ComEd Industrial Energy Management Impact Evaluation Report

Energy Efficiency/Demand Response Plan:
Program Year 2021 (CY2021)
(1/1/2021-12/31/2021)

Prepared for:

ComEd

FINAL

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1. Introduction

This report presents the results of the impact evaluation of the CY2021 Industrial Energy Management (IEM) Program.

It summarizes the total energy and demand impacts for the program broken out by relevant measures and program structure details. The appendices provide the impact analysis methodology and details of the total resource cost (TRC) analysis inputs. CY2021 covers January 1, 2021, through December 31, 2021.

2. Program Description

The IEM Program provides customers with resources to design and implement a customized energy management program. This program is part of the Industrial Systems Program. Cascade Energy implements this program and:

- Helps customers identify no- and low-cost opportunities to reduce their usage
- 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; the savings for these projects are closed out on an annual calendar year cycle. The minimum commitment is 1 year, and the customer has options to renew at the end of the year. For CY2021, the capital measures included refrigeration, variable speed drives (VSD), compressed air, and economizers. The program had 35 participants with savings in CY2021 (see Table 2-1).

Table 2-1. Number of Participants

Participation	Total
Total Participants with O&M Measures	35
Total Participants with Capital Measures	5
Total Participants	**35**

Note: Five participants have both capital and O&M measures, so the total number of participants is 35.

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 CY2021. There were no gas savings reported for this program, and the evaluation team did not identify any gas savings associated with the program.

Table 3-1. Total Annual Incremental Electric Savings

Savings Category	Units	Ex Ante Gross Savings	Program Gross Realization Rate	Verified Gross Savings	Program Net-to-Gross Ratio (NTG) ‡	CY2019 Net Carryover Savings	CY2020 Net Carryover Savings	Verified Net Savings
Electric Energy Savings	kWh	10,597,231	1.01	10,668,396	Varies	N/A	N/A	10,523,099
Electric Energy Savings - Converted from Gas	kWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total Electric Energy Savings	kWh	10,597,231	1.01	10,668,396	Varies	N/A	N/A	10,523,099
Summer Peak§ Demand Savings	kW	-	N/A	-	N/A	N/A	N/A	N/A

Note: The “Verified Net Savings” in row one (Electric Energy Savings) includes primary kWh savings as a result of measure implementation. It does not include carryover savings, secondary kWh savings from wastewater treatment or electric heating penalties as they don’t apply to this program.

N/A = not applicable (refers to a piece of data that cannot be produced or does not apply).

§ The coincident summer peak period is defined as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

‡ Source: Guidehouse memo to ComEd titled “Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021.” Dated April 14, 2021.

Source: ComEd tracking data and evaluation team analysis

4. Cumulative Persisting Annual Savings

Table 4-1 and Figure 4-1 show the measure-specific and total verified gross savings for the IEM Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2021. The electric CPAS across all measures installed in 2021 is shown in Table 4-1. The historic rows in each table are the CPAS contribution back to CY2020. Figure 4-1 shows the savings across the effective useful life (EUL) of the measures.

There were no gas savings reported or evaluated for this program, so electric CPAS is equivalent to total CPAS.

