



ComEd

Custom Incentives Evaluation Report

FINAL
Energy Efficiency / Demand Response Plan:
Plan Year 8 (PY8)
(6/1/2015-5/31/2016)

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Commonwealth Edison Company

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Prepared by:

Kumar Chittory, Itron, Inc. Ben Cheah, Itron, Inc.



www.navigant.com

Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
Randy.Gunn@Navigant.com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.Com

Robert Neumann Associate Director
312.583.2176
Rob.Neumann@Navigant.com

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E. EXECUTIVE SUMMARY

This report presents a summary of the findings and results from the impact evaluation of the program year eight (PY8)¹ Custom Incentives (Custom) program, which is one of several included in ComEd’s Smart Ideas for Your Business suite of energy efficiency programs for business customers. This program provides a custom incentive, based on an ex ante savings-based formula, for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects. Custom incentives are available based on the project’s energy savings, provided the project meets all program eligibility requirements. The Custom program pays an incentive of \$0.07/kWh saved for eligible projects. Incentives cannot exceed 100 percent of the total project cost or 100 percent of the incremental project cost. The primary objectives of this evaluation are to quantify gross and net impacts. PY8 represents the eighth full year of implementation and evaluation of the Custom program.

The Custom program also provides an early commitment incentive option to commercial and industrial (C&I) customers. The early commitment option provides incentive funding certainty once an application is approved. To qualify for this option, projects must reduce energy consumption by a minimum of 500,000 kWh. For qualifying early commitment projects, the program pays an incentive of \$0.06/kWh saved. Incentives are paid after successful completion of the project has been verified and will not be subject to change based on actual verified energy savings.

E.1. Program Savings

Table E-1 summarizes the electricity savings from the Custom program.

Table E-1. PY8 Total Program Electric Savings

Savings Category	Energy Savings (MWh)	Peak Demand Savings (MW)
Ex Ante Gross Savings	33,949	2.926
Verified Gross Savings	26,725	3.601
Verified Net Savings	18,173	2.449

Source: ComEd tracking data and Evaluation team analysis.

Based on the gross impact sample size of 20 projects in PY8, the evaluation results yielded a gross energy realization rate of 0.79 and a gross peak demand realization rate of 1.23. The relative precision for the gross impact results at a one-tailed 90 percent confidence level is ± 11 percent for the energy realization rate and ± 16 percent for the demand realization rate. To calculate net savings, the evaluation team used a deemed net-to-gross (NTG) ratio of 0.68 for energy and demand savings in accordance with the Illinois Stakeholder Advisory Group (SAG)-approved values. The SAG deemed NTG was based on the PY6 evaluations.

In the course of our research for PY8, the evaluation team completed 13 on-site measurement and verification (M&V) audits and seven desk reviews. Program implementers are continuing to collect site-specific pre- and post-metered data for the majority of projects which contributed significantly to the accuracy of the ex ante savings estimates (energy realization rate ≥ 1.0) for five projects in the on-site sample and four projects in the desk-review sample.

¹ The PY8 program year began June 1, 2015 and ended May 31, 2016.

E.2. Results Summary

The following table summarizes the key metrics from PY8.

Table E-2. PY8 Results Summary

Participation	Units	PY8
Verified Net Savings	MWh	18,173
Verified Net Demand Reduction	MW	2.449
Verified Gross Savings	MWh	26,725
Verified Gross Demand Reduction	MW	3.601
Program Realization rate (kWh)	%	79%
Program Realization rate (kW)	%	123%
Program NTG Ratio †	%	68%
Projects completed ‡	#	75

Source: ComEd tracking data and Evaluation team analysis.

† A deemed value. Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

‡ The values for number of measures and customers touched are set equal to the number of projects completed in PY8.

E.3. Findings and Recommendations

The PY8 gross energy realization rate of 0.79 is lower than the PY7 rate of 0.99. This is the lowest energy realization rate in the past six years of program evaluation. The project-level realization rates ranged from one percent to 216 percent, which demonstrates a very large variation in evaluated savings.

The demand realization rate for PY8 was high, at 1.23. There were five projects in PY8 that had ex post demand savings but the program did not claim them. The evaluation calculated demand savings for all the projects in the sample, including those where demand savings had not been claimed. This resulted in a higher than normal demand realization rate. In addition, the high demand gross realization rate was also influenced by one project attaining an extremely high peak kW realization rate.

For the most part the reasons for savings discrepancies were unforeseen and perhaps beyond the ComEd program staff control (e.g., changes in measure operating patterns, fluctuations in production). The evaluation team found that the program staff conducted thorough reviews of project savings. The evaluation team found several common issues in the evaluated sample of projects in PY8; these are summarized below.²

Gross Impact Findings

Finding 1. The evaluation adjusted several projects (#20790 and #24299) to properly normalize the operation of equipment based on weather, common CFM levels or other factors that represented typical measure operation.

Recommendation 1. In most cases, savings should be calculated using an “apples-to-apples” approach which includes normalizing the operation from metered data to a common load

² Numbered findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.

profile. Consistent with past recommendations, production data can be used as a normalizing variable. The production data should be collected with sufficient granularity and care must be taken to ensure that there is sufficient correlation with metered data.

Finding 2. The evaluation adjusted several projects (#29521, #28534, #30884, and #31536) to fix calculation errors.

Recommendation 2. The evaluation team recommends that quality control procedures be improved to identify any deficiencies in the ex ante calculations. If possible, the ex ante savings should be validated by alternate approaches as a sanity check.

Finding 3. The evaluation adjusted the baseline on Project #30884. The ex ante analysis used baseline pumping efficiency based on the in-situ system that was severely degraded. Due to the age and condition of the pre case equipment, the evaluation changed the baseline to typical new pump efficiency levels.

Recommendation 3. The evaluation team recommends using prevalent code or Industry Standard Practice (ISP) as the baseline to estimate savings for systems at or near the end of their useful life or for systems in need of constant repair..

Finding 4. For project #27445, the evaluation almost zeroed out the savings due to incorrect distribution of savings between the custom and prescriptive components of the measures completed at this site. The ex-ante analysis calculated the custom program savings by subtracting out the deemed savings in the post-installation case, rather than using actual savings from the prescriptive (deemed) component of the project. Since the actual savings for the prescriptive project were greater than the TRM-based deemed values, the savings for the custom component of the project were reduced to account for this discrepancy.

Recommendation 4. Use greater care when allocating savings between custom and prescriptive projects based on metered data. When possible, actual savings for each portion should be calculated and validated using an alternate approach.

1. INTRODUCTION

1.1 Program Description

ComEd's Smart Ideas for Your Business suite of energy efficiency programs for business customers includes a Custom Incentives (Custom) program. This program provides a custom incentive, based on a formula, for less common or more complex energy-saving measures installed in qualified retrofit and equipment replacement projects. Custom incentives are available based on the project's kWh savings, provided the project meets all program eligibility requirements. For eligible projects, the program pays an incentive of \$0.07/kWh saved. This is the eighth year of implementation of the Custom program.

The Custom program also provides an early commitment incentive option to commercial and industrial (C&I) customers. The early commitment option provides incentive funding certainty once an application is approved. To qualify for this option, projects must reduce energy consumption by a minimum of 500,000 kWh. For qualifying early commitment projects, the program pays an incentive of \$0.06/kWh saved. Incentives are paid after successful completion of the project has been verified and will not be subject to change based on actual verified kWh savings. Incentives for the Custom program cannot exceed 100 percent of the total project cost or 100 percent of the incremental project cost.

1.2 Evaluation Objectives

The evaluation team identified the following key research topics for PY8.

1. Estimate the gross impacts from the program.
2. Identify opportunities for improvement to the ex ante impact calculations and estimates.
3. Assess whether or not the program has met its energy goals.
4. Quantify the net impacts from the program.
5. Provide up-front evaluation input for large or complex projects before it is finalized and paid by the program.

As many features of this program remain similar to prior years, and process findings have been changing relatively little from year to year, a process evaluation was not performed in PY8. For PY8, data needed to estimate the net impacts were collected, but are not reported in this report. These data will be analyzed and reported in the subsequent evaluation period in conjunction with the PY9 NTG efforts.

2. EVALUATION APPROACH

For the PY8 impact evaluation, gross program impact results were developed based on detailed M&V analysis for 20 projects. The NTG used to calculate the PY8 verified net impact was deemed by SAG³ and was derived from PY6 evaluation results. The verified gross savings estimates were multiplied by the deemed NTG to calculate the verified net energy and peak demand savings.

2.1 Overview of Data Collection Activities

The core data collection activities included on-site audits, detailed measurement and verification (M&V) analysis in support of gross impact analysis and telephone surveys in support of the future NTG analysis. The evaluation team did not conduct in-depth interviews with the program manager since process evaluation activities were not planned for PY8 and will conduct these interviews in PY9. However, monthly meetings were held between the evaluation and the implementation team to share updates on the program. The evaluation team kept the PM and ComEd staff apprised of all program related findings on an ad hoc basis. This constant communication ensured that the PM and ComEd staff were fully aware of the direction of evaluation results and that there were no surprises during the reporting phase. The full set of data collection activities is shown in the following tables.

Table 2-1. Primary Data Collection Activities

What	Who	Target Completes	Completes Achieved	When	Comments
Onsite M&V Audit	Participants	15	13	July – October 2016	All Stratum 1 Projects and sampled projects from Stratum 2.
Desk Reviews†	Participants	5	7	August – October 2016	Sampled projects from Stratum 2 and Stratum 3
Telephone Survey‡	Participants	20	16	September – October 2016	Data collection supporting NTG research and analysis.

† Reviews include engineer conducted telephone interviews.

‡The telephone survey results are not used for the PY8 evaluation, but will be used to calculate a combined PY8 and PY9 NTG. These telephone surveys are currently in progress and the evaluation team is in the process of completing the telephone surveys with the participants in the gross sample.

The evaluation team reviewed project documentation for all the sampled projects and identified the projects where sufficient documentation was provided to complete a detailed engineering desk review. Based on the review, the evaluation team determined that on-site surveys should be conducted for 13 projects instead of the evaluation plan estimate of 15 projects.

2.2 Verified Savings Parameters

The following table presents the parameters that were used in the verified gross and net savings calculations and indicates those examined through evaluation activities and those that were deemed.

³ Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

Table 2-2. Verified Savings Parameter Data Sources

Gross Savings Input Parameters	Data Source	Deemed † or Evaluated?
Gross Energy Savings Realization Rate	PY8 Analysis	Evaluated
Gross Peak Demand Savings Realization Rate	PY8 Analysis	Evaluated
NTG Ratio	SAG†	Deemed
Net Energy Savings	PY8 Analysis	Evaluated
Net Peak Demand Savings	PY8 Analysis	Evaluated

† Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

2.2.1 Verified Gross Program Savings Analysis Approach

The evaluation team’s objective for the verified gross program savings analysis was to verify the accuracy of the PY8 ex ante gross savings estimates claimed in the Custom program tracking system. This was completed through on-site M&V analysis for 13 sites plus seven engineering desk reviews. The engineering methodologies used to calculate evaluation-based savings for the 20 completed PY8 sampled projects are described below.

On-site data collection included verification of measure installation, functioning system and planned system operation, and specific details of any variation between the ex ante and ex post verifications. On-site audits also entailed collection of customer-stored data to support downstream M&V calculations. Measurement data obtained from the sites, including spot measurements, run-time hour data logging, and post-installation interval metering, were used to calibrate the site-specific analyses. Customer-supplied data from the facility’s energy management systems (EMS) or supervisory control and data acquisition (SCADA) systems were also obtained when available.

For the seven desk review projects, the evaluation team conducted an engineering review of the algorithms and an audit of ex ante calculation models used by the program to estimate energy and peak demand savings. The engineering audit of program calculations determined if the inputs into the program calculations were reasonable and acceptable or if they needed any revisions based on evaluation findings. In addition to the desk reviews, the evaluation team completed telephone interviews with the site contacts for each project and used the information collected during these interviews in the savings verification.

The evaluation team performed engineering calculations to derive evaluated gross energy and demand savings based on data collected during the on-site audit or the desk review process. The team included a preliminary judgment to identify those assumptions with higher uncertainty or potential to influence the program savings estimates in the engineering reviews. Evaluation team used data obtained during the M&V efforts to verify measure installation, determine installed measure characteristics, assess operating hours and relevant modes of operation, identify the characteristics of the replaced equipment, support the selection of baseline conditions and perform ex post savings calculations. Evaluation used peak kW savings calculation methodology that was consistent with PJM peak summer demand requirements⁴ for each project to calculate the peak kW reduction.

The final step involved discussion of project-level results with the implementation teams and ComEd’s program staff to ensure that both the evaluation team and the implementation teams agree on their understanding of the project scope and details.

⁴ PJM defines the coincident summer peak period as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, during the months of June through August.

The evaluation team then estimated verified gross savings for each sampled project and, using sample weights, extrapolated the sample-level results to the population to calculate verified gross savings for the entire population of projects. Additional details on the sampling approaches are described in Section 2.3.

2.2.2 Verified Net Program Savings Analysis Approach

The primary objective of the net savings analysis is to determine the program's net effect on customers' electricity usage. After the evaluation assessed gross program impacts, the net program impacts were derived by estimating a NTG that quantifies the percentage of the gross program impacts. The SAG determined NTG values be deemed prospectively and used to calculate verified net savings for the Custom program. The table below shows the deemed NTG values.

Table 2-3. Verified Net Savings Parameters

Input Parameters	Value	Deemed or Evaluated?
Energy Savings NTG	0.68	Deemed (derived from PY6 evaluation results) †
Peak Demand Savings NTG	0.68	Deemed (derived from PY6 evaluation results) †

† A deemed value. Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

Verified net energy and coincident peak demand savings were calculated by multiplying the verified gross savings estimates by the deemed NTG. In PY8, the NTG values used to calculate the verified net savings were based on NTG research conducted in PY6. The NTG evaluation result from PY6 for energy and demand is 0.68. The SAG approved and documented this NTG method.⁵

As part of the PY8 evaluation, NTG analysis was not performed. The evaluation team conducted NTG interviews with the Custom project participants in the PY8 gross sample, but the data was not analyzed and reported for PY8. A combined NTG analysis for PY8 and PY9 will be performed during the PY9 evaluation.

