIX A: PEAK DEMAND DEFINITIONS

Table 39: IESO EM&V Protocol Peak Period Definitions

Definition Source	Months	Days and Hours	Calculation of Demand Savings
EM&V Protocols: Standard Peak Calculation	Summer: Jun-Aug	Weekdays 1pm-7pm	Average over entire peak period
	Winter: Jan-Dec	Weekdays 6pm-8pm	
EM&V Protocols: Alternative Peak Protocols for Weather-Dependent Measures	Summer: Jun-Aug	Weekdays 1pm-7pm	Weighted average of the top hour in each of 3 months per IESO weights
	Winter: Jan-Dec	Weekdays 6pm-8pm	

APPENDIX B: PHASE 1 PROCESS EVALUATION PROGRAM SNA

Appendix B contains the Phase 1 Process Evaluation Program Snapshots completed for the PY2016 Evaluation.

B.1 CROSS-CUTTING PHASE 1 PROCESS EVALUATION SNAPSHOT

Certain program components like data tracking or marketing are more efficiently delivered when managed across programs than when each program team does each separately. The programs are also affected by the broader structure and environment, including policy, the IESO's oversight processes, and coordination between LDCs. This snapshot presents initial observations and further research for cross-cutting program aspects organized by five overarching program steps.

Initial Observations	Further Research
Program Design	
‣ LDCs have flexibility to allocate and adjust their portfolio funding and savings targets to individual programs to achieve overall assigned goals. ‣ LDCs have responsibility over budgets and must maintain a TRC cost-effectiveness ratio of at least 1 in new CFF. ‣ There are opportunities for collaboration with gas utilities and integrating/cross-marketing greenhouse gas elements.	‣ Study potential areas for gas collaboration and greenhouse gas integration.
Management	
‣ IESO input is needed early on during program redesign process. ‣ The mid-term incentive for LDCs puts a large focus on hitting interim savings targets by the end of 2017. ‣ Clarity or additional guidance is needed on several processes, including invoicing timelines, reporting, and program rule waivers. ‣ Decision-making authority and responsibility is not always clear. ‣ Training opportunities are extensive and valued.	‣ Assess all unclear processes, and search for places where streamlining can help, or additional guidance is needed. ‣ Develop responsibility and accountability matrix for IESO staff. ‣ Gather information on trainings offered across IESO, LDCs, TR, and other stakeholders to assess what works and opportunities for collaboration or cross-marketing.

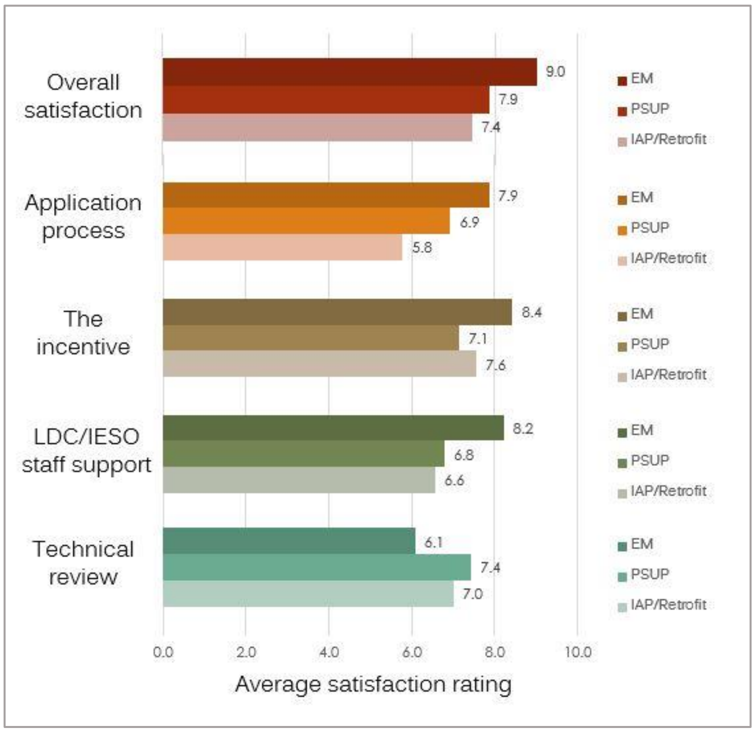
Delivery/Execution	
- Data systems are not adequate for program tracking. - Reporting data flows are unclear. - Marketing is done primarily by direct outreach to customers. - Channel partners are important to promote the programs. - Anecdotal evidence suggests variation in LDC implementation of the programs.	- Review existing systems and data exchange architecture. Assess what additional functionalities new systems should have. - Create process diagram for reporting. - Study the formality of existing channel partner networks and opportunities to better leverage them. - Analyze variation in LDC implementation to identify successful features for sharing and unnecessary differences for eliminating.
Customer Experience	
- Different industries have different priorities and program experiences. - Reducing energy bills, avoiding future energy price volatility, and furthering corporate sustainability policies are customers' most important motivators. - An overwhelming majority of participants had previously participated in IESO/LDC programs and even more planned to participate again.	- Develop industry-specific profiling. - Continue to monitor customer motivations and satisfaction by program.
Technical Review/Evaluation	
- There are no systematically reported savings for Industrial programs. - Technical review is discussed in greater detail in program sections.	- Develop a template for reported savings.

Largest Successes	Largest Opportunities
Ample training opportunities on technical and sales topics	Clarifying processes for LDCs and participants
Healthy collaboration between LDCs	Program redesigns to be responsive to the market
Direct outreach model to reach customers	Limited-function data systems
Popularity of programs from repeat customers	IESO organizational complexity
Program “maturing” from previous framework	Gas utility and greenhouse gas integration
	Leveraging channel partners

B.2 CUSTOMER PERSPECTIVES PHASE 1 PROCESS EVALUATION SNAPSHOT

All participants in PSU and IAP were interviewed along with a sample of EM participants. The process part of the interview asked about the customer’s satisfaction with parts of the program and their experience, while the NTG portion gathered perspectives on their motivations for performing the project.

Customer Satisfaction



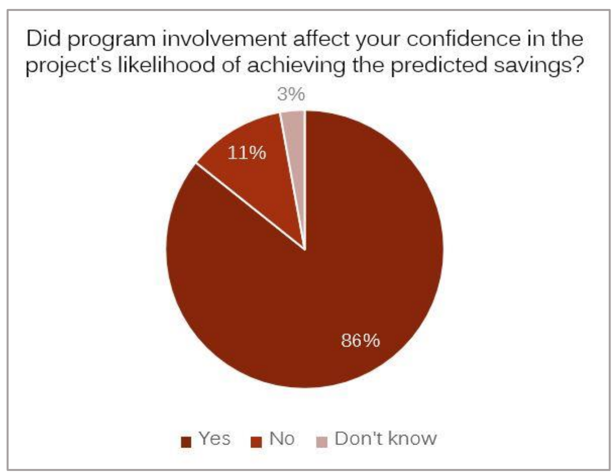
Note: a total of 37 participants were interviewed. Counts for each program can be found in *Section 3* of the PY2016 Report.