Table 4-1. Cumulative Persisting Annual Savings – Electric

End Use Type	Research Category	EUL	CY2021 Verified Gross Savings (kWh)	NTG*	Lifetime Net Savings (kWh)†	Verified Net kWh Savings 2018	2019	2020	2021	2022	2023	2024	2025	2026
O&M	O&M	5.0	10,036,668	1.00	50,183,342				10,036,668	10,036,668	10,036,668	10,036,668	10,036,668	
Capital	Refrigeration	20.0	310,333	0.77	4,779,130				238,957	238,957	238,957	238,957	238,957	238,957
Capital	VSD	15.0	161,519	0.77	1,865,550				124,370	124,370	124,370	124,370	124,370	124,370
Capital	Compressed Air	13.0	103,082	0.77	1,031,847				79,373	79,373	79,373	79,373	79,373	79,373
Capital	Economizer	10.0	56,794	0.77	437,313				43,731	43,731	43,731	43,731	43,731	43,731
CY2021 Program Total Electric Contribution to CPAS			**10,668,396**		**58,297,181**				**10,523,099**	**10,523,099**	**10,523,099**	**10,523,099**	**10,523,099**	**486,431**
Historic Program Total Electric Contribution to CPAS‡								**3,945,821**	**3,945,821**	**3,945,821**	**3,945,821**	**3,945,821**	**-**	**-**
Program Total Electric CPAS								**3,945,821**	**14,468,920**	**14,468,920**	**14,468,920**	**14,468,920**	**10,523,099**	**486,431**
CY2021 Program Incremental Expiring Electric Savings§														**10,036,668**
Historic Program Incremental Expiring Electric Savings‖													**3,945,821**	**-**
Program Total Incremental Expiring Electric Savings#													**3,945,821**	**10,036,668**

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
O&M	O&M												
Capital	Refrigeration	238,957	238,957	238,957	238,957	238,957	238,957	238,957	238,957	238,957	238,957	238,957	238,957
Capital	VSD	124,370	124,370	124,370	124,370	124,370	124,370	124,370	124,370	124,370			
Capital	Compressed Air	79,373	79,373	79,373	79,373	79,373	79,373	79,373					
Capital	Economizer	43,731	43,731	43,731	43,731								
CY2021 Program Total Electric Contribution to CPAS		**486,431**	**486,431**	**486,431**	**486,431**	**442,699**	**442,699**	**442,699**	**363,326**	**363,326**	**238,957**	**238,957**	**238,957**
Historic Program Total Electric Contribution to CPAS‡		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Electric CPAS		**486,431**	**486,431**	**486,431**	**486,431**	**442,699**	**442,699**	**442,699**	**363,326**	**363,326**	**238,957**	**238,957**	**238,957**
CY2021 Program Incremental Expiring Electric Savings§		**-**	**-**	**-**	**-**	**43,731**	**-**	**-**	**79,373**	**-**	**124,370**	**-**	**-**
Historic Program Incremental Expiring Electric Savings‖		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Incremental Expiring Electric Savings#		**-**	**-**	**-**	**-**	**43,731**	**-**	**-**	**79,373**	**-**	**124,370**	**-**	**-**

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
O&M	O&M												
Capital	Refrigeration	238,957	238,957										
Capital	VSD												
Capital	Compressed Air												
Capital	Economizer												
CY2021 Program Total Electric Contribution to CPAS		**238,957**	**238,957**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Program Total Electric Contribution to CPAS‡		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Electric CPAS		**238,957**	**238,957**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CY2021 Program Incremental Expiring Electric Savings§		**-**	**-**	**238,957**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Historic Program Incremental Expiring Electric Savings‖		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Program Total Incremental Expiring Electric Savings#		**-**	**-**	**238,957**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Note: The green highlighted cell shows program total first-year electric savings. The gray cells are blank, indicating values irrelevant to the CY2021 contribution to CPAS.

* A deemed value. Source: Guidehouse memo to ComEd titled “Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021.” Dated April 14, 2021.

† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Historic savings go back to CY2020.