2.3 Sampling

2.3.1 Profile of Population

The table below presents the three sampling strata used in the evaluation of the Custom program. This was based on a total of 75 tracking records. Table 2-4 presents the number of records by stratum, along with the claimed ex ante gross MWh, claimed MW, and the amount of incentive paid.

⁵ Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, found on the IL SAG website at <http://ilsag.info/net-to-gross-framework.html>.

Table 2-4. PY8 Custom Program Participation by Sampling Strata

Sampling Stratum	Ex ante MWh Impact Claimed	Ex ante kW Impact Claimed	Tracking Records	Incentive Paid to Applicant (\$)
1	9,412	789	4	492,753
2	12,928	1,067	14	817,163
3	11,609	1,070	57	673,005
PY8 Total	33,949	2,926	75	1,982,921

Source: Evaluation Team analysis

2.3.2 Gross Impact (M&V) Sample

Consistent with the evaluation plan, a stratified random sampling approach was used to select the gross impact sample of 20 projects. The gross impact (M&V) sampling was conducted in two waves. For Wave 1, ComEd’s tracking database extract dated April 11, 2016 was used to select 14 M&V sample points. Using the April 11, 2016 tracking extract, Custom records were sorted and placed in three strata using ex ante savings kWh to create roughly equal contributions to total program savings.

When the August 19, 2016 extract became available for Wave 2 sampling, the strata boundaries defined on April 11, 2016 were preserved. This ensured that the Wave 1 sample remained representative of the projects installed before April 11, 2016, and that it could be easily combined with the additional Wave 2 sample to estimate PY8 results. Six additional M&V sample points were selected from the incremental projects installed between April 11, 2016 and August 19, 2016, so that the sample reflects the final population distribution of savings within each stratum. Overall, a total of 20 M&V sample points were selected, consistent with the PY8 evaluation plan. The random sample of 20 projects was drawn to achieve a one tailed 90/10 confidence/precision level.

Table 2-5 provides a profile of the gross impact M&V sample for the Custom program in comparison with the program population. This table shows the resulting sample that was drawn which consists of 20 projects. These projects make up 17,863 MWh of the ex ante impact claim and represent 53 percent of the ex ante impact claim for the program population. Also shown are the ex ante based MWh sample weights for each of the three strata. Note that a census of the four strata 1 projects was picked and these projects accounted for about 53 percent of the total sample MWh.

Table 2-5. PY8 Gross Impact Sample by Strata

Sampling Strata	Population Summary			Completed Interviews		
	Number of Tracking Records (N)	Ex ante MWh Impact Claimed	MWh Weights	Number of Tracking Records (n)	Ex ante MWh	Sampled % of Population MWh
1	4	9,412	0.28	4	9,412	100%
2	14	12,928	0.38	8	7,054	55%
3	57	11,609	0.34	8	1,396	12%
TOTAL	75	33,949	-	20	17,863	53%

Source: Evaluation Team analysis

2.3.3 Telephone Survey Sample

Per the evaluation plan, the target for the participant surveys was to capture NTG results for all 20 participants in the gross sample for the Custom program in PY8. Data from these surveys were in support of the future net-to-gross component of the evaluation.

2.4 Process Evaluation

The evaluation team did not conduct a process evaluation in PY8 mainly because many features of the Custom program remained consistent with prior years, and program administrative procedures have changed relatively little from year-to-year. The evaluation team conducted detailed process evaluations for PY4 and PY5 and findings have been stable from year-to-year. In PY8, the evaluation team placed priority on the net and gross impact evaluation efforts to optimize the use of evaluation budgets.

3. GROSS IMPACT EVALUATION

The evaluation team reviewed ComEd’s tracking data extract to determine reported PY8 ex ante gross savings. The verified gross program impacts for the evaluation for the Custom program were developed based on on-site M&V analysis for 13 projects and engineering desk reviews for seven projects.

3.1 Tracking System Review

ComEd provided the evaluation team with direct access to their on-line tracking system and data for evaluation purposes. The on-line system was easy to work with and provided viewing access to the project tracking data plus downloading rights to project documentation in electronic format for each sampled project. This documentation was complete and greatly facilitated the evaluation efforts.

3.2 Gross Program Impact Parameter Estimates

The evaluation team developed gross program impacts based on on-site audits and detailed M&V analysis for 13 projects and thorough engineering desk reviews supported with telephone interviews for seven projects. The verified gross impact results for PY8 are shown in Table 3-1 below.

Table 3-1. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed or Evaluated?
Energy Savings Realization Rate	0.79	Evaluated
Peak Summer Demand Savings Realization Rate	1.23	Evaluated

Source: Evaluation Team analysis

3.3 Verified Gross Program Impact Results

Based on the gross impact sample size of 20 projects in PY8, the evaluation results yielded a gross energy realization rate of 0.79 and a gross demand realization rate of 1.23. The resulting total program verified gross savings is 26,725 MWh and 3.60 MW as shown in Table 3-2. The table presents the ex post savings for each stratum but they are not statistically significant at the 90/10 level.

Table 3-2. PY8 Verified Gross Impact Savings Estimates by Measure Type

	Sample Size	Gross Energy Savings (MWh)	Gross Peak Demand Savings (MW)	Summer PJM Peak Demand (MW)
Strata 1				
Ex-Ante Gross Savings		9,412	0.79	0.79
Verified Gross Realization Rate	4	62%	100%	100%
Verified Gross Savings		5,838	0.79	0.79
Strata 2				
Ex-Ante Gross Savings		12,928	1.07	1.07
Verified Gross Realization Rate	8	75%	135%	135%
Verified Gross Savings		9,719	1.44	1.44
Strata 3				
Ex-Ante Gross Savings		11,609	1.07	1.07
Verified Gross Realization Rate	8	96%	128%	128%
Verified Gross Savings		11,168	1.37	1.37
Total				
Ex-Ante Gross Savings		33,949	2.93	2.93
Verified Gross Realization Rate	20	79%	123%	123%
Verified Gross Savings		26,725	3.60	3.60

Source: Evaluation Team analysis.

The PY8 energy realization rate of 0.79 reflects a drop in the upward trend that the program achieved in the past few program years. A significant contributor to this was the low realization rate for the higher saving projects (those in Strata 1 and 2). For example, if we are to analyze the top five savers in the sample, the overall unweighted realization rate for those projects is 0.59. Three of those five project have an energy realization rate of less than 0.40.

For Custom project 27936, an independent evaluation was performed since there were some discrepancies in methodology between the evaluation and the implementation team. The independent evaluation presented the overall findings and the recommended savings for this project in a memo⁶. The recommended savings from the memo are included in the evaluation report.

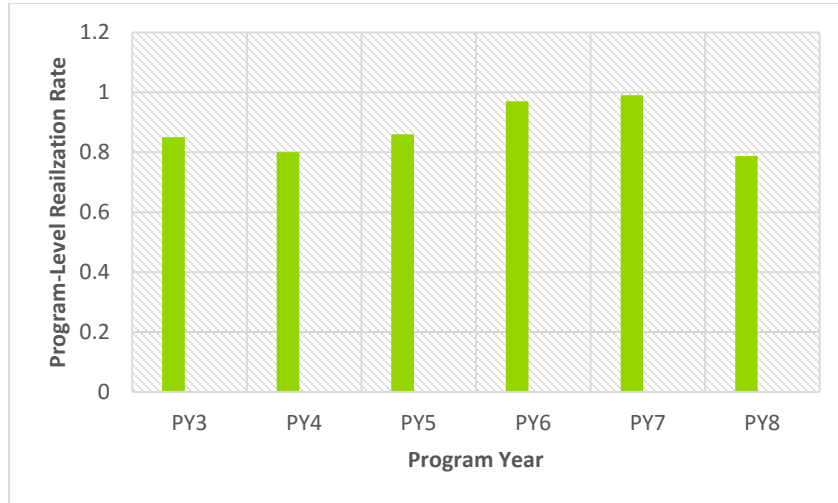
It must be noted that one project (project #27445), which represents approximately 4 percent of the sample savings, had an energy realization rate of 0.01. The majority of the additional savings claimed through trended data for this lighting project were claimed under the prescriptive program, which resulted in low ex-post savings. Reasons such as these and others observed in the higher savings projects contributed to the overall low energy realization rate.

When gross ex post impacts for a sampled project were found to be different than the ex ante impacts, the evaluation documented the associated savings gap. For some projects, there was only one factor (e.g., the measure was not operating as documented in the ex ante documentation), while others had multiple factors (e.g. ex ante analysis overestimated the hours of operation, *and* the ex ante analysis incorrectly calculated savings based on a degraded in-situ system performance). A detailed project-level listing of reasons for savings gap is provided below.

⁶ Memo was developed by Roger Hill, InCA, and submitted to ComEd on March 9, 2017. The memo is included in this report as Appendix 6.2.

Figure 3-1 below compares the overall program-level energy realization rates achieved over the last six program years.

Figure 3-1. PY8 Custom Program Energy Realization Rates across Program Years



Source: Evaluation Team analysis.

As evident in the figure above, the program level energy realization rates were moving toward one in recent years, indicating a strong correlation between the ex ante and ex post savings values. This was due, in part, to close coordination between the implementation and evaluation teams. Both teams discussed any issues and outliers ahead of time so any gaps in savings are sufficiently addressed. In addition, the evaluation team provided early feedback on projects in the ComEd pipeline to ensure the projects comply with evaluation standards such as baseline selection and other evaluation related assessments. This helped reduce the savings gap significantly, especially during PY6 and PY7, resulting in an energy realization rate of greater than 0.97. Despite the continued coordination in PY8, the energy realization rate saw a substantial drop. As mentioned above, this reduction in energy realization rate was primarily due to the higher saving projects (those in Strata 1 and 2) achieving lower ex post savings. In PY9, the evaluation team will be working with the implementation team closely and providing early feedback for large projects to bring the realization rate closer to one.

An examination of the site-level savings reveals considerable variation in the realization rate across projects. Table 3-3 below shows the site-specific ex ante and ex post savings along with stratum level realization rates.

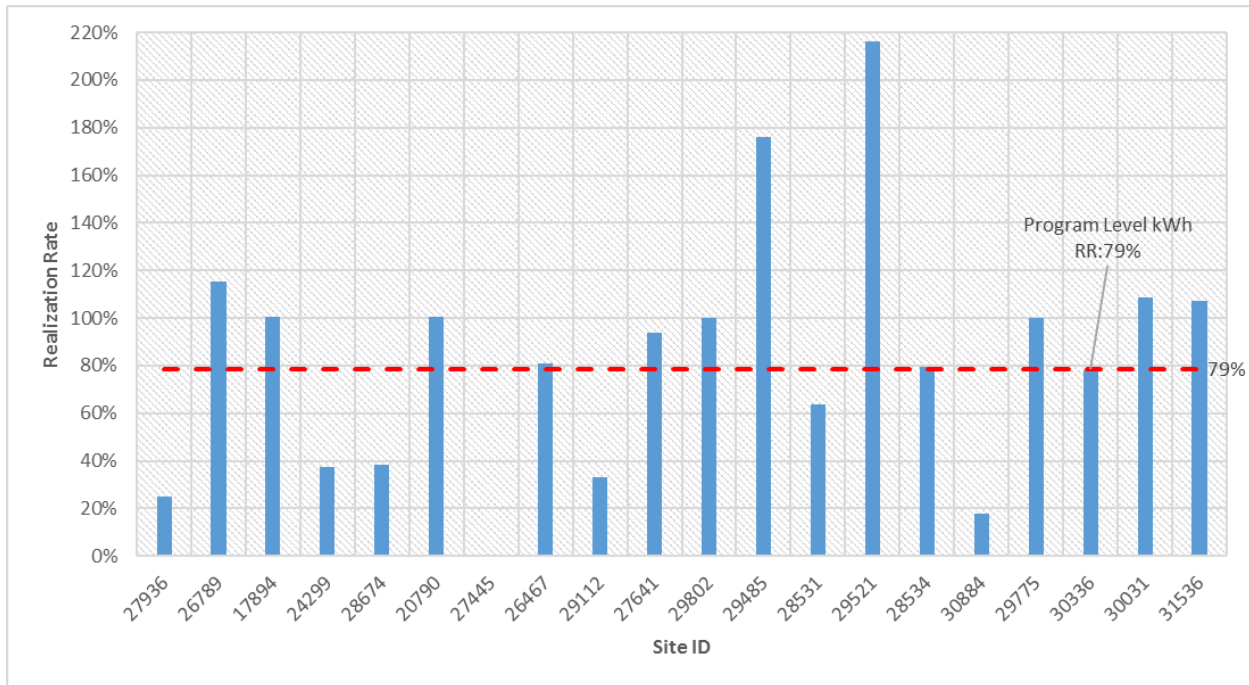
Table 3-3. Gross Impact Realization Rate Results for the Selected Custom Sample

Sampled Application ID	Sample-Based Ex Ante MWh Impact Claimed	Sample-Based Ex Ante kW Impact Claimed	Sampling Strata	Ex Ante-Based MWh Gross Impact Weights by Strata	Sample-Based Evaluation Research Findings Gross MWh Impact	Sample-Based Evaluation Research Findings Gross kW Impact	Application - Specific Evaluation Research Findings Gross MWh Realization Rate	Application - Specific Evaluation Research Findings Gross kW Realization Rate	Sample-Based Evaluation Research Findings Gross MWh Realization Rate	Sample-Based Evaluation Research Findings Gross kW Realization Rate
27936	3,757	447	1	0.40	946	108.00	0.25	0.24		
26789	2,166	342	1	0.23	2,498	330.61	1.15	0.97	0.62	1.00
17894	1,726	0	1	0.18	1,735	126.20	1.01	-		
24299	1,763	0	1	0.19	659	226.69	0.37	-		
28674	1,500	333	2	0.21	577	212.53	0.39	0.64	0.75	1.35
20790	810	0	2	0.11	813	77.80	1.00	-		
27445	737	0	2	0.10	5	0.74	0.01	-		
26467	698	121	2	0.10	564	115.30	0.81	0.95		
29112	668	114	2	0.09	222	40.50	0.33	0.36		
27641	614	47	2	0.09	577	141.26	0.94	3.01		
29802	1,351	0	2	0.19	1,351	327.70	1.00	-	0.96	1.28
29485	677	236	2	0.10	1,193	236.00	1.76	1.00		
28531	373	65	3	0.27	238	80.70	0.64	1.24		
29521	128	2	3	0.09	276	39.15	2.16	20.61		
28534	111	9	3	0.08	88	10.04	0.79	1.15		
30884	104	21	3	0.07	18	3.66	0.18	0.18		
29775	55	29	3	0.04	55	29.00	1.00	1.00		
30336	34	8	3	0.02	26	5.06	0.78	0.65		
30031	451	61	3	0.32	490	87.50	1.09	1.43		
31536	141	52	3	0.10	151	58.80	1.07	1.13		
TOTAL	17,863	1,886	-	NA	12,485	2,257	NA	NA	0.79	1.23

Source: Evaluation Team analysis

The gross energy realization rates for all evaluated projects are shown below in Figure 3-2. The PY8 site-level energy realization rates ranged from 0.01 to 2.16, which indicates significant variation in realization rates across projects. For 10 of the 20 projects, the gross energy realization rate was greater than the program energy realization rate (0.79). Four projects received a realization rate near one. Two projects had an extremely high realization rate (#29485 and #29521) of over 1.75, while six other projects had realization rates of less than 0.40 (#27936, #24299, #28674, #27445, #29112, and #30884).

