Guidehouse

ComEd Industrial Energy Management Impact Evaluation Report

Energy Efficiency / Demand Response Plan: Program Year 2020 (CY2020) (1/1/2020-12/31/2020)

Prepared for:

ComEd

FINAL

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Table of Contents

List of Tables and Figures

1. Introduction

This report presents results from the CY2020 impact evaluation of ComEd's Industrial Energy Management (IEM) Program. It summarizes the total energy and demand impacts for the program broken out by relevant measure and program structure details. The appendices provide the impact analysis methodology and details of the total resource cost (TRC) inputs. CY2020 covers January 1, 2020 through December 31, 2020.

2. Program Description

The IEM Program provides customers with resources to design and implement a customized energy management program. The IEM Program is part of the Industrial Systems Program but has its own NTG value[1]. Cascade Energy implements this program and helps the customers identify no- and low-cost opportunities to reduce their usage and also provides recommendations and implements energy efficiency measures where capital cost is needed. The low-cost projects are referred to as operations and maintenance (O&M) projects and the savings for these projects will be closed out on an annual calendar year cycle. The minimum commitment is for 1 year and the customer will have options for renewal at the end of the year.

The program started in CY2020 with 13 participants and distributed 103 measures across only O&M projects as Table 2-1 shows. No capital projects were completed in CY2020.

Table 2-1. CY2020 Volumetric Findings Detail

Participation	O&M
Participants	13
Total Measures	103
Number of Units per Project	7.9
Installed Projects	13

Source: ComEd tracking data and evaluation team analysis

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand savings the IEM Program achieved in CY2020. The evaluation team did not identify any gas savings associated with the program.

[1] Source: Revised Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021 memo sent to ComEd in April 2021.

Table 3-1. CY2020 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Summer Peak* Demand Savings (kW)
Electricity		
Ex Ante Gross Savings	3,935,668	NR
Program Gross Realization Rate	1.00	NA
Verified Gross Savings	3,945,821	95
Program Net-to-Gross Ratio (NTG)	1.00	1.00
Verified Net Savings	3,945,821	95
Converted from Gas†		
Ex Ante Gross Savings	0	NA
Program Gross Realization Rate	NA	NA
Verified Gross Savings	0	NA
Program Net-to-Gross Ratio (NTG)	NA	NA
Verified Net Savings	0	NA
Total Electric Plus Gas		
Ex Ante Gross Savings	3,935,668	NR
Program Gross Realization Rate	1.00	NA
Verified Gross Savings	3,945,821	95
Program Net-to-Gross Ratio (NTG)	1.00	1.00
Verified Net Savings	3,945,821	95

NA = not applicable (refers to a piece of data cannot be produced or does not apply).
* The coincident summer peak period is defined as 1:00 p.m.-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

Source: ComEd tracking data and evaluation team analysis

NTG Source: Revised Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021 memo sent to ComEd in April 2021.

4. Cumulative Persisting Annual Savings

Table 4-1 shows the verified gross savings for the IEM Program and the cumulative persisting annual savings (CPAS) in CY2020. Figure 4-1 shows the savings across the useful life of the measures. The electric CPAS across all measures installed in 2020 is 3,945,821 kWh (Table 4-1). Figure 4-1 shows the savings across the useful life of the measures. The historic rows in each table are the CPAS contribution back to CY2018. Since this is a new program there are no historic savings from previous years.

The evaluation team found no gas savings for this program attributable to ComEd and as such electric CPAS is equivalent to total CPAS.