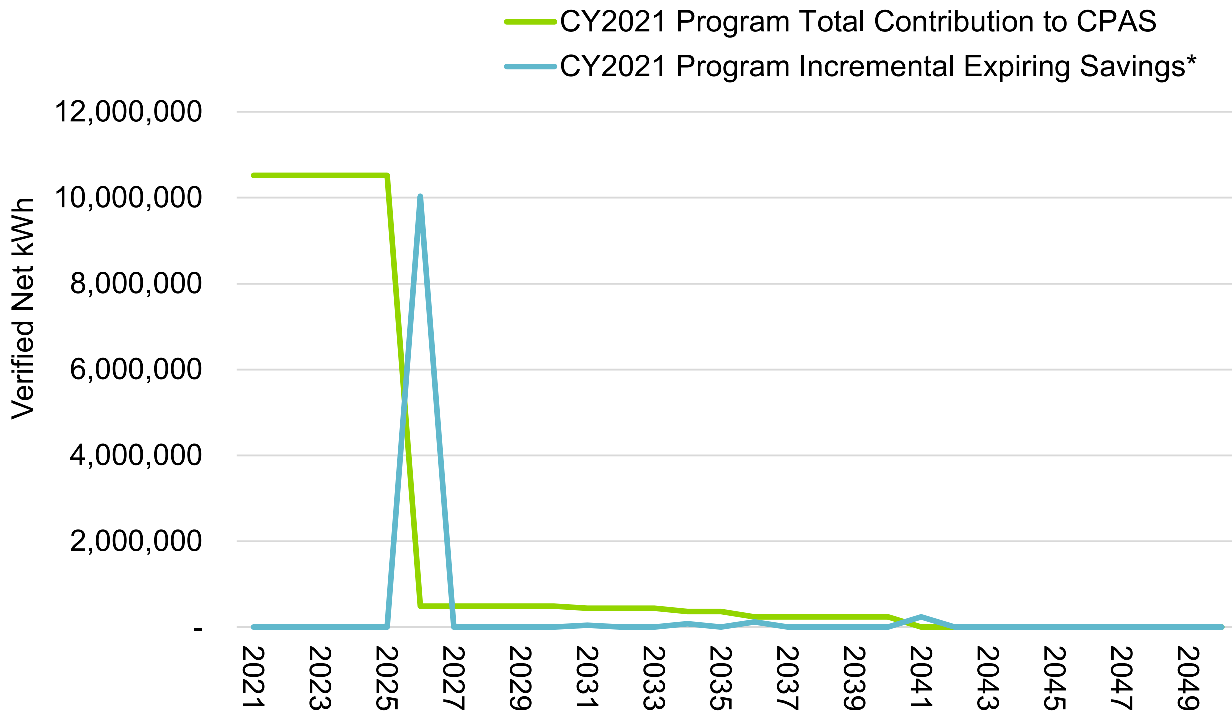
§ Incremental expiring savings are equal to CPAS Y_{n-1} - CPAS Y_n.

|| Historic incremental expiring savings are equal to Historic CPAS Yn-1 – Historic CPAS Yn

Program total incremental expiring savings is equal to current year total incremental expiring savings plus historic total incremental expiring savings.

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

The program included the measures shown in Table 5-1 and Figure 5-1.

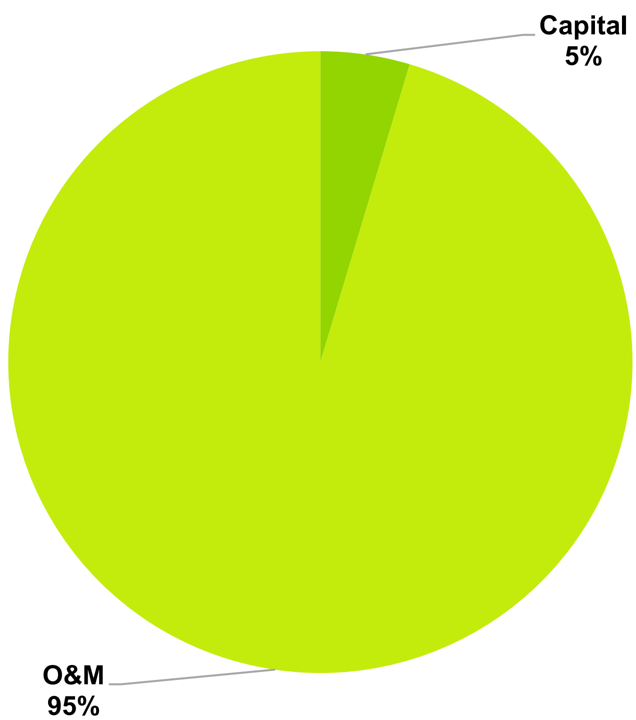
Table 5-1. Number of Measures by End Use Type

End Use Type	Research Category	Total Participants
O&M	O&M	35
Capital	Refrigeration	1
Capital	VSD	1
Capital	Compressed Air	2
Capital	Economizer	1
	Total	**35**

Note: Five participants have both capital and O&M measures, so the total number of participants is 35.