Figure 3-2. PY8 Custom Program Project Energy Realization Rates (shown by Project ID)



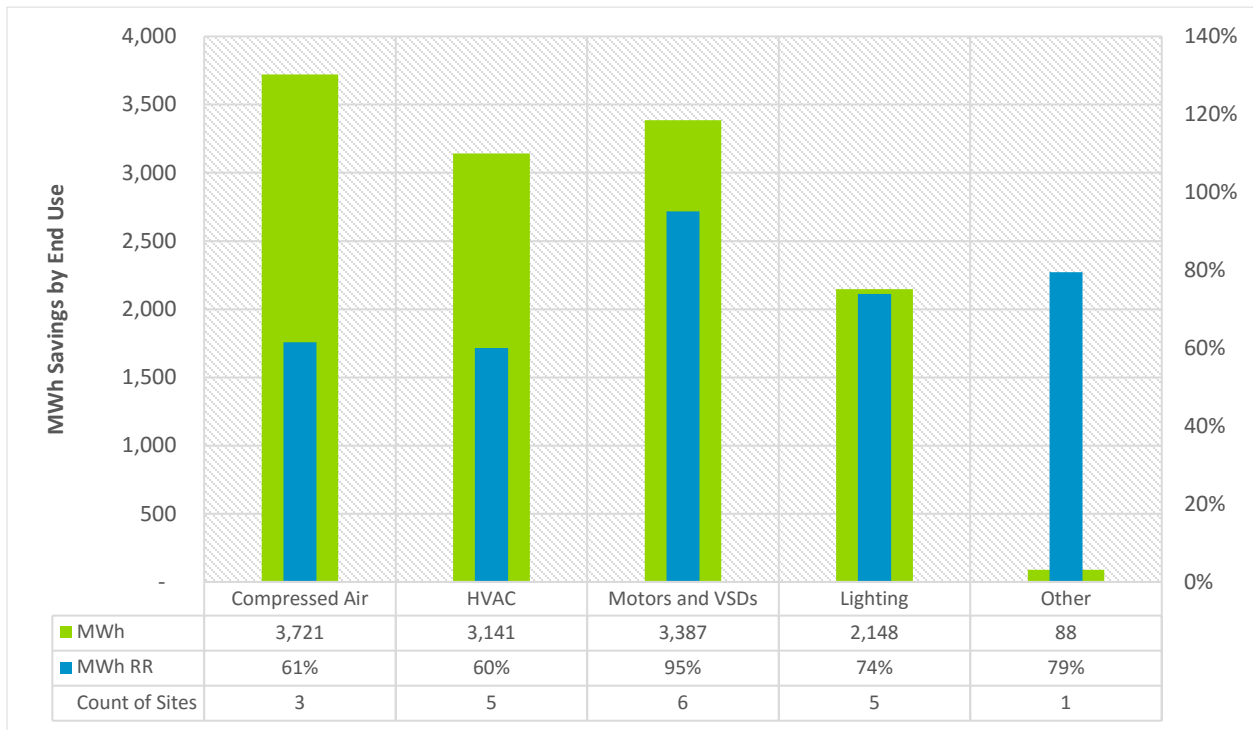
Source: Evaluation Team analysis.

The evaluation team also looked at the distribution of program savings by end-use and determined that the following five end-uses (shown below with number of projects and percentage contribution to ex ante savings) encompassed the sampled set of 20 projects in PY8.

- Compressed Air (3, 34%)
- HVAC (5, 29%)
- Motors and VSDs (6, 20%)
- Lighting (5, 16%)
- Other (1, 1%)

As noted above, Compressed Air and HVAC projects represented about 40 percent of the sample count and accounted for 63 percent of the sample energy savings. There were six Motors and VSDs projects, which represented about 30 percent of the sample count and 20 percent of the sample energy savings. Five Lighting projects accounted for 16 percent of the sample energy savings and represented a quarter of the sample count. There was one project in the 'Other' category, which entailed a refrigeration measure. These breakouts by end-use can be seen below in Figure 3-3. The chart also shows the realization rate (unweighted) by each end-use. Three end-uses (Motors and VSDs, Lighting, and Other) achieved a realization rate (unweighted) of 0.74 or greater while the Compressed Air and HVAC end-uses had close to a 0.60 realization rate.

Figure 3-3. PY8 Custom Program Energy Savings and Unweighted Realization Rate by End-Use



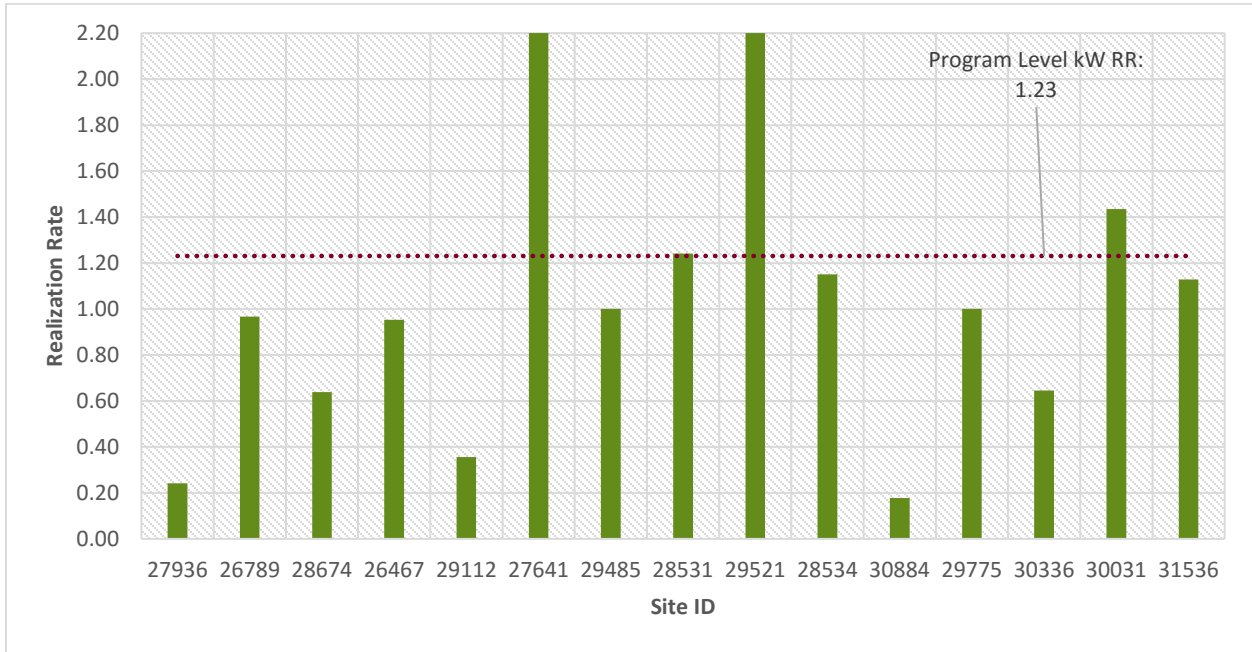
Source: Evaluation Team analysis.

In PY8, the evaluation team evaluated and reported demand savings for all sites where demand savings could be verified. The evaluation team determined that all 20 sampled sites had demand savings during the PJM peak summer period. However, as noted above, only 15 projects had claimed ex ante demand savings.

The PJM peak summer demand savings realization rates for the 15 projects with claimed ex-ante demand savings are shown below in

Figure 3-4. The PY8 site-level demand realization rate results ranged from 0.18 to 20.61 which indicates a very large variation in realization rates across projects. Site-level realization rates were reported for 15 sites, and of those, seven projects had realization rates below 1.0 (RR between 0.18 to 0.97), while the remaining eight had realization rates equal to or above 1.0 (RR between 1.00 and 20.61).

Figure 3-4. PY8 Custom Program PJM Peak Demand Realization Rates (by Project ID)



Source: Evaluation Team analysis.

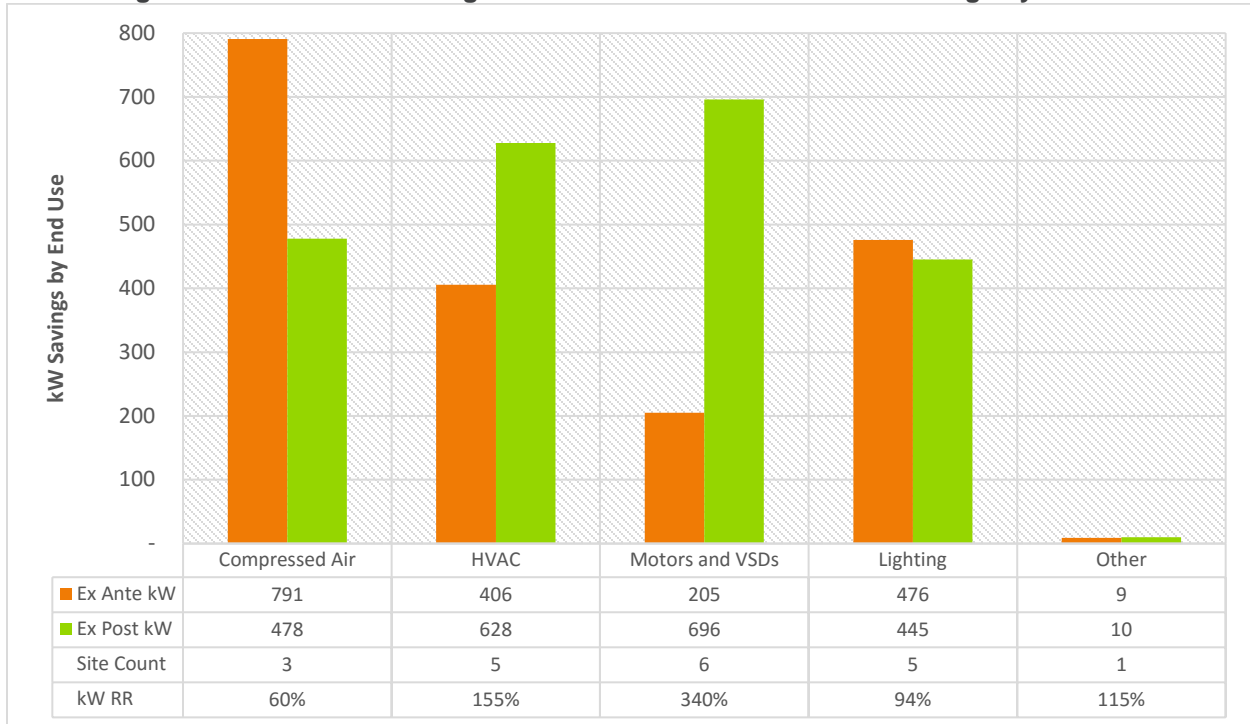
* Projects 27641 and 29521 have very high kWh realization rates which exceed the scale of the graph.

** Projects which did not claim demand savings are not shown here. These projects are 17894, 24299, 20790, 27445, and 29802.

Gross realization rate for ex post PJM peak summer demand savings in PY8 was 1.23. The implementation team estimated the demand savings during the PJM peak summer period for 15 of 20 projects in the gross sample. Demand savings were not claimed for the remaining five projects. The evaluation team calculated and reported demand savings for all the 20 sites in the gross sample.

Figure 3-5 provides a graphic representation of ex ante and ex post demand savings for the sites in the gross sample by end-use. All end-uses except Compressed Air had a realization rate (unweighted) greater than 0.90. Motors and VSDs achieved a high gross demand realization rate of 3.4.

Figure 3-5. PY8 Custom Program PJM Peak Summer Demand Savings by End-Use



Source: Evaluation Team analysis.

The relative precision (RP) for the gross impact results at a one-tailed 90 percent confidence level is ± 11 percent for the energy realization rate and ± 16 percent for the kW realization rate, as seen below in Table 3-4 and

Table 3-5. The achieved relative precision rates at a one-tailed 90 percent confidence level for both energy and demand are higher than the evaluation targeted energy realization rate of ± 10 percent. This is due to the large fluctuation in realization rates seen in the PY8 sample. For energy savings by stratum, both strata 2 and 3 had an RP around 20 percent, based on energy realization rates ranging from 0.01 to 2.16. The high relative precision for the demand savings is attributable in part to the extremely high demand realization rate achieved for project #29521, but also to the three strata 2 sites where no ex ante demand savings were claimed.

Table 3-4. Gross MWh Realization Rates and Relative Precision at 90% Confidence Level

Stratum	Relative Precision \pm %	Low	Mean	High
Stratum 1	0%	0.62	0.62	0.62
Stratum 2	19%	0.61	0.75	0.9
Stratum 3	21%	0.76	0.96	1.16
PY8 kWh RR	11%	0.70	0.79	0.88

Source: Evaluation Team analysis.

Table 3-5. Gross kW Realization Rates and Relative Precision at 90% Confidence Level

Stratum	Relative Precision ± %	Low	Mean	High
Stratum 1	0%	1.00	1.00	1.00
Stratum 2	35%	0.88	1.35	1.82
Stratum 3	19%	1.04	1.28	1.51
PY8 kW RR	16%	1.04	1.23	1.42

Source: Evaluation Team analysis

The evaluation team has provided ComEd with site-specific M&V reports for each verified project. These site-specific impact evaluation reports summarize the ex ante savings in the final application, as well as the ex post M&V plan, data collected at the site and all the calculations and parameters used to estimate savings.