Table 4-1. Cumulative Persisting Annual Savings (CPAS) – Electric

End Use Type	Research Category	EUL	CY2020 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings (Including Those Converted from Gas Savings) 2018	2019	2020	2021	2022	2023	2024	2025	2026
O&M	O&M	5.0	3,945,821	1.00	19,729,105			3,945,821	3,945,821	3,945,821	3,945,821	3,945,821		
CY2020 Program Total Contribution to CPAS			3,945,821		19,729,105			3,945,821	3,945,821	3,945,821	3,945,821	3,945,821	-	-
Historic Program Total Contribution to CPAS‡						-	-	-	-	-	-	-	-	-
Program Total CPAS						-	-	3,945,821	3,945,821	3,945,821	3,945,821	3,945,821	-	-
CY2020 Program Incremental Expiring Savings§									-	-	-	-	3,945,821	-
Historic Program Incremental Expiring Savings‡§								-	-	-	-	-	-	-
Program Total Incremental Expiring Savings§								-	-	-	-	-	3,945,821	-

Note: The green highlighted cell shows the program's total first year electric savings. The gray cells are blank, indicating values irrelevant to the CY2020 contribution to CPAS.

* Source: Revised Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021 memo sent to ComEd in April 2021.

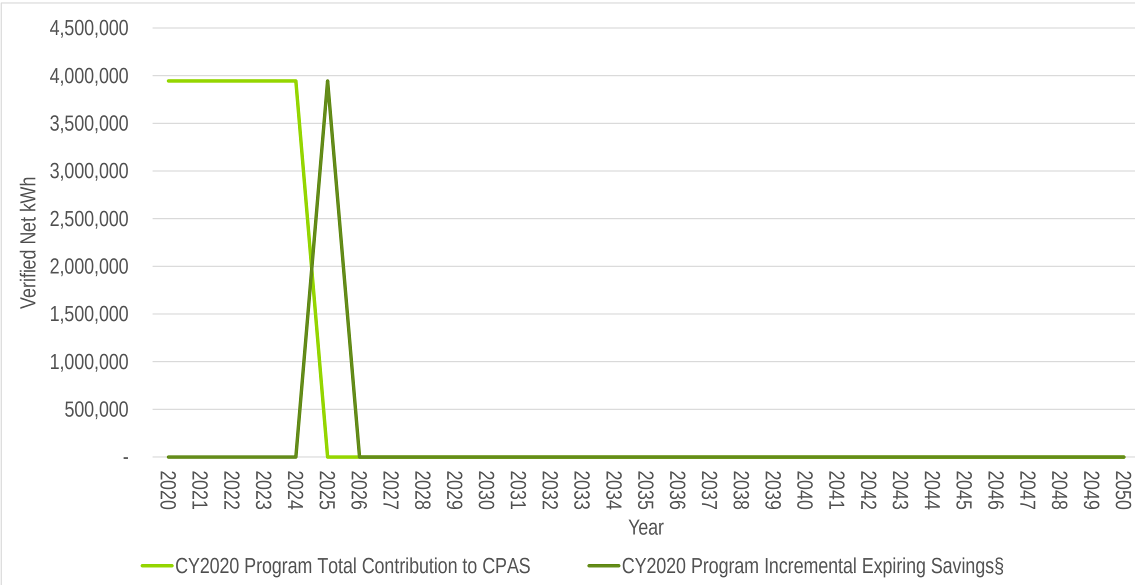
† Lifetime savings are the sum of CPAS savings through the effective useful life (EUL).

‡ Historical savings go back to CY2018.

§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.

Source: Evaluation team analysis

Figure 4-1. Cumulative Persisting Annual Savings



§ Expiring savings are equal to CPAS Y_{n-1} - CPAS Y_{n}.

Source: Evaluation team analysis

5. Program Savings by Measure

There is only one measure in this program in CY2020 (O&M) and so measure-level results are the same as the program-level results discussed in the previous section.

6. Impact Analysis Findings and Recommendations

6.1 Impact Parameter Estimates

The evaluation team used bottom-up calculations for each measure to estimate the savings for the O&M projects where they did not use a regression-based model. For the bottom-up engineering calculations, the evaluation team used site-specific input parameters either based on logged metered data, interviews with the site contact, or engineering assumptions.
The assumptions or the rationale behind some of the input parameters like affinity factors and power factors were not documented in the project files. Table 6-1 shows the range of values used for these input parameters. .