Participation Perspectives

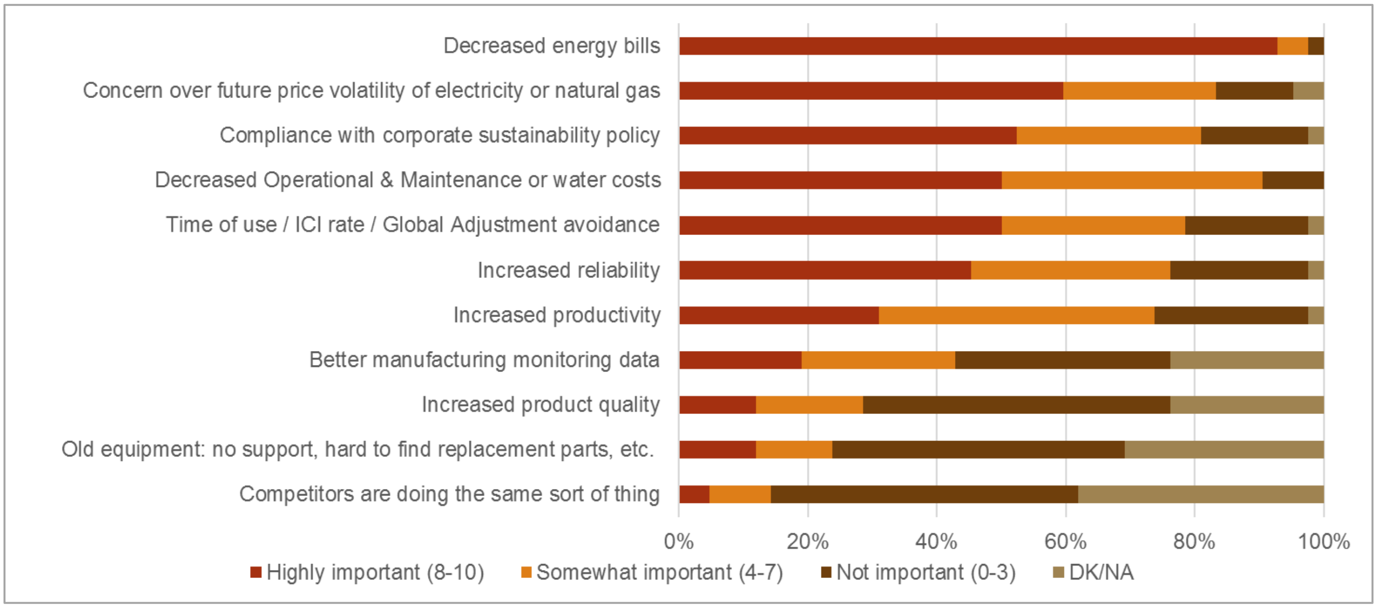
74% Respondents that had participated in a CFF program previously

91% Percentage that said their experience with past conservation projects influenced them to do additional ones

78% IAP/Retrofit participants
86% PSUP participants
100% EM participants
that said they planned to participate in another CFF program in the future.



Customer Motivations



B.3 PSUP PHASE 1 PROCESS EVALUATION SNAPSHOT

PSUP provides incentives for customers to install large energy efficiency or behind-the-meter generation (BMG) projects. There are several different program pathways depending on the type and size of the project. All projects require a detailed engineering study to proceed into the program. This snapshot presents initial observations and further research for PSUP organized by four overarching program steps.

Initial Observations	Further Research
Program Design	
• While PSUP incentives are high, contracting and M&V are seen to be burdensome, which inhibits participation and push projects to Retrofit and/or Program-Enabled Savings. • The “clawback” funding mechanism for engineering studies, where the study incentive is deducted from the project incentive, may discourage customers from PSUP participation. • There is an ongoing question about CHP eligibility as it is often a net emitter of greenhouse gases. However, it comprises the majority of past project	• Review peer Industrial program structures, including engineering study incentive and design, contracting processes, M&V requirements, and incentives to inform PSUP working group. • Additional research as appropriate to support implementation of the preliminary recommendations for this section.

savings and the future program pipeline. ▸ There is no mechanism for rewarding over-performance of savings.	
Delivery/Execution	
▸ LDCs are funding fewer engineering studies under new framework due to impacts on program cost-effectiveness if the study does not convert into a project. ▸ LDCs indicated that engineering studies often don't leave customers "shovel-ready." ▸ PSUP application review and contracting stages are two major barriers. ▸ BMG was not considered during the initial program design. This creates confusion regarding interconnection and process requirements.	▸ Deep dive into engineering study process to identify barriers and propose mitigation approaches. ▸ Develop process flow diagrams to help clarify key processes and responsibilities, building on overall program logic models.
Customer Experience	
▸ Customer confusion and frustration with application and TR processes is common. ▸ Participants gave the program relatively high satisfaction ratings in the initial interviews despite the pain points.	▸ Peer program review of M&V practices regarding timing, scope, and level of rigour. ▸ Additional PSUP customer interviews in Phase 2 to explore process bottlenecks.
Technical Review/Evaluation	
▸ LDCs and customers feel that TR M&V and documentation requirements are overly burdensome, resulting in project delays and customers pursuing alternate programs.	▸ Assess options for and effects of reducing M&V rigour during both application review and M&V period. ▸ Review project documents and work with TR firm to inform checklists.

Largest Successes	Largest Opportunities
▸ High satisfaction ratings ▸ Attractive incentives ▸ Detailed engineering study helpful for customers	▸ Engineering study process revisions to encourage conversions ▸ Participation agreement/approval process ▸ Requirement checklists to guide data collection/documentation ▸ M&V extent and rigour ▸ BMG-specific materials and process

B.4 EM PHASE 1 PROCESS EVALUATION SNAPSHOT

The EM program pays for a full-time resource at a large facility. In return, the EM must achieve a certain amount of energy savings per year (1,000–2,000 MWh per year, with at least 10% of the savings coming from non-incented projects). This snapshot presents initial observations and further research for the EM program organized by four overarching program steps.