Some general observations from the gross impact sample where the savings were adjusted downwards are listed by project ID below:

- 27936—This project went through an independent third-party review. The primary factor for the reduced savings was the finding that the baseline controls for some machines had fully-automated shut down sequences, and others were adequately monitored by the operators to reduce excessive operation in no-load conditions. Therefore, there was not a lot of improvement with the new sequencer controls. Additional discussion of this project can be found in Appendix 6.2.
- 28674— The evaluation reduced savings for this project due to the installed equipment not operating as expected in the ex ante model. Specifically, it appears that the flow reductions predicted are not being achieved and more pumps and chillers are operating than expected.
- 27445— The evaluation nearly eliminated savings for this project. The ex ante analysis used metered data to estimate the savings for the custom project and prescriptive project together. The implementation team estimated the ex-ante savings for the Custom project by subtracting the deemed prescriptive-project savings from the total savings for this project. The ex post prescriptive savings were much higher than the deemed savings and it resulted in minimal savings from the Custom project. This validates the low savings for the Custom project.
- 26467— The evaluation reduced savings for this project due to two adjustments. First, the ex ante analysis assumed a brake horsepower for the baseline fan systems that was greater than described by the customer and vendor. Adjusting the brake horsepower for the baseline resulted in reduction of savings. In addition, the ex ante analysis incorrectly de-rated the performance curve for the baseline fan system resulting in an artificially poor performance curve.
- 24299— The evaluation reduced savings for this project due to normalizing the operation of the system to a constant ton-hour output. This removed the differences in operation in the pre and post metered data sets due to changes in building load due to removal of lab spaces and changes in water-side economizer operation.
- 29112— The evaluation reduced savings for this project due to two factors. First, the ex ante analysis calculated the baseline wattage for this agricultural building using the allowable lighting power density for a warehouse from 90.1. Since the space is controlled to a specific lumen level, the evaluation reduced this wattage based on the total wattage that would have required to output a similar lumen level. In addition, the customer dimmed the lights for a majority of the time which reduced the energy usage of the baseline and proposed systems. This adjustment reduced the savings further.

- 27641— The evaluation slightly reduced savings for this project due to two factors. First, the evaluation adjusted the power factor relationship for the post case to account for variations in load, with the power factor at full load matching the pre case. This was partially offset by an increase in savings due to adjustments to the operating hours and duty cycle.
- 28531— The evaluation reduced savings for this project primarily due to the customer reporting lower hours of operation than used in the ex ante analysis.
- 28534— The evaluation reduced savings for this project due to errors in the ex ante analysis. The daily energy usage and TDA values for the cases were incorrectly calculated. Adjusting those values reduced the baseline energy usage and the savings.
- 30884— The evaluation reduced savings for this project due to two adjustment factors. First, the ex ante analysis calculated savings based on a severely degraded existing system performance. Due to the age and condition of the existing system, the evaluation estimated the savings using the guidance from ComEd work papers. In addition, the ex ante analysis overestimated the hours of operation for the pumps in the system.
- 30336— The evaluation team used the actual operating profiles based on metered data instead of the assumed operating profiles used in the ex ante analysis. Adjustments to the duty cycle and operating hours reduced the savings for this project.

Some general observations from the gross impact sample where the savings were adjusted upwards are listed by project ID below:

- 26789— The evaluation slightly increased savings for this project and the specific reasons for adjustment are not apparent due to differences in approach. It is likely that the increased savings are due to reduced flow rates in the evaluation due to lower production levels.
- 20790— The evaluation slightly increased savings for this project due to the evaluation normalizing the pre and post data to typical meteorological year data. In the ex ante analysis, the savings were based on a simple average.
- 17894— The evaluation slightly increased savings due to the addition of data collected during the evaluation.
- 29485— The evaluation increased savings for this project due to the lighting operating significantly more hours than anticipated in the ex ante analysis.
- 30031— The evaluation increased savings due to increase in the lighting hours of operation to account for security lighting that operated continuously.
- 31536— The evaluation increased savings for this project due to calculation errors in the ex ante analysis which underestimated the energy usage of the pumps and chillers, and the associated savings.
- 29521— The evaluation increased savings for this project due to two primary reasons. First cell reference errors in the original analysis underestimated the savings by 73 percent. In addition, the evaluation updated the duty cycle for the compressor based on collected data, which increased the savings by an additional 43 percent.

4. NET IMPACT EVALUATION

The Illinois Stakeholder Advisory Group (SAG)⁷ determined that the NTG values for the Industrial System Optimization Program should be deemed prospectively and used to calculate verified net savings. The table below shows the deemed NTG values and the PY8 verified net savings.

Table 4-1. PY8 Verified Net Impact Savings Estimates by Measure Type

Gross Savings Input Parameters	Value	Deemed † or Evaluated?
Energy Savings NTG Ratio	0.68	Deemed
Demand NTG Ratio	0.68	Deemed

† A deemed value. Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

Unlike in previous program cycles, the evaluation team did not perform NTG research to calculate NTG based on the PY8 evaluation findings alone. Instead, the evaluation team and ComEd decided that a joint PY8/PY9 NTG evaluation would be performed. Therefore, the evaluation team performed telephone surveys of the eight gross sample points in PY8 and that analysis will be performed and combined with the PY9 findings.

⁷ Source: ComEd_NTG_History_and_PY8_Recommendations_2015-02-24_v2_clean.xls, which is to be found on the IL SAG website here: <http://ilsagfiles.org/>

5. FINDINGS AND RECOMMENDATIONS

The PY8 gross energy realization rate of 0.79 is lower than the PY7 rate of 0.99. This is the lowest energy realization rate in the six years of program evaluations. The project-level realization rates ranged from one percent to 216 percent, which demonstrates a very large variation in evaluated savings.

The demand realization rate for PY8 was high, at 1.23. There were five projects in PY8 that had ex post demand savings, but the program did not claim them. The evaluation calculated demand savings for all the projects in the sample including those where demand savings had not been claimed. This resulted in a higher than normal demand realization rate. In addition, the high demand gross realization rate was influenced by one project attaining an extremely high peak kW realization rate.

The reasons for savings discrepancies were unforeseen and perhaps beyond the control of ComEd program staff (e.g., changes in measure operating patterns, fluctuations in production). The evaluation team did find that program staff conducted thorough reviews of project savings. The evaluation team found several common issues in the evaluated sample of projects in PY8; these are summarized previously.⁸

Gross Impact Findings

Finding 1. The evaluation adjusted several projects (#20790 and #24299) to properly normalize the operation of equipment based on weather, common CFM levels or other factors that represented typical measure operation.

Recommendation 1. In most cases, savings should be calculated using an “apples-to-apples” approach which includes normalizing the operation from metered data to a common load profile. Consistent with past recommendations, production data can be used as a normalizing variable. The production data should be collected with sufficient granularity and care must be taken to ensure that there is sufficient correlation with metered data.

Finding 2. The evaluation team adjusted several projects (#29521, #28534, #30884, and #31536) to fix calculation errors.

Recommendation 2. The evaluation team recommends that quality control procedures be improved to identify any deficiencies in the ex ante calculations. If possible, the ex ante savings should be validated by alternate approaches as a sanity check.

Finding 3. The evaluation team adjusted the baseline on Project #30884. The ex ante analysis used baseline pumping efficiency based on the in-situ system that was severely degraded. Due to the age and condition of the pre case equipment, the evaluation changed the baseline to typical new pump efficiency levels.

Recommendation 3. The evaluation team recommends using prevalent code or Industry Standard Practice (ISP) as the baseline to estimate savings for systems at or near the end of their useful life or for systems in need of constant repair.

Finding 4. For project #27445, evaluation zeroed most of the savings due to incorrect savings distribution between the custom and prescriptive components of the measures completed at this site. The ex-ante analysis calculated the custom program savings by subtracting out the deemed savings in the post-installation case, rather than using actual savings from the prescriptive (deemed) component of the project. Since the actual savings for the prescriptive project were greater than the TRM-based deemed values, the savings for the custom component of the project were reduced to account for this discrepancy.

⁸ Numbered findings and recommendations in this section are the same as those found in the Executive Summary: Findings and Recommendations section of the evaluation report for ease of reference between each section.

Recommendation 4. Use greater care when allocating savings between custom and prescriptive projects based on metered data. When possible, actual savings for each portion should be calculated and validated using an alternate approach.

6. APPENDIX

6.1 Survey Instruments

6.1.1 Customer Survey

**COMED SMART IDEAS FOR YOUR BUSINESS PROGRAM
PARTICIPANT SURVEY – CUSTOM PROJECTS
PY8**

INTRODUCTION

[READ IF CONTACT=1]

Hello, this is _____ from Opinion Dynamics calling on behalf of ComEd. This is not a sales call. May I please speak with <PROGRAM CONTACT>?

Our records show that <COMPANY> purchased <ENDUSE>, which was recently installed and received an incentive from ComEd. We are calling to do a follow-up study about <COMPANY>'s participation in this program, which is called the Smart Ideas for Your Business Program. Your answers will provide very important information that will help ComEd improve its program. I was told you're the person most knowledgeable about this project. Is this correct? [IF NOT, ASK TO BE TRANSFERRED TO MOST KNOWLEDGABLE PERSON OR RECORD NAME & NUMBER.]

This survey will take about 20-25 minutes. Is now a good time? [If no, schedule call-back]

[READ IF CONTACT=0]

Hello, this is _____ from Opinion Dynamics calling on behalf of ComEd. I would like to speak with the person most knowledgeable about recent changes in cooling, lighting, or other energy-related equipment for your firm at this location.

[IF NEEDED] Our records show that <COMPANY> purchased <ENDUSE>, which was recently installed and received an incentive from ComEd. We are calling to do a follow-up study about your firm's participation in this program, which is called the Smart Ideas for Your Business Program. Your answers will provide very important information that will help ComEd improve its program. I was told you're the person most knowledgeable about this project. Is that correct? [IF NOT, ASK TO BE TRANSFERRED TO MOST KNOWLEDGABLE PERSON OR RECORD NAME & NUMBER.]

This survey will take about 20-25 minutes. Is now a good time? [If no, schedule call-back]

SCREENING QUESTIONS

- A1. Just to confirm, between June 1, 2014 and May 31, 2015 did <COMPANY> participate in ComEd's Smart Ideas for Your Business Program at <ADDRESS>? (IF NEEDED: This is a program where your business received an incentive for installing one or more energy-efficient products covered under the program.)
- 1 (Yes, participated as described)
 - 2 (Yes, participated but at another location)
 - 3 (NO, did NOT participate in program)
 - 00 (Other, specify)
 - 98 (Don't know)
 - 99 (Refused)

[SKIP A2 IF A1=1,2]

- A2. Is it possible that someone else dealt with the energy-efficient product installation?
- 1 (Yes, someone else dealt with it)
 - 2 (No)
 - 00 (Other, specify)
 - 98 (Don't know)
 - 99 (Refused)

[IF A2=1, ask to be transferred to that person. If not available, thank and terminate. If available, go back to A1]

[IF A1=2, 3, 00, 98, 99: Thank and terminate. Record disposition as “Could not confirm participation”.]

Before we begin, I want to emphasize that this survey will only be about the <ENDUSE> you installed through the Smart Ideas for Your Business Program at <ADDRESS>. [IF NECESSARY, READ PROJECT DESCRIPTION: <PROJDESC>]

PY8 NET-TO-GROSS MODULE

Variables for the net-to-gross module:

<NTG> (B=Basic rigor level, S= Standard rigor level. All questions here are asked if the standard rigor level is designated. Basic rigor level is designated through skip patterns)

Smart Ideas for your Business (ComEd)

<PROGRAM> (Name of energy efficiency program)

<ENDUSE> (Type of measure installed; from program tracking dataset)

<VEND1> (Contractor who installed new equipment, from program tracking dataset)

<OTHERPTS> (Variable to be calculated based on responses. Equals 1- minus response to N3p.)

<MSAME> (Equals 1 if same customer had more than one project of the same measure type; from program tracking database)

<NSAME> (Number of additional projects of the same measure type implemented by the same customer; from program tracking database)

<FSAME> (Equals 1 if same customer also had a project of a different measure type at the same facility; from program tracking database)

<FDESC> (Type of project of a different measure type at the same facility; from program tracking database)

VENDOR INFORMATION

I would like to get some information on the VENDORS that may have helped you with the implementation of this equipment.

- V1 Did you work with a contractor or vendor that helped you with the choice of this equipment?
- 1 (Yes)
 - 2 (No)
 - 8 (Don't Know)
 - 9 (Refused)

[SKIP TO V4 IF V1=2, 8, or 9]

- V3 Did you also use a DESIGN or CONSULTING Engineer?
- 1 (Yes)
 - 2 (No)
 - 8 (Don't know)
 - 9 (Refused)

- V4 Did your utility account manager assist you with the project that you implemented through the ComEd Smart Ideas® for Your Business Program? (IF NEEDED: A utility account manager is an employee of ComEd who is assigned to your company to provide assistance)
- 1 (Yes)
 - 2 (No, don't have a utility account manager)
 - 3 (No, have a utility account manager but they weren't involved)
 - 8 (Don't know)
 - 9 (Refused)

NET-TO-GROSS BATTERY

I'd now like to ask a few questions about the thought process you used that resulted in the energy efficient installations and incentive by the program. We want to understand how you thought about energy efficiency and what influenced your decision to install <MEASURE> through ComEd's program.

A2aa. Did this new energy efficiency equipment that you installed through the program replace existing equipment or was it added to control or work directly with existing equipment?

- 01 Replaced existing equipment
- 02 Added to control or work directly with existing equipment
- 00 Other (record VERBATIM)
- 98 (Don't know)
- 99 (Refused)

N00 In deciding to do a project of this type, there are usually a number of reasons why it may be undertaken. In your own words, can you tell me why this project was implemented? (IF NEEDED: Were there any other reasons?) (MULTIPLE RESPONSE OF THREE)

DO NOT READ

- 1 To replace old or outdated equipment
- 2 As part of a planned remodeling, build-out, or expansion
- 3 To gain more control over how the equipment was used
- 4 The maintenance downtime and associated expenses for the old equipment were too high
- 5 Had process problems and were seeking a solution
- 6 To improve equipment performance
- 7 To improve the product quality
- 8 To comply with codes set by regulatory agencies
- 9 To comply with company policies regarding regular/normal maintenance/replacement policy
- 10 To get an incentive from the program
- 11 To protect the environment
- 12 To reduce energy costs
- 13 To reduce energy use/power outages
- 14 To update to the latest technology
- 00 Other (RECORD VERBATIM)
- 98 (Don't know)
- 99 (Refused)

N2 When did you first learn about ComEd's Smart Ideas for your Business Program? Was it BEFORE or AFTER you DECIDED to implement the measure that qualified for the incentive? (NOTE TO INTERVIEWER: "the measure" refers to the specific energy efficient equipment installed through the program.)