Table 6-1. Input Parameter Ex Ante Values

Input Parameters	Ex Ante Values
Power Factors (Induction Motor Applications)	These values typically ranged from 0.82 to 0.9 in the calculators
Power Factors (Electronically Commutated Motor (ECM) Applications)	
Power Factors (VFD Applications)	
Affinity Factors (Fans)	Calculations typically used 2.7
Affinity Factors (Pumps)	

Source: Evaluation team analysis of program documents

As this is the first year of the program, the evaluation team makes no recommendations for changes to these values. However, we will prioritize working with ComEd to ensure consistent and accurate approaches when using engineering assumptions in bottom up calculations.

6.2 Other Impact Findings and Recommendations

The evaluation team developed several recommendations based on findings from the CY2020 evaluation.

Finding 1. The projects where the evaluation team calculated savings using a bottom-up approach often used standard variables like power factors or affinity factors in their calculations. In many cases, factors like the power factors were not measured values. For power factors, these standard values ranged from 0.82 to 0.9 for most applications. For affinity factors, the typical value used was 2.7. The evaluation team did not revise the calculations based on this finding, as we recognize this is the first year of the program, and no prior guidance has been given on standard values like these.

Recommendation 1. The evaluation team recommends further discussions between the evaluation team and ComEd to ensure aa consistent methodology when using engineering estimates for values like power factors and affinity factors. Consistency across projects and across programs for deemed or standard variables will ensure that differences in assumptions are not driving variances in savings for similar measures. Where project-specific information warrants alternative values, documentation should be provided by ComEd to support the changes from these recommended values.

Finding 2. O&M projects using bottom-up calculations often involve measures that may interact or overlap. One project had two measures that affected the same piece of equipment, yet both measure savings were based on the same baseline energy consumption. This resulted in double counting of the savings.

Recommendation 2. For O&M projects using bottom-up calculations and not a whole building model, ensure that projects with multiple measures affecting the same equipment accurately handle the interactive effects or overlaps between multiple measures and do not double count the savings.

Finding 3. One project used amp loggers to monitor a lighting measure involving shutting off lights at nights and weekends. The downside to using amp loggers to monitor lighting is that lighting is not often the only load on the circuit. Without clarifying the number of lights metered, the areas metered, and what other loads are on the circuits, it makes it difficult to conclude the overall lighting load and the effect of measure implementation. Lighting loggers are easier to use, don't require calibration to the load, or further exploration of the load on the circuit.

Recommendation 3. The implementation team should use lighting loggers to monitor both pre- and post-improvement lighting usage rather than amp loggers, where data logging is warranted or installed. One or 2 weeks of lighting logger data should be sufficient to determine if the lights follow a schedule. ComEd should support a sufficient sample of lights in different areas and keep track of the number of lights each logger represents. The number of emergency fixtures that are always on should also be noted in the project documentation and accounted for in the analysis.

Finding 4. For O&M projects where savings were estimated using a regression-based model, there were often more unconventional variables used in the model. While the evaluation team found the models to result in a good fit, it would be useful if the project documentation clarified how these regression variables are developed.

Recommendation 4. Explanations or analysis showing the thought process behind how different regression variables are chosen (especially the more obscure variables) should be provided by the implementation team in the site reports.

Finding 5. The site-level reports provide high level descriptions about the measures implemented but rarely do they provide details about the facility, production, or operation. For example, there was a project that provided savings to chilled water operation but it was not clear what the chiller was used for, facility cooling or process cooling. This type of information is crucial to determine how savings should or could be normalized to a typical year. Similarly, many measures claimed continuous operation but often did not take facility or equipment downtimes into account. Ensuring this documentation makes its way into the site reports also helps to make sure data like facility downtimes and operation is properly accounted for in the analysis. There was one project where the site contact informed the evaluation team they are closed five days a year, but the ex ante calculations used 8760 hours of run time in their analysis.