Initial Observations	Further Research
Program Design	
• LDCs are very supportive of the performance-based payment option. • There is no mechanism to reward overperformance on non-incented savings.	• Analyze performance against goals by EM, including trends by salary/ performance payment, industry, and LDC. • Study impact of EM on the facility.
Delivery/Execution	
• Non-incented projects are often O&M or behavioral programs – important but hard to measure the impact of. • The EM Hub is seen as having a lot of potential to be more widely utilized.	• Delve into EM process, including reporting. • Gain EM perspectives on the Hub, how they use it, and how it can help them. • Assess training and collaboration opportunities.
Customer Experience	
• The EM program was widely praised by stakeholders and customers alike. • The main customer benefit is having a dedicated resource to drive projects. • Very high satisfaction ratings – average of 9 on a 0–10 scale from EM supervisors.	• Interview a sample of EMs to understand their experience.
Technical Review/Evaluation	
• Persistence of O&M/behavioral projects is controversial – EMs are tracked on first-year savings, but LDCs have to deliver savings persisting to 2020. • Project supporting documentation varies widely in detail and analysis methods.	• Explore opportunities to better leverage the non-incented savings aspect and what data fields must be collected.

Largest Successes	Largest Opportunities
▸ Very high satisfaction ratings ▸ Good support for EMs – TR, LDC trainings; EM Hub; LDC monitoring ▸ Generally high performance by EMs discussed in interviews (to be researched in Phase 2)	▸ Non-incented projects – use of O&M and behavioral savings ▸ Non-incented projects – motivation to overachieve 10% ▸ Gathering enough data from EMs

B.5 IAP PHASE 1 PROCESS EVALUATION SNAPSHOT

IAP is administered by IESO to all transmission-connected customers to provide the same opportunities as the LDC programs. IAP has several sub-programs that mirror the LDC offerings: Retrofit, Process and Systems, Energy Manager, and High Performance New Construction. This snapshot presents initial observations and further research for IAP organized by four overarching program steps.

Initial Observations	Further Research
Program Design	
▸ Programs are very similar to LDC-led ones. ▸ IAP has not participated in the program redesign process (i.e., PSUP working group). ▸ The Dec 2016 directive allowing companies with at least 1 transmission-connected facility to use IAP for all of their facilities will increase the eligible population and change their characteristics.	▸ Interview team members; understand plan for reaching additional facilities made eligible for IAP by the Dec 2016 directive. ▸ Assess the impact the PSUP working group proposed changes would have on IAP and if further changes are warranted.
Delivery/Execution	
▸ Processes differ by program subpart, though are similar to LDC program rules. ▸ The vertically-integrated team at IESO has the potential to work quickly, though it may be understaffed for the amount of work.	▸ Interview team members to assess responsibilities, workload, and data flows; review processes that impact project timing and customer experience.
Customer Experience	
▸ IAP staff noted this is an area they want to continue to improve. ▸ The average satisfaction rating was 7.4 on a 0-10 scale, lower than PSUP (7.9) or EM (9.0). ▸ Customer pain points were around the amount of work required, especially with TR, and on IESO/TR	▸ Survey customers on an ongoing basis; run additional interviews with nonparticipants and past participants who have had little involvement since their original project. ▸ Consider ways that the program staff can remedy the program perceptions.

staff turnover.	
Technical Review/Evaluation	
TR is run the same for IAP as it is for the LDC-led programs. Customer grievances on data requests are similar to PSUP.	Assess effects of reducing M&V rigour during both application review and M&V period. Review project documents and work with TR firm to inform checklists.

Largest Successes	Largest Opportunities
Very high participation rate More flexibility for program design Attractive incentives	Customer experience and support PSUP working group proposed changes and impact on IAP if implemented Customer effort required for application/reporting

B.6 PES PHASE 1 PROCESS EVALUATION SNAPSHOT

Initial Observations	Further Research
Overall Process	
There was a large jump in PES claims, with more than 90 received for PY2016. LDCs see PES as an attractive option to claim savings without paying direct incentives. PES guidelines were developed for the prior program framework, and LDCs are unclear on documentation requirements to reach appropriate levels of rigour with claims.	In support of the impact recommendations above, conduct a detailed review of PES program guidelines to inform IESO in updating content regarding claim documentation requirements, data needs, and customer interface procedures.

B.7 M&T PHASE 1 PROCESS EVALUATION SNAPSHOT

Initial Observations	Further Research
Overall Process	
• The evaluators had limited insight into this program due to low participation rates. • Few LDCs had direct experience with the program. • LDCs suggested that the program's complexity and extensive M&V requirements are primary factors in underutilization. • LDCs noted that the Retrofit M&T program has much more achievable requirements, making it more attractive to customers.	• Research program guidelines and barriers to participation to develop program design or marketing recommendations. • Explore components of Retrofit M&T program for potential application to M&T, or to combine programs. • Consider what future collaboration opportunities may exist to incorporate continuous improvement and SEM principles into the M&T program design, and to work more directly with gas utilities.

APPENDIX C: SELECT METHODOLOGY DETAILS

This appendix contains details about the evaluation methodology that are excluded from the body of the report for brevity. An overview of the evaluation methodology can be found in *Section 3*.

C.1 GROSS SAVINGS DATA COLLECTION AND REVIEW

C.1.1 DATA SOURCES

Table 40 below contains a list of the data sources used from verifying gross savings.

Table 40: Data & Information Sources Used for Impact Evaluation

Item	Description	Source
Reported (Ex-Ante) participation & savings	Savings by program, project, & measure	Technical Reviewer
Participant contact information	For project-specific interviews and site visit coordination	Technical Reviewer & IESO
Project files	Including M&V data & documentation	Technical Reviewer & IESO
Reporting template(s)	For impact reporting	IESO
Cost-effectiveness parameters	Avoided costs, admin costs, discount rate	IESO

EcoMetric used several distinct data-collection techniques to fulfill evaluation objectives, explained below.

C.1.2 GROSS SAVINGS VERIFICATION METHODS

C.1.2.1 Project Documentation Review

Project documentation was mostly provided by IESO's technical reviewer, and in some cases, by the customer or IESO program staff. Project files utilized for review and analysis included project incentive applications, engineering workbooks, equipment cut sheets, invoices, email exchanges, technical drawings, M&V plans and reports, and digital photos.

C.1.2.2 Project Audits

Project audits verify the accuracy of savings calculations, assumptions, and M&V conducted by the technical reviewer, contractors, customers, and any other parties involved in the application, implementation, and technical review process. Audits were performed for each project in the sample, utilizing technology-specific methods and tools, and testing the calculations and assumptions used to estimate reported savings for each project.

Level 1 audits consist of a desk review of project documentation and supporting calculations, including applications, savings worksheets, M&V plans, M&V reports, engineering studies, metered data, invoices, and any other documents made available.

Level 2 audits expand upon the work conducted in the Level 1 audits, and as stated above, in many cases, included an on-site review of the equipment installation and operating parameters.

C.1.2.2.1 Analysis Approach & Methods

Data collected from the Level 1 and 2 audit activities enabled EcoMetric to verify energy and demand savings for each sampled project (gross verified savings). Ratios of gross verified to reported savings are *realization rates (RR)*.