- 1 (Before)
- 2 (After)
- 8 (Don't know)
- 9 (Refused)

N3 Next, I'm going to ask you to rate the importance of the program as well as other factors that might have influenced your decision to implement the measure that qualified for the incentive. Think of the degree of importance as being shown on a scale with equally spaced units from 0 to 10, where 0 means not at all important and 10 means extremely important. Now using this scale please rate the importance of each of the following in your decision to implement the measure at this time. [FOR N3b-n, RECORD 0 to 10; 96=Not Applicable; 98=Don't Know; 99=Refused]

(If needed: How important in your DECISION to implement the project was...)

N3b. Availability of the PROGRAM incentive

[ASK IF N3b=8, 9, 10]

N3bb. Why do you give it this rating? [OPEN END; 98=Don't know; 99=Refused]

N3c. Information provided through the technical assistance you received from the program's field staff

[SKIP N3cc IF NTG=B]

[ASK IF N3c=8, 9, 10]

N3cc. Why do you give it this rating? [OPEN END; 98=Don't know; 99=Refused]

[ASK N3d IF V1=1]

N3d. Recommendation from an equipment vendor or contractor that helped you with the choice of the equipment

N3e. Previous experience with this type of equipment

N3f. Recommendation from ComEd or DNV/GL program staff

[SKIP N3ff IF NTG=B]

[ASK N3ff IF N3f=8, 9, 10]

N3ff. Why do you give it this rating?

N3h. Information from ComEd marketing materials

[SKIP N3hh IF NTG=B]

[ASK IF N3h=8, 9, 10]

N3hh. Why do you give it this rating?

[ASK N3i IF V3=1]

N3i. A recommendation from a design or consulting engineer

N3j. Standard practice in your business/industry

[SKIP N3k IF V4>1]

N3k. Endorsement or recommendation by a ComEd account manager

[SKIP N3kk IF NTG=B]

[ASK IF N3k=8, 9, 10]

N3kk. Why do you say that?

N3l. Corporate policy or guidelines

N3m. Payback on the investment

N3n. Were there any other factors we haven't discussed that were influential in your decision to install this MEASURE?

00 [Record verbatim]

96 (Nothing else influential)

98 (Don't Know)

99 (Refused)

[ASK N3nn IF N3n=00]

N3nn. Using the same zero to 10 scale, how would you rate the influence of this factor? [RECORD 0 to 10; 98=Don't Know; 99=Refused]

Thinking about this differently, I would like you to compare the importance of the PROGRAM with the importance of other factors in implementing the <ENDUSE> project.

[READ IF (N3D, N3E, N3I, N3J, N3L, N3M, OR N3N)=8,9,10; ELSE SKIP TO N3p]

You just told me that the following other factors were important:

[READ IN ONLY ITEMS WHERE THEY GAVE A RATING OF 8 or higher]

(N3D) Equipment Vendor recommendation

(N3E) Previous experience with this measure

(N3I) Recommendation from a design or consulting engineer

(N3J) Standard practice in your business/industry

- (N3L) Corporate policy or guidelines
- (N3M) Payback on investment
- (N3N) Other factor

N3p If you were given a TOTAL of 10 points that reflect the importance in your decision to implement the <ENDUSE>, and you had to divide those 10 points between: 1) the program and 2) other factors, how many points would you give to the importance of the PROGRAM?
Points given to program: [RECORD 0 to 10; 98=Don't Know; 99=Refused]

[CALCULATE VARIABLE "OTHERPTS" AS: 10 MINUS N3p RESPONSE; IF N3p=98, 99, SET OTHERPTS=BLANK]

N3o And how many points would you give to other factors? [RECORD 0 to 10; 98=Don't Know; 99=Refused] [The response should be <OTHERPTS> because both numbers should equal 10. If response is not <OTHERPTS> ask INC1]

INC1 The last question asked you to divide a TOTAL of 10 points between the program and other factors. You just noted that you would give <N3p RESPONSE> points to the program. Does that mean you would give <OTHERPTS> points to other factors?
1 (Yes)
2 (No)
98 (Don't know)
99 (Refused)

[IF INC1=2, go back to N3p]

CONSISTENCY CHECK ON PROGRAM IMPORTANCE SCORE

[ASK IF (N3p>7 AND ALL OF (N3b, N3c, N3f, N3h, AND N3k)=0,1,2), ELSE SKIP TO N4aa]

N4 You just gave <N3p RESPONSE> points to the importance of the program, I would interpret that to mean that the program was quite important to your decision to install this equipment. Earlier, when I asked about the importance of individual elements of the program I recorded some answers that would imply that they were not that important to you. Just to make sure I have recorded this properly, I have a couple questions to ask you.

N4a When asked about THE AVAILABILITY OF THE PROGRAM INCENTIVE, you gave a rating of ...<N3B RESPONSE> ... out of ten, indicating that the program incentive was not that important to you. Can you tell me why?
00 [Record VERBATIM]
98 (Don't know)
99 (Refused)

N4b When I asked you about THE INFORMATION PROVIDED THROUGH THE TECHNICAL ASSISTANCE, you gave a rating of ...<N3C RESPONSE> ... out of ten, indicating that the information provided was not that important to you. Can you tell me why?
00 [Record VERBATIM]
98 (Don't know)
99 (Refused)

N4c When I asked you about THE RECOMMENDATION FROM A Smart Ideas for your Business COMED PROGRAM STAFF PERSON, you gave a rating of ...<N3F RESPONSE> ... out of ten, indicating that the information provided was not that important to you. Can you tell me why?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N4d When asked about THE INFORMATION from COMED's MARKETING MATERIALS, you gave a rating of ...<N3H RESPONSE> ... out of ten, indicating that this information from the program or utility marketing materials was not that important to you. Can you tell me why?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[SKIP N4e IF V4>1 or N3k=96,98,99]

N4e When asked about THE ENDORSEMENT or RECOMMENDATION by YOUR UTILITY ACCOUNT MANAGER, you gave a rating of <N3K RESPONSE> ... out of ten, indicating that this Account manager endorsement was not that important to you. Can you tell me why?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[ASK IF N3p<3 AND ANY ONE OF (N3b, N3c, N3f, N3h, OR N3k=8,9,10) ELSE SKIP TO N5]

N4aa You just gave <N3p RESPONSE> points to the importance of the program. I would interpret that to mean that the program was not very important to your decision to install this equipment. Earlier, when I asked about the importance of individual elements of the program I recorded some answers that would imply that they were important to you. Just to make sure I understand, would you explain why the program was not very important in your decision to install this equipment?

Now I would like you to think about the action you would have taken with regard to the installation of this equipment if the utility program had not been available.

[IF A2aa=1 (MEASURE=REPLACEMENT), THEN ASK]

N5 Using a scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely", if ComEd's efficiency program had not been available, what is the likelihood that you would have installed exactly the same equipment? [RECORD 0 to 10; 98=Don't know; 99=Refused]

[IF A2aa=2 (MEASURE=ADD-ON) THEN ASK]

N5aa Using a scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely", if the **PROGRAM** had **not** been available, what is the likelihood that you would have installed exactly the same item/equipment at the same time as you did? [RECORD 0 to 10; 98=Don't know; 99=Refused]

[IF A2aa=1 (MEASURE=REPLACEMENT) AND N5>0 THEN ASK, ELSE SKIP TO N5A]

Next, I'd like to ask a couple of questions to help us estimate at what point in the future you would definitely have replaced your existing equipment. We understand that you can't know exactly when you would have done this, especially so far into the future. We're just trying to get a sense of how long you think the current equipment or process would have kept serving your company's needs before you had to or chose to replace it.

N5ab. If the program had not been available, how likely is it that you would have installed exactly the same project or efficiency of equipment within **1 year** of when you installed your <ENDUSE> project? Please use a likelihood scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely" [RECORD 0 to 10; 98=Don't know; 99=Refused]

[IF N5ab<8 THEN ASK, ELSE SKIP TO N7a]

N5ac. If the program had not been available, how likely is it that you would have installed exactly the same project or efficiency of equipment within **3 years** of when you installed your <ENDUSE> project? (IF NEEDED: Please use a likelihood scale from 0 to 10, where 0 is “Not at all likely” and 10 is “Extremely likely”) [RECORD 0 to 10; 98=Don't know; 99=Refused]

[IF N5ac<8 THEN ASK, ELSE SKIP TO N7a]

N5ad. If the program had not been available, how likely is it that you would have installed exactly the same project or efficiency of equipment within **5 years** of when you installed your <ENDUSE> project? (IF NEEDED: Please use a likelihood scale from 0 to 10, where 0 is “Not at all likely” and 10 is “Extremely likely”) [RECORD 0 to 10; 98=Don't know; 99=Refused]

[IF N5ad=(0,1,2) THEN SKIP TO N5ae, ELSE ASK N7a]

N7a Without the program, when do you think you would have installed the <ENDUSE>? (Prompt, if necessary.)

- 0 (at the same time you did)
- 1 (up to 6 months later)
- 2 (7 months to 1 year later)
- 3 (more than 1 year up to 2 years later)
- 4 (more than 2 years up to 3 years later)
- 5 (more than 3 years up to 4 years later)
- 6 (more than 4 years later)
- 8 (Don't know)
- 9 (Refused)

[ASK N7b IF N7a=6]

N7b. Why do you think it would have been over 4 years later?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N5ae. Now I would like you to think one last time about what action you would have taken if the program had not been available. Supposing that you had not installed the program qualifying equipment, which of the following alternatives would you have been MOST likely to do?

- 1. Install fewer units
- 2. Install standard efficiency equipment or whatever required by code
- 3. install equipment more efficient than code but less efficient than what you installed through the program
- 4. repair or overhaul the existing equipment
- 5. do nothing (keep the existing equipment as is)
- 00. something else (specify what _____)
- 98. (Don't know)
- 99. (Refused)

CONSISTENCY CHECKS

[ASK N5a-d IF N3b=8,9,10 AND N5=8,9,10]

N5a I have a follow-up question on one of your earlier responses. When you answered ...<N3B RESPONSE> ... for the question about the influence of the incentive, I would interpret that to mean that the incentive was quite important to your decision to install. Then, when you answered <N5 RESPONSE> for how likely you would be to install the same equipment without the incentive, it sounds like the incentive was not very important in your installation decision.

I want to check to see if I am misunderstanding your answers or if the questions may have been unclear. Will you explain the role the incentive played in your decision to install this efficient equipment?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N5b Would you like for me to change your score on the importance of the incentive? You gave a score of <N3B_RESPONSE>. Or would you like to change your score on the likelihood you would install <MEASURE> without the incentive? You gave a rating of <N5_RESPONSE>. We can change both if you wish. .

- 1 (Change importance of incentive rating)
- 2 (Change likelihood to install the same equipment rating)
- 3 (Change both)
- 4 (No, don't change)
- 8 (Don't know)
- 9 (Refused)

[ASK IF N5b=1,3]

N5c How important was... availability of the PROGRAM incentive? (IF NEEDED: in your DECISION to implement the project) [Scale of 0 to 10, where 0 means not at all important and 10 means extremely important; 98=Don't know, 99=Refused]

[ASK IF N5b=2,3]

N5d If the utility program had not been available, what is the likelihood that you would have installed exactly the same equipment? [Scale of 0 to 10, where 0 means "Not at all likely" and 10 means "Extremely likely"; 98=Don't know, 99=Refused]

CONSISTENCY CHECK #3: TIMING OF INSTALLATION DECISION VS. ALL THREE PROGRAM SCORES

[ASK IF N2=2 AND (ANY OF N3b/N5c, N3f, N3h=8,9,10 OR N3p>70 OR N5/N5d<3)]

N5e In response to an earlier question, you noted that you learned about the program AFTER you had already decided to install the <ENDUSE> that qualified for the incentive. However, based on

- READ IF N3b/N5c=8,9,10: "the rating of <N3b/N5c RESPONSE> you gave to the program incentive"
- READ IF N3f=8,9,10: "the rating of <N3f RESPONSE> you gave to the recommendation from a ComEd or DNV/GL program staff person"
- READ IF N3h=8,9,10: "the rating of <N3h RESPONSE> you gave to information you received through the Smart Ideas or ComEd marketing materials"
- READ IF N3p>70: "the <N3p RESPONSE> you allocated to the program"
- READ IF N5/N5d<3: the likelihood of only <N5/N5d> out of 10 that you would have installed exactly the same equipment without the program,

it sounded like the program was important in your decision to install the high efficiency equipment.

I want to make sure I'm understanding your answers correctly, or if the questions may have been unclear. Will you explain the role the incentive program played in your selection of the efficiency

level of the installed equipment as well as the scope of the project? [OPEN END; 98=Don't Know, 99=Refused]

[ASK IF N3j>7]

N6 In an earlier question, you rated the importance of STANDARD PRACTICE in your industry very highly in your decision making. Could you please rate the importance of the PROGRAM, relative to this standard industry practice, in influencing your decision to install this measure? Would you say the program was much more important, somewhat more important, equally important, somewhat less important, or much less important than the industry's standard practice?

- 1 (Much more important)
- 2 (Somewhat more important)
- 3 (Equally important)
- 4 (Somewhat less important)
- 5 (Much less important)
- 8 (Don't know)
- 9 (Refused)

PAYBACK BATTERY [ASK N8-N10a IF N3m=6,7,8,9,10]

I'd like to find out more about the payback criteria <COMPANY> uses for its investments.

N8 What financial calculations does <COMPANY> make before proceeding with installation of a MEASURE like this one?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N9 What is the payback cut-off point <COMPANY> uses (in months) before deciding to proceed with an investment? Would you say...