Source: ComEd tracking data and evaluation team analysis

Figure 5-1. Verified Net Savings by End Use Type – Electric



Source: ComEd tracking data and evaluation team analysis

Measure-level energy savings are provided in Table 5-2. These tables provide the verified net energy savings by measure type. The evaluation sample for the IEM participants was drawn at the strata level, not at the measure level. Therefore, the sample results were rolled up to the population rather than at the measure level. The verified gross savings for each research category was estimated by multiplying the realization rate for each end use type with the ex ante savings estimates. ComEd does not report peak demand reduction for the IEM program, and no peak demand reductions were evaluated.

Table 5-2. Energy Savings by Measure – Electric

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)	EUL (years)
O&M	O&M	9,969,717	1.01	10,036,668	1.00	10,036,668	5.0
Capital	Refrigeration	308,263	1.01	310,333	0.77	238,957	20.0
Capital	VSD	160,442	1.01	161,519	0.77	124,370	15.0
Capital	Compressed Air	102,394	1.01	103,082	0.77	79,373	13.0
Capital	Economizer	56,415	1.01	56,794	0.77	43,731	10.0
	Total	**10,597,231**	**1.01**	**10,668,396**		**10,523,099**	

* A deemed value. Source: Guidehouse memo to ComEd titled “Net-to-Gross (NTG) approach for the ComEd Industrial Energy Management (IEM) Program for CY2020 and CY2021.” Dated April 14, 2021.

Source: ComEd tracking data and evaluation team analysis

6. Impact Analysis Findings and Recommendations

The evaluation team developed several recommendations for ComEd based on findings from the CY2021 evaluation.

Finding 1. Two sampled participant projects had observed metered data that was quite different from the data the evaluation team expected to see based on the ex ante documentation review. In one example, the project notes stated the pump was running at full speed except for a few hours a week, yet the meter data showed very different findings. Through discussions with the customer, the evaluation team received confirmation and additional data demonstrating that the week of meter data was atypical and should not be used in the calculations. Revising the calculations based on this information increased savings for the measure by 20%. For a second measure, compressor usage was significantly different for two different Tuesdays. In conversations with the site contact, it was clear this was due to production, but no normalization due to production was attempted.

> **Recommendation 1.** Validate any logger data collected and used for savings calculations against expected trends. Graphically representing the data helps the engineer see trends that may not be apparent while looking at the raw data. The following types of questions should be asked when looking at the graphical data:
>
> - Does this data represent the expected operation? If the equipment is supposed to operate at full speed throughout the year, does the logger data reflect that? If the equipment is expected to see reduced usage on weekends, does it?
> - Is the data consistent across similar periods (i.e., days of the week, weekends vs. weekdays, nights vs. days, etc.)? If not, are there external factors the data need to be normalized for?
> - When extrapolating data to the rest of the year, is the extrapolation reasonable? Are there any seasonal variations that should be accounted for?

Finding 2. For one participant project, only two out of the four chillers were logged. The ex ante calculations assumed that the other two chillers operated in a similar fashion as those logged. However, the two logged chillers showed very different operation, and there was no documentation that suggested the operation of the two non-logged chillers would see similar operation to that of the logged chillers.

> **Recommendation 2.** When extrapolating logger data to other pieces of non-logged equipment, ComEd should ensure the logged data matches the expected operation on the non-logged equipment. When there are large differences in logged results, documentation should be provided to ensure that the extrapolation to non-logged equipment is reasonable.

Finding 3. The ex ante calculations for one participant project utilized a regression model to calculate energy savings which did not include statistically significant variables in its analysis, even when the comparison models created during the ex ante calculations confirmed their significance and those models showed higher R^2 results. The evaluation team revised the model to include these variables, increasing savings for the model by 11%. Another participant project's ex ante regression model mentioned the significance of regional precipitation data in the model but did not account for it in the final model or provide any indication as to why it was not accounted for.