For the Energy Manager Non-Incented measures, where a sample was used, the weighted-average sample realization rate for each stratum (technically-reviewed, non-technically-reviewed) was applied to the population of eligible Energy Manager projects to derive the overall program gross verified savings. The same approach was conducted for IAP Retrofit, IAP Energy Manager and PES programs.

For PSU and IAP CI, a census of projects was analyzed, resulting in a unique realization rate (or adjustment factor) for each project. In these cases, the program-level RRs are equal to *total verified savings* divided by *total reported savings*. Program- and stratum-level realization rates are included and explained in detail in *Section 4: Portfolio Evaluation Results*.

C.2 NET SAVINGS ANALYSIS

C.2.1 NET SAVINGS DATA COLLECTION

C.2.1.1 Verification Methods (NTG Questionnaire Design)

EcoMetric created a new NTG questionnaire for analysis of PY2016 sites, retaining the structural tenets of the prior method but adding additional factors and questions on timing, context, and influences to help the analysts' ability to triangulate and crosscheck responses. These enhancements were originally planned to be implemented in future years of the evaluation but after review and discussions with IESO evaluation staff, many of these changes were accelerated and incorporated into the PY2016 surveys. The resulting questionnaire consisted of a common core set of questions and unique program-specific sections and response choices depending on the program. The questionnaire required a longer interview than what has been used in the past, but one that considered complex decision-making in context and is highly defensible.

The PY2017 questionnaire leveraged the changes made for PY2016, with some minor enhancements, including:

- **Survey multiple decision-makers where appropriate.** For larger and more complex projects, multiple people are often involved in decision-making. Where possible and desirable, the EcoMetric team will seek to interview multiple decision-makers to develop more informed NTG estimates. This approach was used in a few cases during PY2016 and was expanded to ensure that the right decision-maker(s) are interviewed for NTG purposes.
- **Integrate modeled partial net (MPN) approach where appropriate.** For a subset of projects – primarily generation projects and/or unique, complex measures with a range of efficiency alternatives – the EcoMetric team estimated net savings using a modeled partial net (MPN) methodology.

  The traditional free-ridership approach first establishes a gross baseline (e.g. industry standard practice) and then conducts a free-ridership interview to determine the degree of influence the program had in moving the customers from the gross baseline to the high efficiency alternative that was installed. This is an excellent approach for straightforward measures, for those where only two efficiency options are available (the binary choice of the high or low efficiency options), when the questionnaire must be written to cover diverse technologies, when non-technical interviewers are used, or when the study cannot afford individual project analysis. Most measures fit in one of these categories.

  In contrast, the MPN method uses a series of questions to identify specifically what technology the customer would have installed without the program. This data is then used to directly estimate a project-specific net (not gross) baseline using engineering recalculations. The MPN approach is based on obtaining details about the exact other option the customer would have installed absent the program. This is considered "direct to net" because it skips the gross baseline step. Gross baseline must be established as well to express the net effect in the context of the free rider convention, but it is of secondary importance. The "partial" in "modeled partial net" recognizes that technique does not account for most spillover.

  While MPN can be used as the primary free-ridership method, due to its higher cost of implementation and our interest in preserving methodological continuity, the evaluation team leveraged MPN for only a subset of projects.

  For both the traditional and MPN methods, the result will be the direct free-ridership estimate, which is then subject to the same influence and contextual considerations.

C.2.1.2 Net-to-Gross/Attribution Interviews

The primary data collection method for NTG data was through in-depth self-report interviews. This approach was consistent with the PY2016 approach and is allowed by the Conservation First Framework 2015-2020 EM&V Protocols and Requirements. The general NTG process is as follows:

C.2.1.3 Survey Development

The NTG surveys addressed two discrete components of net savings analysis: free-ridership and spillover. For free-ridership, the questionnaire used a consistent approach to PY2016, calculating both a direct free-ridership score and an indirect score that incorporates questions about program influence and any other factors that possibly influenced the decision to implement the project.

C.2.1.4 Training and Testing

Prior to roll-out of the NTG survey instruments, EcoMetric conducted training exercises to ensure that the team has the appropriate training and expertise to conduct the interviews. This included a refresher session on interviewing tone, follow-up questions, time management, and avoiding leading questions, as well as pre-tests of interview scripts and pilot testing with initial recruited participants.

C.2.1.5 Recruitment

EcoMetric takes considerable steps to ensure that interviews are conducted with the primary decision-maker(s) involved in the decision-making, or at the very least, aware of the decision-making criteria for the project. The EcoMetric team works with IESO and LDCs to identify the primary decision-makers for each project by first reviewing the project files and customer contact information.

Once likely decision-makers are identified, IESO and LDC staff send personalized recruitment emails to these contacts notifying them of the upcoming interview. EcoMetric then contacts the customers directly, screening them prior to starting the interview to confirm that they were the decision-maker or involved/aware of the decision-making process. The Evaluation Team leverages a combination of email and phone messages to customers at different times of day and week, and logs each contact attempt (time, date, target, result), in a contact tracking system.

Table 41 below presents the disposition report, a table summarizing EcoMetric's recruitment activities for the PY2017 activities.

Table 41: Disposition Report of NTG Recruitment

Disposition	PSU	IAP/Retrofit	EM	Total
Population[41]	31	25	20	76
Sampling Method	census	Census	stratified sample with certainty stratum	
Total Individuals Contacted (multiple contacts for some customers)	42	24	22	88
Total Contact Attempts	91	52	44	187
Interviews Completed (individuals)	28	19	16	63
Dropped Interview	0	0	0	0
Not Recruited	3	2	3	8

Interview Preparation – In preparation for the interviews, the EcoMetric staff reviewed the project files for each customer to understand the projects completed, timelines, and any other unique characteristics of each customer. For customers that implemented multiple projects during the study year, EcoMetric investigated the two projects with the largest electricity savings to capture most savings without creating an excessive burden on the interviewee.

Post-processing – After completing each interview, the interviewer reviewed and clarified notes and submitted the interview results for quality control (QC). During the QC, results were reviewed for completeness and consistency.