- 1 0 to 6 months
- 2 7 months to 1 year
- 3 more than 1 year up to 2 years
- 4 more than 2 years up to 3 years
- 5 more than 3 years up to 5 years
- 6 Over 5 years
- 8 (Don't know)
- 9 (Refused)

N10 Does your company generally implement projects that meet the required financial cut-off point?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

[ASK N10aa IF N10=2]

N10aa Why doesn't your company generally implement projects that meet the required financial cut-off point?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N10a Did the incentive play an important role in moving your project within the acceptable payback cutoff point?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

CORPORATE POLICY BATTERY [ASK N11-N17 IF N3L=6,7,8,9,10 AND NTG=S]

N11 Does your organization have an environmental policy to reduce environmental emissions or energy use? Some examples would be to "buy green" or use sustainable approaches to business investments.

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

[ASK N12-N17 IF N11=1]

N12 What specific policy influenced your decision to adopt or install the <ENDUSE> through the Smart Ideas for your Business program?

- 00 [RECORD VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N12a When did your organization adopt that policy?

- 00 [RECORD VERBATIM]
- 98 (Don't know)
- 99 (Refused)

N13 Had that policy caused you to adopt energy efficient <ENDUSE> at this facility before participating in the ComEd efficiency program?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

[ASK N15-N16 IF N13=1 OR N14=1]

N15 Did your organization receive an incentive for a previous installation of <ENDUSE>?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

[ASK N16 IF N15=1]

N16 To the best of your ability, please describe.... [Record VERBATIM; 98=Don't know; 99=Refused]

- a. the amount of incentive received
- b. the approximate timing
- c. the name of the program that provided the incentive

[ASK N17 IF N13=1 OR N14=1]

N17 If I understand you correctly, you said that <COMPANY> 's corporate policy has caused you to install energy efficient <ENDUSE> previously at this and/or other facilities. I want to make sure I fully understand how this corporate policy influenced your decision versus the Smart Ideas for your Business program. Can you please clarify that?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

STANDARD PRACTICE BATTERY [ASK N18-N22 IF N3j=6,7,8,9,10 AND NTG=S]

N18 Approximately, how long has use of energy efficient <ENDUSE> been standard practice in your industry?

M [00 Record Number of Months; 98=Don't know, 99=Refused]

Y [00 Record Number of Years; 98=Don't know, 99=Refused]

N19 Does <COMPANY> ever deviate from the standard practice?

1 (Yes)

2 (No)

8 (Don't know)

9 (Refused)

[ASK IF N19=1]

N19a Please describe the conditions under which <COMPANY> deviates from this standard practice.

00 [Record VERBATIM]

98 (Don't know)

99 (Refused)

N20 How did this standard practice influence your decision to install the <ENDUSE> through the Smart Ideas for Your Business program

00 [Record VERBATIM]

98 (Don't know)

99 (Refused)

N20a Could you please rate the importance of the Smart Ideas for Your Business program, versus this standard industry practice in influencing your decision to install the <ENDUSE>. Would you say the Smart Ideas for Your Business program was...

1 Much more important

2 Somewhat more important

3 Equally important

4 Somewhat less important

5 Much less important

8 (Don't know)

9 (Refused)

N21 What industry group or trade organization do you look to to establish standard practice for your industry?

00 [Record VERBATIM]

98 (Don't know)

99 (Refused)

N22 How do you and other firms in your industry receive information on updates in standard practice?

00 [Record VERBATIM]

98 (Don't know)

99 (Refused)

DESIGN ASSISTANCE

N23 Who provided the most assistance in the design or specification of the <ENDUSE> you installed through the program? (If necessary, probe from the list below.)

1 (Designer)

2 (Consultant)

3 (Equipment distributor)

- 4 (Installer)
- 5 (ComEd/Smart Ideas for your Business account manager)
- 6 (ComEd staff)
- 00 (Other, specify)
- 98 (Don't know)
- 99 (Refused)

[SKIP N24 IF N23=98, 99]

- N24 Please describe the type of assistance that they provided.
- 00 Record VERBATIM
 - 98 Don't know
 - 99 Refused

ADDITIONAL PROJECTS

[ASK N26 IF MSAME=1]

Our records show that <COMPANY> also received an incentive from Smart Ideas for your Business ComEd for <NSAME> other <ENDUSE> project(s).

- N26 Was it a single decision to complete all of those <ENDUSE> projects for which you received an incentive from Smart Ideas for your Business or did each project go through its own decision process?
- 1 (Single Decision)
 - 2 (Each project went through its own decision process)
 - 00 (Other, specify)
 - 98 (Don't know)
 - 99 (Refused)

[ASK N27 IF FSAME=1 ELSE SKIP TO EARLY REPLACEMENT BATTERY]

Our records show that <COMPANY> also received an incentive from Smart Ideas for your Business for a <FDESC> project at < ADDRESS >.

- N27 Was the decision making process for the <FDESC> project the same as for the <ENDUSE> project we have been talking about?
- 1 (Same decision making process)
 - 2 (Different decision making process)
 - 00 (Other, specify)
 - 98 (Don't know)
 - 99 (Refused)

EARLY REPLACEMENT BATTERY

[SKIP TO SPILLOVER MODULE, IF NOT QN00=01-09]

Earlier, when I asked you a question about why you decided to implement the project, you gave reasons related to [READ LIST OF ISSUES MENTIONED IN N00]. Now I would like to ask some follow up questions regarding the responses you gave me.

[ASK IF N00=1,ELSE SKIP TO ER4],

- ER1. Approximately how old was the existing equipment, in years?
- ___ Estimated Age
 - 98 (Don't know)
 - 99 (Refused)

[ASK IF ER1=98]

- ER1a. Approximately in what year was the existing equipment purchased?
- ___ Estimated Year of Purchase

- 98 (Don't know)
- 99 (Refused)

ER2Y. How much longer do you think it would have lasted?

YEAR__ Estimated Remaining Useful Life

- 98 (Don't know)
- 99 (Refused)

ER3. Would it be possible to obtain a copy of the original invoice for this equipment?

1. Yes [ARRANGE FOR DELIVERY]

2 No

- 98 (Don't know)
- 99 (Refused)

[ASK IF ER3=1]

EMAIL. Can you please provide your email address so that we might contact you and obtain the invoice?

[OPEN END]

[ASK IF N00=2]

ER4. Can you please describe the remodeling, build out or capacity expansion that you did and the role the project played in it?

00 (Other, specify)

98 (Don't know)

99 (Refused)

[ASK IF N00=3]

ER5. Can you please describe how the existing equipment had operated before you upgraded it, and why you sought increased control over it?

00 (Other, specify)

98 (Don't know)

99 (Refused)

[ASK IF N00=4, ELSE SKIP TO ER10]

ER6. What percentage of downtime did you experience in the past year?

_____ Downtime Estimate

98 (Don't know)

99 (Refused)

ER7. What percentage of downtime did you experience in the previous years?

_____ Previous Year Downtime Estimate

98 (Don't know)

99 (Refused)

ER8. Over the last 5 years, have maintenance costs been increasing, decreasing or staying about the same?

1. Increasing

2. Decreasing

3. Staying the same

98 (Don't know)

99 (Refused)

ER9Y. In your opinion, based on the economics of operating this equipment, for how many more years could you have kept this equipment functioning?

_____ Estimate of Remaining Useful Life (in years)
 98 (Don't know)
 99 (Refused)

ER9M. In your opinion, based on the economics of operating this equipment, for how many more years could you have kept this equipment functioning?

MONTH

_____ Estimate of Remaining Useful Life
 98 (Don't know)
 99 (Refused)

[ASK IF N00=5, ELSE SKIP TO ER12]

ER10. Can you briefly describe the process problems that you experienced prior to this project?

00 (Other, specify)
 98 (Don't know)
 99 (Refused)

ER11. Was it critical that these process problems be resolved as soon as possible?

1. Yes
 2. No
 98 (Don't know)
 99 (Refused)

[ASK IF N00=6]

ER12. Which of the following statements best describes the performance and operating condition of the equipment you replaced through the ComEd Smart Ideas for your Business program?

1. Existing equipment was fully functioning, and without significant issues
2. Existing equipment was fully functioning with minor issues
3. Existing equipment was fully functioning, but with significant issues
4. Existing equipment had failed or did not function.
5. Existing equipment was obsolete
00. Other (RECORD VERBATIM)
96. Not applicable, ancillary equipment (VSD, EMS, controls, etc.)
- 98 (Don't know)
- 99 (Refused)

[ASK IF N00=7, ELSE SKIP TO ER15]

ER13. Can you briefly describe these product quality improvements that this project provided?]

00 (Other, specify)
 98 (Don't know)
 99 (Refused)

ER14. Was it critical that these product quality improvements be made as soon as possible?

1. Yes
 2. No
 98 (Don't know)
 99 (Refused)

[ASK IF N00=8, ELSE SKIP TO ER19]

ER15. Can you briefly describe the specific code/regulatory requirements that this project addressed?

00 (Other, specify)
 98 (Don't know)
 99 (Refused)

ER16. Was it critical that your company comply with this code(s) as soon as possible?

- 1. Yes
- 2. No
- 98 (Don't know)
- 99 (Refused)

[ASK IF N00=9, ELSE SKIP TO SPILLOVER MODULE]

ER19. Can you briefly describe the specific company policies regarding regular/normal maintenance/replacement policy(ies) that were relevant to this project?

- 00 (Other, specify)
- 98 (Don't know)
- 99 (Refused)

ER20. Was it critical that your company comply with these policies as soon as possible?

- 1. Yes
- 2. No
- 98 (Don't know)
- 99 (Refused)

PY8 SPILLOVER MODULE

Thank you for discussing the new <ENDUSE> that you installed through the Smart Ideas for Your Business Program. Next, I would like to discuss any energy efficient equipment you might have installed OUTSIDE of the program.

SP1 **Since receiving an incentive for the project we just discussed**, did you implement any ADDITIONAL energy efficiency measures at this facility or at your other facilities within ComEd's service territory that did NOT receive incentives through any utility or government program?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

[ASK SP1a-SP1c IF SP1=1, ELSE SKIP TO FIRMOGRAPHICS?]

SP1a. Do you plan to apply for incentives for these energy efficiency measure(s) through a utility program in the future?

- 1 Yes [SKIP TO SP1b]
- 2 No [SKIP TO SP2]
- 8 (Don't know) [SKIP TO SP2]
- 9 (Refused) [SKIP TO SP2]

SP1b. Which program(s) do you plan to apply to for incentives for these measures?

- 00 Record VERBATIM
- 98 (Don't know)
- 99 (Refused)

SP1c. Approximately when do you plan to apply for incentives through these programs?

- 00 Record VERBATIM
- 98 (Don't know)
- 99 (Refused)

[ASK IF SP1=1, ELSE SKIP TO FIRMOGRAPHICS?]

SP2 What was the first measure that you implemented? (IF RESPONSE IS GENERAL, E.G., "LIGHTING EQUIPMENT", PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

- 1 (Lighting: T8 lamps)
- 2 (Lighting: T5 lamps)
- 3 (Lighting: Highbay Fixture Replacement)
- 4 (Lighting: CFLs)
- 5 (Lighting: Controls / Occupancy sensors)
- 6 (Lighting: LED lamps)
- 7 (Cooling: Unitary/Split Air Conditioning System)
- 8 (Cooling: Room air conditioners)
- 9 (Cooling: Variable Frequency Drives (VFD/VSD) on HVAC Motors)
- 10 (Motors: Efficient motors)
- 11 (Refrigeration: Strip curtains)
- 12 (Refrigeration: Anti-sweat controls)
- 13 (Refrigeration: EC motor for WALK-IN cooler/freezer)
- 14 (Refrigeration: EC motor for REACH-IN cooler/freezer)
- 00 (Other, specify)
- 96 (Didn't implement any measures)
- 98 (Don't know)
- 99 (Refused)

[SKIP TO FIRMOGRAPHICS IF SP2=96, 98, 99]

SP3. What was the second measure? (IF RESPONSE IS GENERAL, E.G., "LIGHTING EQUIPMENT", PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

- 1 (Lighting: T8 lamps)
- 2 (Lighting: T5 lamps)
- 3 (Lighting: Highbay Fixture Replacement)
- 4 (Lighting: CFLs)
- 5 (Lighting: Controls / Occupancy sensors)
- 6 (Lighting: LED lamps)
- 7 (Cooling: Unitary/Split Air Conditioning System)
- 8 (Cooling: Room air conditioners)
- 9 (Cooling: Variable Frequency Drives (VFD/VSD) on HVAC Motors)
- 10 (Motors: Efficient motors)
- 11 (Refrigeration: Strip curtains)
- 12 (Refrigeration: Anti-sweat controls)
- 13 (Refrigeration: EC motor for WALK-IN cooler/freezer)
- 14 (Refrigeration: EC motor for REACH-IN cooler/freezer)
- 00 (Other, specify)
- 96 (There was no second measure)
- 98 (Don't know)
- 99 (Refused)

[SKIP SP4 IF SP3=96, 98, 99]

SP4 What was the third measure? (IF RESPONSE IS GENERAL, E.G., "LIGHTING EQUIPMENT", PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

- 1 (Lighting: T8 lamps)
- 2 (Lighting: T5 lamps)
- 3 (Lighting: Highbay Fixture Replacement)
- 4 (Lighting: CFLs)
- 5 (Lighting: Controls / Occupancy sensors)
- 6 (Lighting: LED lamps)
- 7 (Cooling: Unitary/Split Air Conditioning System)
- 8 (Cooling: Room air conditioners)
- 9 (Cooling: Variable Frequency Drives (VFD/VSD) on HVAC Motors)
- 10 (Motors: Efficient motors)
- 11 (Refrigeration: Strip curtains)
- 12 (Refrigeration: Anti-sweat controls)
- 13 (Refrigeration: EC motor for WALK-IN cooler/freezer)
- 14 (Refrigeration: EC motor for REACH-IN cooler/freezer)
- 00 (Other, specify)
- 96 (There was no third measure)
- 98 (Don't know)
- 99 (Refused)

SP5 I have a few questions about the FIRST measure that you installed. (If needed, read back measure: <SP2 RESPONSE>) [OPEN END]

- a. Can you briefly explain why you decided to install this energy efficiency measure on your own, rather than going through a utility incentive program?
- b. Why did you not install this measure through the Smart Ideas for your Business Program?
- c. Please describe the SIZE, TYPE, and OTHER ATTRIBUTES of this measure.
- d. Please describe the EFFICIENCY of this measure.
- e. How many of this measure did you install?
- ee. When did you install this measure?