> **Recommendation 3.** When using a regression model to estimate savings, ensure that all statistically significant variables are accounted for in the final model.

Finding 4. In five of the 12 participant projects in the evaluation sample, the ex ante calculations used both regression models to calculate measure savings and bottom-up calculations[1] to calculate savings for measures implemented after the end date used in the regression model. For at least two of these projects, there should have been sufficient time at the end of the year to true up the model to incorporate the latest measures implemented.

> **Recommendation 4.** Whenever possible, utilizing a single method of savings for the project ensures that potential interactions between measures are accounted for.

Finding 5. Summer peak demand savings were not reported for any measures in the population. For some projects, demand savings have been calculated in the project documentation but not reported. There were other projects that may see summer peak demand savings, but they were not calculated.

> **Recommendation 5.** ComEd should calculate and report PJM peak demand savings when applicable.

[1] Bottom-up calculations estimate the savings for each individual measure based on the site-specific or deemed inputs.

Appendix A. Impact Analysis Methodology

The evaluation team used a stratified random sampling approach to select the gross impact sample of 12 IEM participants.[2] The team sorted each set of projects separately based on the level of ex ante kilowatt-hour (kWh) savings and placed the projects in three strata.

Table A-1 provides a profile of the gross impact measurement and verification sample for the IEM participant in comparison with the IEM population. The resulting sample consists of 12 participants. These projects make up approximately 6.1 million kWh, which represents 58% of the ex ante impact reported for the custom project population. The table also shows the ex ante-based kWh sample weights for each of the three strata.

Table A-1. CY2021 IEM Gross Impact Sample by Strata

	Population Summary			Sample		
Strata	Number of Tracking Records (N)	Ex Ante Gross Savings (kWh)	kWh Weights	Number of Tracking Records (n)	Ex Ante Gross Savings (kWh)	Sampled % of Population kWh
1	4	3,448,195	0.33	4	3,448,195	100%
2	7	3,622,277	0.34	4	2,023,887	56%
3	24	3,526,759	0.33	4	658,063	19%
Total	**35**	**10,597,231**	**1.00**	**12**	**6,130,145**	**58%**

Source: ComEd tracking data and evaluation team analysis

A.1 Extrapolating Sample Results to the Population

There are two basic statistical methods for combining individual gross realization rates from the sample projects into an estimate of verified gross kWh savings for the population: separate and combined ratio estimation.[3]

- For a **separate ratio estimator**, the evaluation team calculates a separate gross kWh savings realization rate for each stratum and then combines them.
- For a **combined ratio estimator**, the evaluation team completes a single gross kWh savings realization rate calculation without first calculating separate gross realization rates by stratum.

The evaluation team used the separate ratio estimation technique to estimate verified gross impacts for the IEM population. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework,[4] which identifies best practices in program evaluation. The team matched these steps to the stratified random sampling method used to

[2] Only four participants had capital measures, and the evaluation team ensured these participants were included in the overall sample. One participant had two capital measures.

[3] A full discussion and comparison of separate versus combined ratio estimation can be found in *Sampling Techniques*, Cochran, 1977, pp. 164-169.

[4] Tec Market Works, *The California Evaluation Framework*, prepared for the California Energy Commission, June 2004. Available at **http://www.calmac.org**.

create the sample for the program. The evaluation team used the standard error to estimate the error bound around the estimate of verified gross impacts.

A.2 Site-Level Savings Methodology

For CY2021, the evaluation team reviewed a sample of participants. The team calculated gross savings for the CY2021 IEM Program using the implementer-provided calculation methodologies—either whole building regression-based models or bottom-up engineering calculations for each measure. The 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 the input data did not include outliers in the baseline and impact estimation periods and made sure 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 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 an appropriate algorithm was used and applicable inputs and assumptions went into those algorithms.
  - Analyzed logging data for outliers in the baseline and impact estimation periods and made sure 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 ex ante workbook reviews.
  - Identified measures that would run at full load during the summer peak period and where peak demand reduction could be calculated.[5]
- Modified the overall models as needed, either from the data reviews or from the interviews with the site contact. No changes were made to any of the engineering adjustment factors.