Recommendation 5. The evaluation team recommends that the site report includes documentation on facility type, facility operation, and equipment operations. This will provide a more complete picture of the project upfront and allow the evaluation team to better tailor questions for their interview with the site contact.

Finding 6. There were several projects that had installed meters to log the amps of the equipment but the meter data was not used to estimate the savings. Instead, they used general assumptions to estimate the savings.

Recommendation 6. For projects using measure-specific bottom-up calculations, the implementation team should use actual metered data to calculate savings where appropriate. Using site-specific data when available will provide a more accurate estimate of savings than using generic assumptions.

Finding 7. Measures are installed over the course of the implementation year. For O&M projects using regression model-based projects, this means that the full impact of certain measures, especially those installed later in the program year, may not be captured in the model due to installation timing. While this may underestimate savings in the current implementation year, it is expected that these savings will be fully captured in the following year if the customer continues to participate in the program.

Appendix A. Impact Analysis Methodology

For CY2020, the evaluation team reviewed a census of projects. The evaluation team calculated gross savings for the CY2020 IEM Program using the implementer-provided calculation methodologies—either whole building regression-based models or bottom-up engineering calculations for each measure. The evaluation team took the following steps for each project:

- Reviewed the ex ante documentation provided by ComEd, namely the site reports and the final calculation workbooks or models.
- For whole building regression-based models:
  - Replicated the final and all alternative baseline models to ensure the accuracy of the reported baseline and validated that the variables employed (and their resulting parameter estimates) were intuitive and defensible.
  - Verified that the input data did not include outliers in both the baseline and impact estimation periods and made sure that any deviations to the normal operation were either removed or explained. This included ensuring that any out-of-model adjustments were correctly implemented. For these projects, no further follow up with the site contact was necessary.
  - Reviewed alternate models to ensure that the final ex ante model provided the best representation of savings. For these projects, the evaluation team agreed with the models and no changes were made.
- For measure-specific bottom-up engineering calculations:
  - Reviewed each measure individually to ensure that an appropriate algorithm was used and that applicable inputs and assumptions went into those algorithms.
  - Analyzed logging data for outliers in both the baseline and impact estimation periods and made sure that any deviations to the normal operation were either removed or explained.
  - Interviewed site contacts where necessary about pre- and post-improvement facility and equipment operation and runtimes, equipment assumptions in the workbooks, and any other questions that arose from the review of the ex ante workbooks.
  - Identified measures that would run at full load during the summer peak period and where peak demand reduction could be calculated.[2]
- Modified the overall models as needed, either from the databook reviews or from the interviews with the site contact. No changes were made to any of the engineering adjustment factors, but Section 6 includes recommendations to ensure consistency among projects and other ComEd programs.

[2] 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.

- Reviewed the approach taken to annualize the savings, ensuring that whole building regression-based models were weather normalized, and that measure-specific bottom-up engineering calculations accounted for any annual facility or equipment downtime.
- Calculated a final realization rate for each project based on any changes made to the models.

A.1 Impact Analysis Detail

Table A-1 provides site-level impacts. Most projects received only minor changes to their savings.