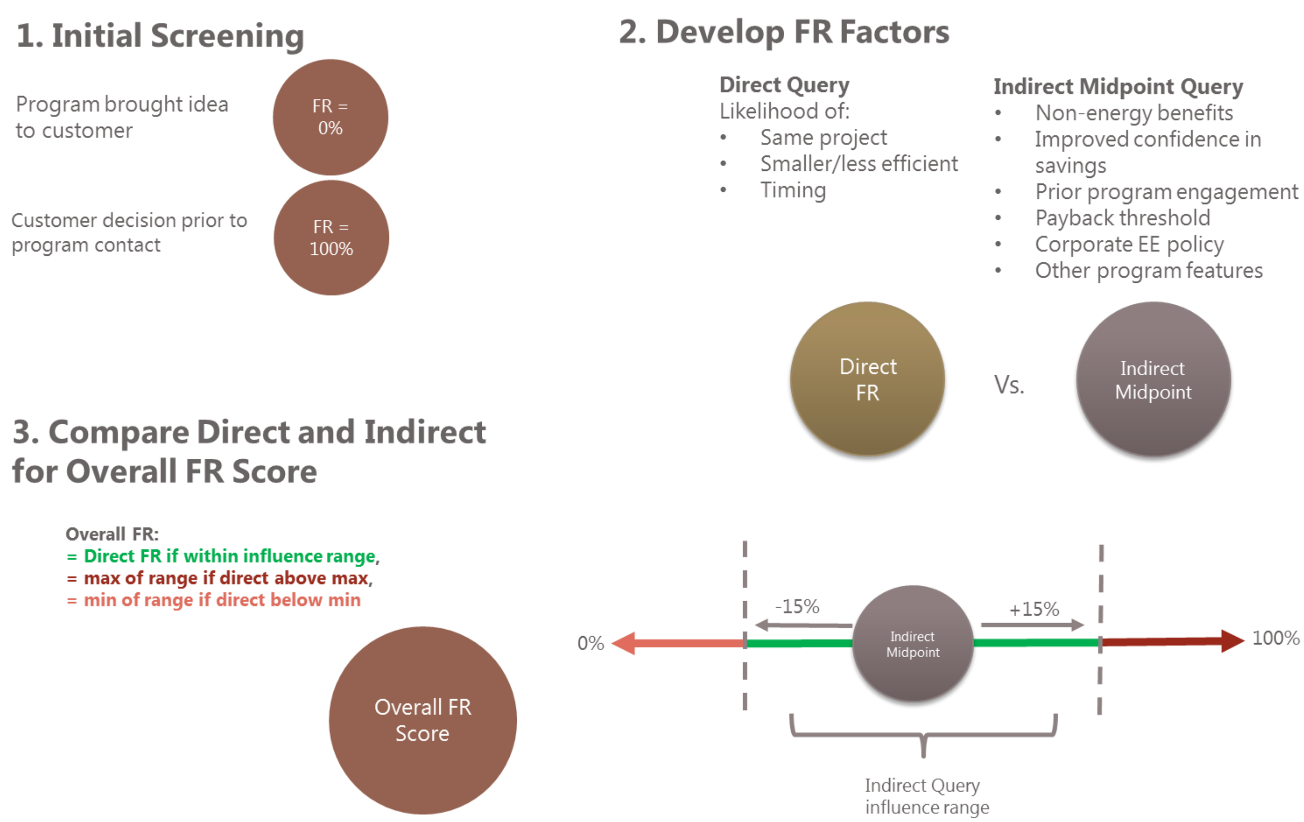
C.2.2 NTG ANALYSIS APPROACH & METHODS

The collected free-ridership data was analyzed first by computing a direct query-based free-ridership from responses on the likelihood of implementing the project absent the program, and likely size, efficiency, and timing of implementation. After estimating free-ridership using this direct method, EcoMetric analysts calculated a probable free-ridership range based on a series of questions about program influence and other factors that possibly influenced the decision to implement the project. The

[41] Population shown here is different than overall evaluation count due to three PSU projects that were evaluated by another evaluation team (Nexant) during the transitional period.

final project free-ridership was then computed by considering the direct query and the range. Figure 21 presents a graphical representation of the calculation approach.

Figure 21: Free-ridership Methodology



To estimate spillover as well as any potential influence of participation on subsequent projects that received incentive funding, the interviewers asked about influenced projects, the degree of program influence, the project sizes, and whether they received program support. As noted above, both completed and planned projects were considered with a discounted presumed effect for planned projects.

EcoMetric computed the free-rider (FR) and spillover (SO) factors to estimate net savings as shown in the following formula:

*Net savings = verified gross savings * (1 – FR + SO)*

For example, an individual project with 1,000,000 kWh/year of tracking savings, a 95% realization rate, 10% free-ridership, and 1% spillover would have verified gross savings of 950,000 kWh/year, an NTG ratio of 0.91 (1-FR+SO = 1 - 0.10+0.01) and verified net savings of 864,500 kWh/yr.

C.3 PROCESS METHODOLOGY

The second phase of the process evaluation, conducted as part of the PY2017 evaluation, built off the first phase in order to complete the comprehensive evaluation of all CFF industrial programs. The PY2017 work featured interviews with a broader set of targets, nonparticipant surveying, document review, and targeted analyses to dive more deeply into the topics identified during the first phase. There were five goals of the second phase:

- Gather additional perspectives from stakeholders and program documentation to add depth and color to the preliminary observations and findings from the first phase.
- Study the specific program processes that were unclear to participants or the evaluators.
- Solicit feedback on participation experiences from a much broader range of stakeholders (participants in all programs, energy managers, partial and nonparticipants).
- Deliver a final comprehensive report with data from both phases and a full set of findings and recommendations, as well as details on progress made towards implementing Phase 1 preliminary recommendations.
- Identify further targeted research studies focusing on specific aspects of the programs that can be performed over the next three years.

These goals were met using a variety of data collection activities, including interviews, surveys, document review, and targeted data analyses where applicable. Each of these are described in more detail below.

C.3.1 PRIMARY DATA COLLECTION: INTERVIEWS AND SURVEYS

In-depth interviews and surveys were the major data source for the Phase 2 research. The research also drew from the Phase 1 research, which likewise centered around interviews. Interviews are typically longer and led by a trained evaluator; they usually feature more open-ended responses and may include follow-up probing questions to understand more about a particular topic or process. Surveys are shorter and consist mostly of close-ended questions. They are often self-administered (i.e., through a web form) or conducted by a survey firm with dedicated staff. The participant interviews are a hybrid: while they consisted mostly of close-ended questions asked to calculate the free-ridership and spillover scores for the NTG study, they were much longer (generally 45 minutes to an hour) and were conducted by evaluation staff trained to ask specific questions about the particular project if needed.

Table 42 shows the primary data collection counts for Phase 2, with the Phase 1 interviews included for comprehensiveness. More detail about sampling and methods for each Phase 2 activity is described below.