SP5f. Was this measure specifically recommended by a program related study, report or program technical specialist?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

SP5g. How significant was your experience in the Smart Ideas for your Business Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant? [SCALE 0-10; 98=Don't Know; 99=Refused]

[SKIP SP5h IF SP5g = 98, 99]

SP5h. Can you explain specifically how your experience with the <PROGRAM> influenced your decision to install this additional high efficiency measure(s)? [OPEN END]

SP5i. If you had not participated in the Smart Ideas for your Business program, how likely is it that your organization would still have implemented this measure, using a 0 to 10, scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure? [SCALE 0-10; 98=Don't Know; 99=Refused]

CONSISTENCY CHECK ON PROGRAM IMPORTANCE RATING VS. NO PROGRAM RATING

[ASK CC1a IF SP5g=0,1,2 AND SP5i =0,1,2]

CC1a When you answered ...<SP5g RESPONSE> ... for the question about the influence of the Smart Ideas for your Business Program on your decision to install this measure, I would interpret that to mean the Program was not very important to your decision. However, when you answered the previous question, it sounds like it was not very likely that you would have installed this measure had you not participated in the Smart Ideas for your Business Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[ASK CC1b IF SP5g=8,9,10 AND SP5i =8,9,10]

CC1b When you answered ...<SP5g RESPONSE> ... for the question about the influence of the Smart Ideas for your Business Program on your decision to install this measure, I would interpret that to mean the Program was quite important to your decision. However, when you answered the previous question, it sounds like it was very likely that you would have installed this measure had you not participated in the Smart Ideas for your Business Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[SKIP TO FIRMOGRAPHICS IF SP3=96, 98, 99]

SP6 I have a few questions about the SECOND measure that you installed. (If needed, read back measure: <SP3 RESPONSE>) [OPEN END]

- a. **Can you briefly explain why you decided to install this energy efficiency measure(s) on your own, rather than going through a utility incentive program?**
- b. Why did you not install this measure through the Smart Ideas for Your Business Program?
- c. Please describe the SIZE, TYPE, and OTHER ATTRIBUTES of this measure.
- d. Please describe the EFFICIENCY of this measure.
- e. How many of this measure did you install?
- ee. When did you install this measure?

SP6f. Was this measure specifically recommended by a program related study, report or program technical specialist?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

SP6g. How significant was your experience in the Smart Ideas for Your Business Program in your decision to implement this Measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant? [SCALE 0-10; 98=Don't Know; 99=Refused]

[SKIP SP6h IF SP6g = 98, 99]

SP6h. **Can you explain specifically how your experience with the <PROGRAM> influenced your decision to install this additional high efficiency measure(s)?** [OPEN END]

SP6i. If you had not participated in the Smart Ideas for Your Business Program, how likely is it that your organization would still have implemented this measure, using a 0 to 10, scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure? [SCALE 0-10; 98=Don't Know; 99=Refused]

CONSISTENCY CHECK ON PROGRAM IMPORTANCE RATING VS. NO PROGRAM RATING

[ASK CC2a IF SP6g=0,1,2 AND SP6i =0,1,2]

CC2a When you answered ...<SP6g RESPONSE> ... for the question about the influence of the Smart Ideas for Your Business Program on your decision to install this measure, I would interpret that to mean the Program was not very important to your decision. However, when you answered the previous question, it sounds like it was not very likely that you would have installed this measure unless you had participated in the Smart Ideas for your Business Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[ASK CC2b IF SP6g=8,9,10 AND SP6i =8,9,10]

CC2b When you answered ...<SP6g RESPONSE> ... for the question about the influence of the Smart Ideas for Your Business Program on your decision to install this measure, I would interpret that to mean the Program was quite important to your decision. However, when you answered the previous question, it sounds like it was very likely that you would have installed this measure had you not participated in the Smart Ideas for your Business Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[SKIP TO FIRMOGRAPHICS IF SP4=96, 98, 99]

SP7 I have a few questions about the THIRD measure that you installed. (If needed, read back measure: <SP3 RESPONSE>) [OPEN END]

- a. **Can you briefly explain why you decided to install this energy efficiency measure(s) on your own, rather than going through a utility incentive program?**
- b. Why did you not install this measure through the Smart Ideas for your Business Program?
- c. Please describe the SIZE, TYPE, and OTHER ATTRIBUTES of this measure.
- d. Please describe the EFFICIENCY of this measure.
- e. How many of this measure did you install?
- ee. When did you install this measure?

SP7f. Was this measure specifically recommended by a program related study, report or program technical specialist?

- 1 (Yes)
- 2 (No)
- 8 (Don't know)
- 9 (Refused)

SP7g. How significant was your experience in the Smart Ideas for your Business Program in your decision to implement this Measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant? [SCALE 0-10; 98=Don't Know; 99=Refused]

[SKIP SP7h IF SP7g = 98, 99]

SP7h. **Can you explain specifically how your experience with the <PROGRAM> influenced your decision to install this additional high efficiency measure(s)?** [OPEN END]

SP7i. If you had not participated in the Smart Ideas for your Business program, how likely is it that your organization would still have implemented this measure, using a 0 to 10, scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure? [SCALE 0-10; 98=Don't Know; 99=Refused]

CONSISTENCY CHECK ON PROGRAM IMPORTANCE RATING VS. NO PROGRAM RATING

[ASK CC3a IF SP7g=0,1,2 AND SP7i =0,1,2]

CC3a When you answered ...<SP7g RESPONSE> ... for the question about the influence of the Smart Ideas Program on your decision to install this measure, I would interpret that to mean the Program was not very important to your decision. However, when you answered the previous question, it sounds like it was not very likely that you would have installed this measure unless you had participated in the Smart Ideas Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

[ASK CC3b IF SP7g=8,9,10 AND SP7i =8,9,10]

CC3b When you answered ...<SP7g RESPONSE> ... for the question about the influence of the Smart Ideas Program on your decision to install this measure, I would interpret that to mean the Program was quite important to your decision. However, when you answered the previous question, it sounds like it was very likely that you would have installed this measure had you not participated in the Smart Ideas Program. Can you please explain the role the program made in your decision to implement this measure?

- 00 [Record VERBATIM]
- 98 (Don't know)
- 99 (Refused)

Firmographics

I only have a few general questions left.

F1a What is <COMPANY>'s business type? (PROBE, IF NECESSARY; IF MANUFACTURING, PROBE IF IT IS LIGHT INDUSTRY OR HEAVY INDUSTRY)

- 1. (K-12 School)
- 2. (College/University)
- 3. (Grocery)
- 4. (Medical)
- 5. (Hotel/Motel)
- 6. (Light Industry)
- 7. (Heavy Industry)
- 8. (Office)
- 9. (Restaurant)
- 10. (Retail/Service)
- 11. (Warehouse)
- 15. (Property Management/Real Estate)
- 00. (Other, specify)
- 98. (Don't know)
- 99. (Refused)

F1b And is the business type of the facility in which the <ENDUSE> was installed the same?

- 1. Yes
- 2. No
- 8. (Don't know)
- 9. (Refused)

[ASK F1c IF F1b=2]

F1c What is the business type of the facility? (PROBE, IF NECESSARY – CLASS MANUFACTURING AS EITHER LIGHT OR HEAVY INDUSTRY)

1. (K-12 School)
2. (College/University)
3. (Grocery)
4. (Medical)
5. (Hotel/Motel)
6. (Light Industry)
7. (Heavy Industry)
8. (Office)
9. (Restaurant)
10. (Retail/Service)
11. (Warehouse)
15. (Property Management/Real Estate)
00. (Other, specify)
98. (Don't know)
99. (Refused)

F2 Which of the following best describes the ownership of this facility?

1. <COMPANY> owns and occupies this facility
2. <COMPANY> owns this facility but it is rented to someone else
3. <COMPANY> rents this facility
8. (Don't know)
9. (Refused)

[SKIP if F2=1]

F3 Does <COMPANY> pay the electric bill?

1. Yes
2. No
8. (Don't know)
9. (Refused)

F4a How old is this facility? [NUMERIC OPEN END, 0 TO 150; 998=Don't know, 999=Refused]

[ASK F4b IF F4a=998]

F4b Do you know the approximate age? Would you say it is...

1. Less than 2 years
2. 2-4 years
3. 5-9 years
4. 10-19 years
5. 20-29 years
6. 30 years or more years
8. (Don't know)
9. (Refused)

F5a How many employees, including part-time, are employed at this facility? [NUMERIC OPEN END, 0 TO 2000; 9998=Don't know, 9999=Refused]

[ASK F5b IF F5a=9998]

F5b Do you know the approximate number of employees? Would you say it is...

1. Less than 10
2. 10-49

- 3. 50-99
- 4. 100-249
- 5. 250-499
- 6. 500 or more
- 8. (Don't know)
- 9. (Refused)

F6 Which of the following best describes the facility? This facility is...

- 1. <COMPANY>'s only location
- 2. one of several locations owned by <COMPANY>
- 3. the headquarters location of <COMPANY> with several locations

[SKIP F7 IF F2=2]

F7 In comparison to other companies in your industry, would you describe <COMPANY> as...

- 1. A small company
- 2. A medium-sized company
- 3. A large company
- 4. (Not applicable)
- 8. (Don't know)
- 9. (Refused)

6.1.2 Vendor Survey

Vendor NTG Survey Instrument – for ComEd Custom Programs
CI Custom– PY8

Introduction

AA1. Hello, this is _____ from Itron calling on behalf of ComEd. THIS IS NOT A SALES CALL. I am calling about your firm's recent involvement in ... <%ENDUSE>... project sponsored by ComEd for ... <%CUSTOMER>... through the ComEd Smart Ideas for Your Business Program. Our records indicate that ...<%CONTACT>... would be the person most knowledgeable about this. Is he/she available?

- 1 Yes AA5
- 2 No AA2
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

AA2. Who would be the person most knowledgeable about your firm's involvement in ... <%ENDUSE>... project sponsored by ComEd for ...<%CUSTOMER>... through the ComEd Smart Ideas for Your Business Program?

- 1 Record name AA3
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

AA3. May I speak with him/her?

- 1 Yes AA4
- 2 No (not available right now) SCHEDULE APPOINTMENT

AA4. Hello, this is _____ from Itron calling on behalf of ComEd. THIS IS NOT A SALES CALL. I was told that you are the person most knowledgeable about your firm's involvement in ...<%ENDUSE>... project sponsored by ComEd for ...<%CUSTOMER>... through the ComEd Smart Ideas for Your Business Program. Is this correct?

- 1 Yes A1
- 2 No, there is someone else (RECORD NAME AND ASK TO BE TRANSFERRED) AA5
- 3 No and I don't know who to refer you to Thank and Terminate
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

AA5. Am I speaking with ...<%BETTER_CONTACT> ...the representative of your company that worked with ...<%CUSTOMER>... during the time of your firm's involvement in ...<%ENDUSE>... project sponsored by ComEd?

- 1 Yes A1
- 2 Yes, but we need to make an appointment. Reschedule appt.
- 3 No but I will give you to the correct person. AA4
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

Before we start, I would like to inform you that for quality control purposes, this call may be monitored by my supervisor. For the sake of expediency, we will be recording this interview.

A1. Our records indicate that your firm was involved in ...<%ENDUSE>... project sponsored by ComEd in which you recommended that <%CUSTOMER> install <%MEASURE1-%MEASURE3>. Is this correct?

- 1 Yes A2
- 2 No Thank and Terminate
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

[DO NOT READ: The following question will determine if we ask about influences on their recommendations. Please be sure to be thorough with this question. If they truly only installed this equipment, then a "No" is fine]

LOOP/ASK FOR EACH MEASURE (1-3)

A2. As <%CUSTOMER>'s vendor, did you recommend the installation of this <%MEASUREx>?

- 1 Yes A3
- 2 No A3
- 88 Refused A3
- 99 Don't know A3

A3. Can you please explain what was your firm's involvement with ...<%CUSTOMER>'s ... implementation of <%MEASUREx>? [IF NEEDED: were they just an order taker, were they just equipment suppliers, or were they instrumental in what equipment was selected?...if they were instrumental, then you need to go back and correct the answer to the previous question.]

- 77 RECORD VERBATIM A3a
- 88 Refused Thank and Terminate
- 99 Don't know Thank and Terminate

A3a Does your company currently stock and sell <%MEASUREx>s?

- 1 Yes V2
- 2 No V2
- 88 Refused V2
- 99 Don't know V2

[READ] For the sake of expediency, during the balance of the interview, we will be referring to the ComEd Smart Ideas for Your Business Program as the PROGRAM and we will be referring to the installation of ... <%MEASUREx> as the MEASURE. I will repeat this from time to time during the interview as your organization may have installed more than one measure through more than one program.

I am going to ask you to rate the importance of the ComEd Smart Ideas for Your Business in influencing your decision to recommend this <%MEASUREx> to ...<%CUSTOMER>.. Think of the degree of importance as being shown on a scale with equally spaced units from 0 to 10, where 0 means not at all important and 10 means very important, so that an importance rating of 8 shows twice as much influence as a rating of 4.

V2. Using this 0 to 10 scale where 0 is NOT AT ALL IMPORTANT and 10 is EXTREMELY IMPORTANT, how important was the ComEd Smart Ideas for Your Business Program, including incentives as well as program services and information, in influencing your decision to recommend that ...<%CUSTOMER>... install the energy efficiency <%MEASUREx> at this time?

- # Record 0 to 10 score (_____) V3
- 88 Refused V3
- 99 Don't know V3

V3. And using a 0 to 10 likelihood scale where 0 is NOT AT ALL LIKELY and 10 is EXTREMELY LIKELY, if the ComEd Smart Ideas for Your Business Program, including incentives as well as program services and information, had not been available, what is the likelihood that you would have recommended this specific <%MEASUREx> to ...<%CUSTOMER>?

- # Record 0 to 10 score (_____) V4
- 88 Refused V4
- 99 Don't know V4

V4. Approximately, in what percent of projects did you recommend this <%MEASUREx> before you learned about the ComEd Smart Ideas for Your Business Program?

%	Record PERCENTAGE	V5
88	Refused	V5
99	Don't know	V5

V5. And approximately in what percent of projects do you recommend this <%MEASUREx> now that you have worked with the ComEd Smart Ideas for Your Business Program?