Table A-1. CY2020 Project-Level Results

Site Number	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross Realization Rate	Ex Ante Gross Peak Demand Savings (kW)	Verified Peak Demand Savings (kW)	Verified Gross Peak Demand Realization Rate	NTG*	Verified Net Savings (kWh)	Verified Net Peak Demand Savings (kW)	EUL (years)
Site 1	O&M	797,395	797,395	100%	0	10	NA	1.00	797,395	10	5.0
Site 2	O&M	793,351	793,351	100%	0	74	NA	1.00	793,351	74	5.0
Site 3	O&M	773,401	773,401	100%	0	1	NA	1.00	773,401	1	5.0
Site 4	O&M	628,606	628,606	100%	0	0	NA	1.00	628,606	0	5.0
Site 5	O&M	211,294	210,099	99%	0	0	NA	1.00	210,099	0	5.0
Site 6	O&M	161,548	161,548	100%	0	0	NA	1.00	161,548	0	5.0
Site 7	O&M	107,373	107,373	100%	0	0	NA	1.00	107,373	0	5.0
Site 8	O&M	96,260	96,238	100%	0	9	NA	1.00	96,238	9	5.0
Site 9	O&M	95,085	95,085	100%	0	0	NA	1.00	95,085	0	5.0
Site 10	O&M	90,591	90,591	100%	0	0	NA	1.00	90,591	0	5.0
Site 11	O&M	84,979	84,979	100%	0	0	NA	1.00	84,979	0	5.0
Site 12	O&M	75,008	81,290	108%	0	2	NA	1.00	81,290	2	5.0
Site 13	O&M	20,777	25,865	124%	0	0	NA	1.00	25,865	0	5.0
	Total	3,935,668	3,945,821	100%	0	95	NA	NA	3,945,821	95	NA

* Revised net-to-gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021 memo sent to ComEd in April 2021Source: ComEd tracking data and evaluation team analysis

Only sites 12 and 13 saw changes that affected their overall savings by 5% or more. Site 5 and site 8 also saw minor modifications to their savings. The following list includes descriptions of changes made to project savings:

Site 5

The evaluation team used a bin analysis to calculate savings resulting from optimized compressed air sequencing. The original analysis did not include data below 1,000 scfm. The only change made was to adjust the bins slightly to include data down to 800 scfm.

Site 8

This site involved multiple measures affecting various end uses. One measure involved adjusting and locking the production room thermostats so they were all the same temperature. Another measure involved fixing damaged strip curtains in the production area. The baseline energy consumption for the strip curtain measure used the baseline energy consumption of the rooftop units. As this double counted the savings from the thermostat adjustment measures, the baseline of the strip curtain measure was changed to the post-consumption of the thermostat adjustment measure.

Site 12

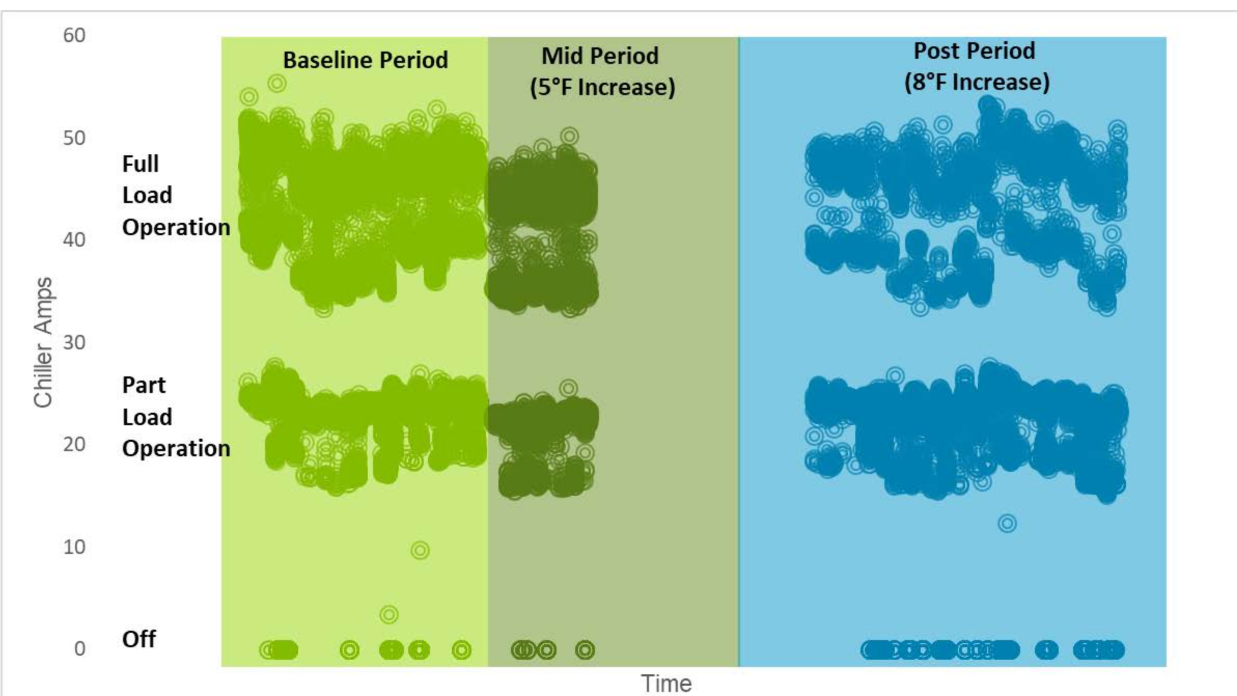
The only change made by the evaluation team to this project had to do with the suction and discharge temperatures based on the pressure-temperature chart for ammonia. It appears that the ex ante calculations roughly estimated the applicable temperature based on the suction and discharge temperatures. Because a trendline can be drawn that accurately represents the pressure-temperature relationship of ammonia, we used this trendline to calculate a more accurate temperature based on the provided pressures. Overall, the savings increased by 8% for this project.