Table 42: Process Interview and Survey Counts

Interview/Survey Target	Phase 1	Phase 2
IESO staff overseeing LDC implementation	4	
IAP staff interviews	2	4
Technical Reviewer interviews	2	
EM interviews		10
LDC interviews	10	
LDC surveys		39
Participant interviews	36	48
PSUP	13	23
EM - LDC	13	10
IAP	3	4
IAP Retrofit	6	6
EM - IAP	1	5
Nonparticipant surveys		75
Large		17
Medium		26
Small		32
Partial participant surveys		13
EM		6
M&T		4
IAP		3
Total	**54**	**189**

C.3.1.1 Stakeholder Interviews

The evaluation team conducted interviews with the IAP program manager (a follow-up from Phase 1), all three IAP business advisors, and a sample of 10 EMs. This EM sample was not intended to be representative of the entire EM population, but to provide a breadth of perspectives from EMs for the process evaluation. EMs were selected out of the sample drawn for the gross and NTG evaluations to leverage communication with each EMs to accomplish multiple evaluation needs and minimize administrative time alerting the LDC and EM that they could be contacted. From this sample, the process evaluation team selected 10 EMs, plus three back-ups, with the following considerations:

- Mix of LDC CFF and IAP EMs: Six interviews were conducted with LDC EMs and four with IAP EMs.
- Range of customer types and industries: The sample was selected to include mining, metals manufacturing, food and beverage processing, automotive manufacturing, and a municipal wastewater treatment plant, among others.
- Range of project counts and sizes: The sample was selected to include facilities that generated a large amount of savings or conducted many non-incented projects in PY2017, and facilities that conducted only a single project and comparatively small savings.

- **Multiple EMs at a facility**: Two facilities selected had multiple EMs, though only one completed the interview.

Three facilities did not respond to the request for interview, so all three facilities in the backup sample were used to complete the interviews.

C.3.1.2 LDC Surveys

The Phase 1 evaluation included interviews with program managers from 10 LDCs representing a mix of sizes and geographic locations. To allow all LDCs with industrial programs to provide feedback and gain quantitative data about how different LDCs manage their programs, the EcoMetric team designed an online survey emailed to all LDC program managers with industrial programs. EcoMetric received a list of contacts for all 68 LDCs from IESO, which was adjusted to 58 contacts to reflect duplicate contacts for LDCs in group CDM plans. The survey was emailed to these contacts, with several reminder emails over the following weeks for nonresponsive LDCs. Thirty-nine LDCs, including all of the largest ones, completed the survey.

C.3.1.3 Participant Interviews

Participant interviews were conducted as part of the NTG evaluation surveys to best leverage each customer touchpoint. The interviews therefore had a dual purpose in asking the customers attribution questions and assessing their program experience. The targeted individual at each customer facility was the decisionmaker involved in the project or, in the case of an EM, the EM's supervisor or manager who was most involved in the decision to apply for an EM. Please see *Section 3.7* for a description of the sampling techniques utilized in conducting these interviews. While questions were designed for the M&T program participants, the EcoMetric team was unable to get in contact with any of the M&T participants.

C.3.1.4 Non- and Partial-Participant Surveys

In addition to understanding the perspectives of those directly served by the programs, the evaluators also gathered data from industrial or institutional customers who have not yet participated in the CFF industrial programs or who started but did not complete a project.

Since there are only 59 transmission-connected IAP customers and the IAP staff was already reaching out to its few nonparticipants, the nonparticipant aspect of the survey focused wholly on distribution-connected nonparticipants for the LDC programs. The first step was to create a list of the population of facilities that were likely to be eligible for the LDC programs (i.e., large enough to produce a project that saved enough energy to meet the programs' requirements) and that had not yet participated. Although each LDC may have a list of its eligible customers and their participation status, the number of data requests to each LDC that this would entail made producing a list by that method unrealistic. Instead, the IESO provided a list of all 104,000 nonparticipating businesses in Ontario that had been purchased from a market research firm. IESO had already removed all businesses that had participated in PSUP, Retrofit, or Small Business Lighting from the list. To determine which facilities were likely to be good targets for the industrial programs, the EcoMetric team used two pieces of data – the NAICS code and square footage fields – and another publicly available dataset to estimate the energy use of each facility. The steps were as follows:

- Filter by facility type: The team selected a set of 2- and 4-digit NAICS codes representing industries that would likely be large enough based on past participation (e.g., all manufacturing codes, mining, hospitals, universities, wastewater treatment plants, etc.)
- Integrate energy use intensity data: The team used web research to find robust data on energy use intensity (i.e., kWh per square foot) by NAICS code for industrial and commercial facilities. The industrial data came from the U.S. Department of Energy's Industrial Assessment Center (IAC) database, featuring data from each of the 18,000 industrial audits that the centers have performed. The team removed outliers and averaged the values for energy use intensity for each 6-digit NAICS code, then used a weighted average to determine energy use intensity for each 4-digit NAICS code. The commercial data came from a summary dataset of the U.S. Energy Information Administration's (EIA) Commercial Buildings Energy Consumption Survey (CBECS).
- Calculate energy usage at each facility: The evaluators assigned an energy use intensity from the IAC or EIA datasets to each facility based on its 4-digit NAICS code, then multiplied by the facility's square footage to determine its estimated MWh usage at the facility. To estimate the energy savings potential for project eligibility (100 MWh for a PSUP small capital project), the team assumed that a project could save around 5% of a facility's energy use on average.
- Remove the smallest facilities: Any facility that was less than 15,000 square feet, had 10 employees or fewer, or was estimated to save 50 MWh or less per project was removed from the dataset.

Stratify by energy savings potential: The EcoMetric team stratified the population into three groups (large, medium, and small) using the total savings potential. The facilities were arranged from large to small according to their energy savings potential and then segmented into three groups so that the cumulative total of each represents a third of the potential energy savings. The totals for each segment, along with the number of completed surveys, are shown in Table 43.

Table 43: Nonparticipant Population and Survey Completes

Type	Population size	Survey Completes	Response Rate
Nonparticipant - Large	191	17	9%
Nonparticipant - Med	621	26	4%
Nonparticipant - Small	1,668	32	2%
	2,480	**75**	**3%**

While the goal was to reach 25 completes for each segment, the number of facilities in the large segment made this difficult to achieve. Nielsen, the survey firm retained by EcoMetric for this survey, called all

2,480 facilities in this population, including the maximum number of attempts (six) for all large and medium facilities. The remaining quota was instead completed with small facilities.

For partial participants, the EcoMetric team determined the number of cancelled projects for each program using the Technical Reviewer's overall application tracker and a M&T-specific spreadsheet. Due to the pending PSUP redesign, IESO asked the team to focus on the EM and M&T programs for the LDC programs. The evaluation team pulled a list of EM and M&T applications that had been cancelled in 2016 or 2017. This list was then provided to the Technical Reviewer, who manually sorted through PDF copies of the applications to find the contact information, as that field is not included in the database and non-sampled project files were not provided to the evaluators.

For IAP, the IAP program manager requested that we survey former participants – i.e. companies that had done IAP projects in the past but none recently. There were eight of these companies, for which the business advisors provided any contact information they had.

The resulting population is shown in Table 44 along with the completes.