%	Record PERCENTAGE	V6a
88	Refused	V6a
99	Don't know	V6a

V6a. In what other ways has the ComEd Smart Ideas for Your Business Program influenced your recommendation that a customer install <%MEASUREx>?

1	Record FIRST mention	V6aa
2	Record SECOND mention	V6aa
3	Record THIRD mention	V6aa
4	No other way	V7b
88	Refused	V7b
99	Don't know	V7b

IF V6a=1 THEN ASK, ELSE V6ab

V6aa. Using a 0 to 10 scale, how important was <%FIRST_MENTION_IN_V6A > in your recommendation that a customer install <%MEASUREx>?

#	Record 0 to 10 score (_____) V6a
88	Refused V6a
99	Don't know V6a

IF V6a=2 THEN ASK, ELSE V6ac

V6ab. Using a 0 to 10 scale, how important was <%SECOND_MENTION_IN_V6A > in your recommendation that a customer install <%MEASUREx>?

#	Record 0 to 10 score (_____) V6ac
88	Refused V6ac
99	Don't know V6ac

IF V6a=3 THEN ASK, ELSE V7b

V6ac. Using a 0 to 10 scale, how important was <%THIRD_MENTION_IN_V6A > in your recommendation that a customer install <%MEASUREx>?

#	Record 0 to 10 score (_____) V7b
88	Refused V7b
99	Don't know V7b

V7b. And how important was the information provided by the ComEd website in your recommendation that a customer install this MEASURE?

#	Record 0 to 10 score (_____) V7c
88	Refused V7c
99	Don't know V7c

V7c. And how important was your firm's past participation in an incentive or study-based program sponsored by ComEd in your recommendation that a customer install this MEASURE?

#	Record 0 to 10 score (_____) V8
88	Refused V8
99	Don't know V8

IF VENDOR ALSO STOCKS AND SELLS PROGRAM QUALIFYING <%MEASURE> (if A3a=1) THEN ASK V8. ELSE SKIP TO V15.

V8. Approximately, what percentage of your sales over the last 12 months of <%MEASUREx>s installed in ComEd's service territory are energy efficient models that qualify for incentives from the program?

%	Record PERCENTAGE	V9
88	Refused	V9
99	Don't know	V9

V9. In what percent of sales situations do you encourage your customers in ComEd's service territory to purchase program qualifying <%MEASUREx>s?

%	Record PERCENTAGE	V9a
88	Refused	V10
99	Don't know	V10

IF V9 < 100% THEN ASK. ELSE SKIP TO V10.

V9a. In what sales situations do you NOT encourage your customers to purchase program qualifying <%MEASUREx>s? And why is that?

77	RECORD VERBATIM	V10
88	Refused	V10
99	Don't know	V10

V10. Of those installations of <%MEASUREx>s in ComEd's service territory that qualify for incentives, approximately what percentage do not receive the incentive?

%	Record PERCENTAGE	V11
88	Refused	V12
99	Don't know	V12

IF V10 > 0%

V11. Why do you think they do not receive the incentive?

77	RECORD VERBATIM	V12
88	Refused	V12
99	Don't know	V12

V12. Do you also recommend <%MEASUREx>s in areas where customers do not have access to incentives for energy efficient models?

1	Yes	V13
2	No	V14
88	Refused	V14
99	Don't know	V14

V13. About what percent of your sales of program-qualifying <%MEASUREx>s are represented by these areas where incentives are not offered?

%	Record PERCENTAGE	V14
88	Refused	V14
99	Don't know	V14

V14. Have you changed your stocking practices of <%MEASUREx>s as a result of ComEd's Program? [IF NEEDED: BY STOCKING PRACTICES, I MEAN THE TYPES OF EQUIPMENT YOU SUPPLY AND SELL IN COMED'S SERVICE TERRITORY.]

1	Yes	V15
2	No	V15
88	Refused	V15
99	Don't know	V15

IF V12=1

V15. Do you promote energy efficient equipment, such as <%MEASUREx>, equally in areas with and without incentives??

1	Yes	V16
2	No	V16
88	Refused	V16
99	Don't know	V16

V16. Do you know of any other vendors that worked with <%CUSTOMER> during their implementation and/or installation of <%MEASUREx>? For example engineers or designers?

1	Yes	V16a
2	No	V17
88	Refused	V17
99	Don't know	V17

V16a. Do you have their business name?

77	RECORD Business name and contact's name and phone number(s)	V17
88	Refused	V17
99	Don't know	V17

END LOOP – MEASURE 1-3

PROCESS MODULE

V17 And finally, for verification purposes only, may I please have your first name?

77 RECORD VERBATIM END

END Those are all the questions I have for you today. Thank you very much for your time.

END OF SURVEY

6.2 Independent Project Review Memo for Project 27936

To: Erin Daughton, ComEd

cc: Randy Gunn, Rob Neumann, Jeff Erickson, Navigant
Jennifer Morris, ICC

From: Roger Hill, InCA

Date: March 9, 2017

Re: Independent Evaluation of Compressed Air Project #27936 - ComEd PY8 Custom Program Evaluation

6.2.1 Review Background

Project #27936 installed an air-compressor sequencer to control the start/stop operation of a compressed-air system which includes eight compressors. A sequencer will generally monitor the operation of each compressor and system pressure and determine which compressors to operate to meet system compressed air demand. A sequencer can save energy by prioritizing the most efficient equipment, ensuring that all machines are fully loaded before starting an additional machine and minimizing the operation of machines in their no-loaded state during which they consume power, but do not supply any compressed air to the system.

In this application, most of the savings for this project was to be derived from running fewer machines at part-load and no-loaded conditions. No-loaded operation is the least efficient operation mode as the compressor motor will continue to draw about 30% of rated full power, while producing no additional compressed air for the system. The reported baseline assumption for the project was fully manual start and stop of the air compressors.

The initial evaluated saving for this project was about 580,000 kWh, far less than the utility estimate of 3,760,000 kWh. ComEd requested a third-party review of the evaluation. In a February 6 memo, that review concluded the data indicates that the compressors shut-down automatically after a fixed period of no-load operation or were otherwise manually controlled to minimize no-load and excess part-load operation. Thus, the potential savings was on the order of 500,000 kWh and the general methodologies used by the evaluator were appropriate and the evaluated savings were reasonable.

ComEd subsequently questioned the initial third-party conclusions, pointing to periods of no-load and part-load when automatic shutdown did not work, citing several concerns

- There is no indication of automatic operation for most compressors.
- The review estimate does not credit the project for reducing the occurrence of multiple machines operating at part load.
- The modeled system performance curve is in error.
- That normalization of data is inappropriate.

This memo describes our new analysis approach for savings and completely supersedes the February 6th third-party review memo. We also describe how the methodology addresses each of the ComEd concerns. In general, the approach to estimating savings avoids using the steps that caused the most concern: performance curves and normalization of flow.

6.2.2 Overall Finding

The independent review for the compressed air project took a new approach to the problem and analyzed the enhanced capacity of the sequencer to minimize the number of operating machines better than the baseline, hybrid automatic-manual controls. Our analysis determined that the sequencer is able to reduce the number of excess operating machines by an average of 0.50 staging compressors at all times. Direct savings from the sequencer is 365,800 kWh.

We also include the pressure reduction savings not included in the February 6th memo. Pressure reduction savings are 580,500 kWh, based on the industry rule-of-thumb for pressure reduction effects on compressor power.

	kW savings	kWh Savings
Program Reported	447.37	3,757,870
Evaluation	89.18	583,657
Third-Party Review	108.00	946,300

Total project savings is 946,300 kWh and 108 kW.

6.2.3 Automatic shut-down indications

ComEd’s recent memo asserts the following control regimens for the eight compressors:

Compressor	ComEd control assertion	Review response
Kaeser 450	Baseload machines / manually staged with production	Acceptable interpretation, however the manual control for baseloading is close to optimal automatic control with minimal opportunities for sequencer savings.
Centac		
NW IR		
East Kaeser	Automatic control is apparent	Confirmed. Very little savings opportunity.
NW Kaeser	No apparent automatic control	The review finds mixed controls for each of these machines. For at least a portion of the monitoring period, each of these machines show a consistent shut-down pattern indicating automatic control. Mostly the data show a period of poor manual control and another period of automatic control. Perhaps manual overrides prevented automatic controls from working properly. Periods of manual control are opportunities for sequencer savings.
West IR		
East IR		
West Kaeser	No data to determine controls	We will account for this machine proportionally to the other load-staging (non-baseload) machines.

See supplemental discussion of each compressor integrated with ComEd in ComEd’s response from February 17.

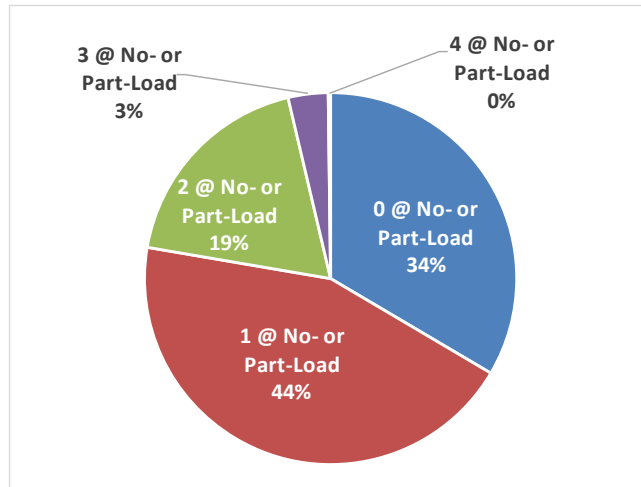
6.2.4 Reduced hours of Multiple machines operating at part- or no-load

After considering several different approaches to estimating savings for this project, we determined that the factor of multiple machines operating in idle or part-load is the most relevant for this project. Ideally, a sequencer will minimize the number of machines loaded to deliver the required air to the loads and minimize the number in no-load or part-load, just as the manual operation attempted to do, but with better results (hopefully). As with all controls, the sequencer will be imperfect as each machine has its own

individual controls to prevent damage or un-necessary cycling. Thus even with the sequencer there will be occasions when excess machines operate.

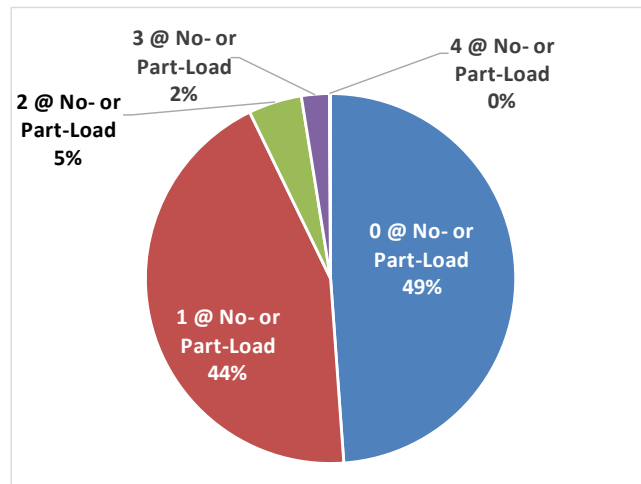
We analyzed the pre-installation and post-installation data to determine the number of machines running at no-load or part-load at each measurement interval and determined a distribution of partly or fully unloaded machines. For each interval we also determined the average kW for the no-load and part-load machines. During the pre-installation period one machine did not have data so we assumed it operated in the under-loaded states the same proportion of hours as the other non-baseload machines.

Figure 6. Number of compressors operating in the no-load or part-load state Pre-installation



The average number of pre-installation machines operating under-loaded is 1.11 machines at all times, and the average power consumption of those no-load and part-load machines is 83.1 kW.

Figure 7. Number of compressors operating in the no-load or part-load state Post-installation



Similarly, the new sequencer is able to operate the system with an excess of only 0.61 machines. On average, the sequencer reduces the number of no-load and part-load machines by 0.50 compressors. The direct savings from the sequencer is

Avoided excess kWh = 83.1 kW/machine x (0.5 excess machines) x 8760 hours = 365,800 kWh.

6.2.5 System Performance curve concerns

The savings estimate methodology no longer uses performance curves, but instead uses the measured power of the no-load and part-load machines to determine average power consumption of the excess operating machines.

6.2.6 Normalization concerns

Normalization of airflow is not necessary with this methodology as we can see from the data that operators manually, or local controllers automatically, shut-down equipment. We can now compare and conclude that the sequencer is an improvement on the baseline start-stop regimen.

6.2.7 Pressure reduction Savings

Finally, we address a factor that was omitted in the prior review, system pressure reduction as an indirect benefit of the sequencer. Though included in the initial evaluated savings, the prior review only looked at the potential for compressor savings due to no-load and part-load hours, but we did not include pressure reduction savings.

Since system pressure reduction is only noted by the evaluators and not measured or trended we have very little data to base an analysis on. Using pressure reduction to estimate changes in airflow is a non-starter as ComEd objects to that methodology. The pressure reduction savings estimate will use the industry-standard rule-of-thumb: 1% savings for each 2 PSI reduction in system pressure. The reported reduction is 9 PSI, thus a 4.5% savings from the baseline annual compressor consumption of 12,900,000 kWh.

6.2.8 Conclusions

This review revises the evaluation findings upwards; however, the revised savings are still short of initial utility estimates. The primary reason for the discrepancy is the erroneous assumption that the baseline controls were fully manual and poorly executed. In fact, we find that several machines had fully automatic shut-down sequences and others were adequately monitored by the operators to reduce excessive operation in no-load conditions. An apparent reduction in compressed air demand in the post-installation period would have resulted in excess machines in the no-load state until local automatic controls or operators manually shut them down, as is evidenced in the baseline period.

This project is analogous to installing a lighting control system in a facility where 25% of the space is occupied by 24x7 operations that never shut down, 25% of the space already has good occupancy sensors and 50% of the space has inconsistent occupancy sensors, but the workers are pretty good at remembering to turn off lights. There is not a lot of room for improvement with the new controls.

The analysis concludes that the sequencer does a better job than the baseline, but only incrementally better.

Pressure reduction savings are 580,500 kWh, based on the industry rule-of-thumb for pressure reduction effects on compressor power. Total project savings is 946,300 kWh and 108 kW.

	kW savings	kWh Savings
Program Reported	447.37	3,757,870
Evaluation	89.18	583,657
Third-Party Review	108.00	946,300