Site 13

This project involved the customer increasing the chiller setpoint temperature by 5°F for 7 months, and by 8°F for the remaining 5 months. The ex ante calculations used a different approach for each time of the year. The ex ante approach calculated savings from raising the temperature 5°F based on metering data, which took an average amperage, converted it to power, and multiplied by 8,760 hours per year. The savings for the additional 3°F were calculated using the assumption that raising the temperature by 1°F would provide 2% energy savings. It was not clear why the ex ante calculations took a different approach taken for both periods when there was logging data for all periods.

The evaluation team used the logger data to come up with average power and a percent runtime when the system is operating at full load, part load, and off for the baseline period, mid period (5°F temperature increase), and post period (8°F temperature increase). We used this data to determine overall savings for this project. See Figure A-1 and Table A-2.

Figure A-1. Site 13 Metering Data



Source: Evaluation team analysis

Table A-2. Site 13 Average Power and Run Times

	Baseline		Mid (5 °F)		Post (8 °F)	
	% Run	Average Power (kW)	% Run	Average Power (kW)	% Run	Average Power (kW)
Full Load	48%	24.29	38%	22.89	12%	24.51
Part Load	50%	13.14	61%	12.35	83%	13.00
Off	2%	-	1%	-	5%	-

Source: Evaluation team analysis

Additionally, a minor change was made to the overall hours of operation. The site contact reported that the facility is shut down for 5 days a year. Overall, the savings for this project increased by 24%.

Appendix B. Total Resource Cost Detail

Table B-1 shows the TRC cost-effectiveness analysis inputs available at the time of finalizing this impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to the evaluation team later.

Table B-1. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	EUL (years)*	ER Flag †	Gross Electric Energy Savings (kWh)	Gross Peak Demand Reduction (kW)	Gross Gas Savings (Therms)	Gross Secondary Savings due to Water Reduction (kWh)	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG (kWh)	NTG (kW)	NTG (Therms)	Net Electric Energy Savings (kWh)	Net Peak Demand Reduction (kW)	Net Gas Savings (Therms)	Net Secondary Savings due to Water Reduction (kWh)	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
O&M	O&M	Projects	12	5.0	No	3,945,821	94.67	NA	NA	NA	NA	1.00	1.00	NA	3,945,821	95	NA	NA	NA	NA
	Total			5.0		3,945,821	95	NA	NA	NA	NA	NA	NA	NA	3,945,821	95	NA	NA	NA	NA

* The total of the EUL column is the weighted average measure life (WAML) and is calculated as the sum product of the EUL and measure savings divided by total program savings.

† Early replacement (ER) measures are flagged as YES; otherwise a NO is indicated in the column.

Source: ComEd tracking data and evaluation team analysis