Table 44: Partial and Former Participant Population and Survey Completes

Type	Population size	Completes	Response Rate
EM partial participant	21	6	29%
M&T partial participant	12	4	33%
IAP former participant	8	3	38%
	41	**13**	**32%**

As with the nonparticipants, Nielsen called all 41 partial and former participants the maximum number of times, with nearly a third of the sample completing the survey – a very high response rate, especially for companies that had not received incentives.

Nielsen provided the raw results to the EcoMetric team, which was split by nonparticipant/partial participant and then into size or program segments where applicable.

C.3.2 DOCUMENT REVIEW

The primary data collection activities were supplemented by document review. Documents were requested and reviewed as needed to supplement the observations made during interviews and surveys, and to aid in understanding program developments. These documents included:

- Ministry directives
- Program rules documents
- PSUP redesign straw proposals and the draft business case
- The prior industrial evaluation report
- Relevant program-level reports, including from the Technical Reviewer

- The Save on Energy webpages for the industrial programs
- Case studies available on the Save on Energy website
- Websites for ICI and various GHG programs

Where applicable, information from these documents are referenced in the findings and cited with the website where the information is available.

C.3.3 TARGETED ANALYSIS

The EcoMetric team also completed several targeted analyses to provide data in support of specific research questions:

- **Energy Manager Cross-Program Participation**: Is there any difference in other CFF program participation between facilities that have an EM and those that do not? Do facilities with EMs better leverage the full suite of CFF offerings?
- **Variance in LDC Implementation**: How consistent is the Industrial Program delivery across LDCs? What strategies have LDCs implemented that were effective, and how can those be shared with other LDCs to improve their performance?

The largest of these was the assessment of EM participation across the suite of IESO programs. The main effort was an analysis built around the Technical Reviewer's application tracker to determine the number and type of projects EM facilities performed compared to non-EM facilities. Later on, the impact evaluation team also performed an independent assessment of the percentage of the savings from each program attributable to EM facilities. Both of these are described below.

C.3.3.1 Energy Manager Cross-Program Participation Analysis

To determine whether facilities with EMs participated more frequently than facilities without, the EcoMetric team had to aggregate all applications submitted by a single customer and determine when EMs were present at each facility. This was all completed with data from the Technical Reviewer's application tracker and an accompanying record of all Retrofit applications from the iCon system provided by IESO. The steps for the analysis are as follows:

- **Filter for CFF applications only**: Application records created before January 1, 2015 were removed from both datasets.
- **Split by LDC/IAP and then by specific programs**: Most of the analysis was conducted directly in the industrial application tracker and was done twice: once for the LDC programs for distribution-connected customers, and once for the IESO IAP programs for transmission-connected customers. After the dataset had been divided into these two groups, the applications were then clearly marked with the program (i.e., PSUP, study, EM, M&T, IAP P&S, IAP Retrofit), the application year, and their status (i.e., completed, in progress, or cancelled). These fields were created as

simplifications of the existing data in the tracker, which included two status fields with different stages and statuses depending on the program and use of the tracker and multiple date fields.

- Add in multi-year EMs: Participants that retain their EM for more than one year do not fill out a second application, so the application tracker only has a record of the EM's first year. The evaluation team manually created "applications" for all second- and third-term EMs so that it was clear which years the participant had an EM on site.
- Create unique participant and facility IDs: The industrial application tracker is arranged by the application ID and does not have any way to connect projects completed at the same facility. The evaluators therefore create participant and facility IDs to collapse the dataset to the facility-level. To complicate matters, the participant names were often spelled differently (a company could be referred to as its short name, a longer name, or its full legal name with "Inc." or "LLC" appended), and the address field often included different pieces of information or could be misspelled. To create the unique IDs, the evaluators used formulas to match the participant names and the first few digits of the address after the street number. A participant ID was assigned to unique companies or customers (e.g., 3M) while a facility ID was assigned to buildings with unique addresses (e.g., 3M – London, 3M – Milton).
- Collapse to the participant level: The team then created a new sheet where each row represented a unique participant and the columns represented the number of EM, Study, PSUP, etc. projects completed each year from 2015-2017. Note that the evaluators chose to organize the data on the participant rather than the facility level, as many facilities are run out of a corporate or main office; a review of the data also showed that enough facility addresses were spelled differently enough to be treated as separate facilities although they seemed to be the same one. The participant level provided a better platform for viewing the grouped data.
- Merge in Retrofit data: The evaluators used the same name-plus-numerical-address method described above to match Retrofit projects with the participants and facilities in the industrial programs. The number of Retrofit projects that each facility completed each year from 2015-2017 was summed and added to the dataset.
- Analyze participation by year: The EcoMetric team then aggregated the data to view the number of facilities participating and the number of projects completed each year and in each program by EM and non-EM facilities. The results from this analysis are discussed in *Section 5.2.6*.

There is one limitation of this analysis, which likely underestimates the contribution of EMs to the portfolio. While this analysis uses calendar-year increments to simplify the analysis, EMs can be hired at any time during the year and have one year from when they start to complete their projects. As a result, a 2017 EM starting in August would have until August 2018 to meet their annual goal and may not have submitted any projects by the end of 2017. It is also possible that a 2016 EM submitted their projects in 2017 but did not stay on for a second year; the 2017 projects would be counted as projects for a non-EM facility. To counter this, the evaluators also calculated participation and project totals for the 2015-2017 period. This still may underestimate EM contributions, as there was only 1 distribution-connected facility and zero transmission-connected facilities with an EM in 2015.

C.3.3.2 Variation in LDC Implementation

The assessment of variation in LDC implementation was carried out through the LDC survey described above. An enhanced variant, finding and interviewing customers with facilities in multiple LDC territories about their different experiences, is an option for PY2018 if matching starts by January 2019.

C.3.4 FINAL ANALYSIS AND SYNTHESIS

Once all interviews, surveys, document review, and targeted analyses had been completed, the evaluation team organized the summary data by the relevant program covered and into sub-topics within each. This allowed the team to identify any trends appearing across datasets and start to formulate findings and recommendations for the key topics. A memo featuring the key findings and recommendations was presented to the IESO evaluation team a month before the final report was due, allowing IESO to provide additional information and feedback. Their comments were incorporated into the writing of this report.

APPENDIX D: COST-EFFECTIVENESS ASSUMPTIONS

D.1 PSUP COST-EFFECTIVENESS ASSUMPTIONS

- Project costs and benefits are included for projects in-service starting in 2017 and included in PY2017 reported impacts.
- Engineering study costs are included for all 2017 studies listed in the LDC Comprehensive Report.
- Engineering Study costs are the sum of "Project Incentive ($)" from the LDC Comprehensive Report where *Program* equals Process & Systems Upgrades, *IESO Reporting Period* equals 2017, and *AppType* equals PS (Preliminary Study) or DS (Detailed Study). *AppTypes* are indexed from the technical reviewer's Application Tracking database.
- Program admin costs (CE Tool Budget Inputs) are aggregated from 2017 Verified LDC CDM Program Costs worksheets as provided by IESO, including CFF costs and CFF CDM Plan Development costs. Aggregate LDC incentives reported in the CFF costs worksheets are not included, as the incentives are included on a per-project basis in the measure inputs.
- Central Services costs are not included.
- Per-unit incentive amounts are the actual incentive amounts paid for each project. Each project is entered as a custom measure in the CE tool, therefore each measure quantity is equal to 1 and the incentive is only included once.
- Custom measure-specific load shapes are utilized for PSUP cost effectiveness analysis.

D.2 EM COST-EFFECTIVENESS ASSUMPTIONS

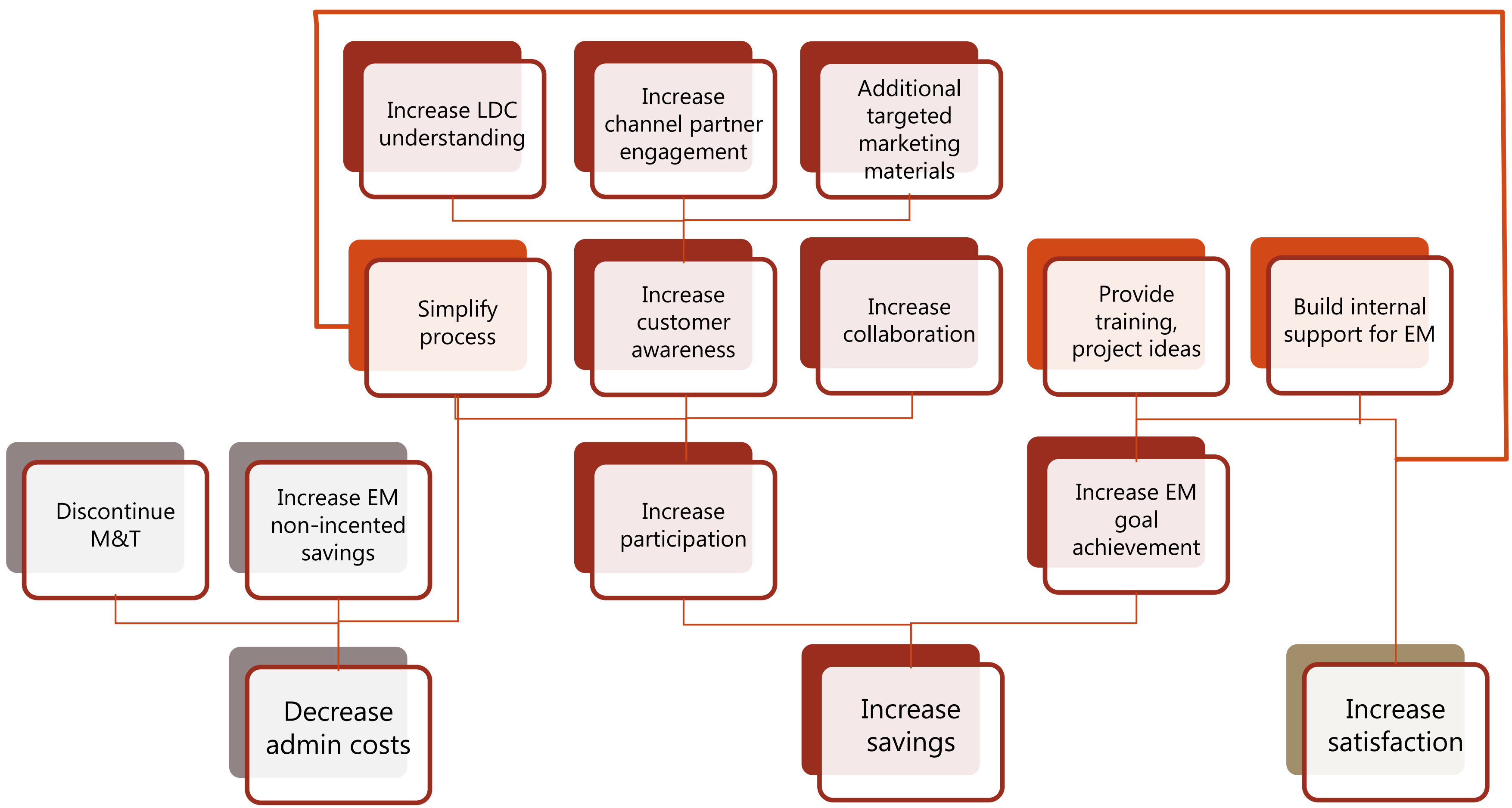
- Project costs and benefits are included only for non-incented Energy Manager measures in-service starting in 2017 and included in PY2017 reported impacts. This includes only those measures invoiced in the LDC Comprehensive Report (281 measures).
- Incentives are not included for Energy Manager measures, as the only measures included in this analysis are non-incented. Incremental lifecycle measure costs (when provided) are included at a measure-specific level, as are administrative costs as provided in the CFF Costs workbooks. The inconsistent reporting of participant cost in the EM tracking data means that incremental measure costs are likely understated, which means the TRC ratio is overstated.
- Central Services costs are not included.
- Custom measure-specific load shapes are utilized for Energy Manager cost effectiveness analysis where possible to improve the accuracy of the avoided cost calculations. Where custom load shapes are unavailable, the most appropriate IESO-provided load shape is utilized based on measure technology and premise type.

D.3 IAP COST-EFFECTIVENESS ASSUMPTIONS

- Project costs and benefits are included for projects in-service starting in 2017 and included in PY2017 reported impacts.
- Engineering Study costs are included for all 2017 studies listed in the LDC Comprehensive Report.
- Engineering Study costs are the sum of "Project Incentive ($)" from the LDC Comprehensive Report where *Program* equals IAP, *IESO Reporting Period* equals 2017, and *AppType* equals PS (Preliminary Study) or DS (Detailed Study). *AppTypes* are indexed from the technical reviewer's Application Tracking database.
- Incentives are not included for IAP Energy Manager measures, as the only measures included in this analysis are non-incented. Incremental lifecycle measure costs (when provided) are included at a measure-specific level, as are administrative costs as provided in the CFF Costs workbooks. The inconsistent reporting of participant cost in the EM tracking data means that incremental measure costs are likely understated, which means the TRC ratio is overstated.
- Custom measure-specific load shapes are utilized for IAP cost effectiveness analysis.

APPENDIX E: BENEFITS OF PROCESS EVALUATION RECOMMENDATIONS

Figure 22: Benefits of Process Evaluation Recommendations



Note that there are often effects beyond the simple pathways shown above; for example, increasing customer satisfaction may in turn mean increased participation form the facility or others to whom they might mention the program offerings and their experience.