[5] PJM defines the coincident summer peak period as 1:00-5:00 p.m. Central Prevailing Time on non-holiday weekdays, June through August.

- Reviewed the approach taken to annualize the savings, ensuring that whole building regression-based models were weather-normalized and 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.

Appendix B. Impact Findings Detailed Results

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

Table B-1. CY2021 Project and Measure-Level Results

Participant	Measure Type	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)
2	O&M	1,114,676	1.00	1,114,676
3	O&M	813,141	1.16	946,788
4	O&M	793,483	1.00	793,483
5	O&M	726,895	1.00	726,895
6	O&M	412,357	1.00	412,357
7	O&M	689,267	0.95	653,811
8	O&M & Capital	391,714	1.00	391,714
9	O&M	530,549	1.00	530,549
13	O&M	79,140	1.00	79,140
14	O&M & Capital	159,128	1.02	163,024
29	O&M & Capital	77,696	1.00	77,696
32	O&M & Capital	342,099	0.99	338,386
	Total	**6,130,145**	**1.02**	**6,228,518**

Note: The verified gross realization rates are based on the sampled projects and are unweighted.

Source: ComEd tracking data and evaluation team analysis

Only participants 3 and 7 saw changes that affected their overall savings by 5% or more. The following list includes descriptions of the changes made to project savings, along with additional project-level findings.

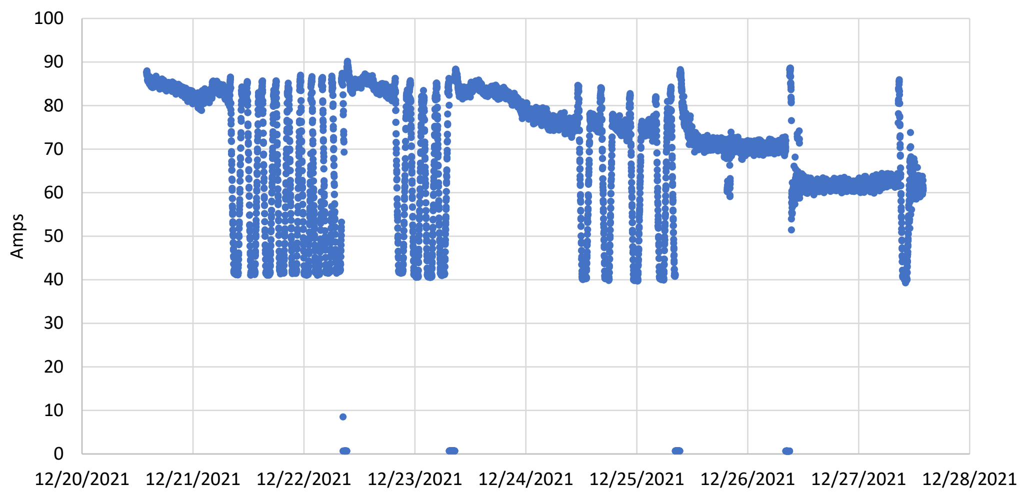
Participant 3: Two major changes were made to the ex ante savings for this project, affecting savings significantly.

- The first is related to the regression-based savings calculated for this project. The ex ante regression model used to calculate savings for the project accounted for only a single independent variable, claiming other variables like flow rates and weather were not statistically significant. The evaluation team found this to be incorrect, and the ex ante comparison models provided in the documentation confirmed the significance of the variables. Furthermore, the single variable in the original ultraviolet (UV) disinfectant model was binary, resulting in just two possible baseline values. The evaluation team revised the model to include influent flow data and cooling degree days as independent variables in addition to the UV disinfectant flag, which was used in the ex ante model. The inclusion of this data increased the model's R^2 value[6] from 0.37 in the ex ante model to 0.54 in the evaluation model. This increased savings for the regression-based model by 11%.

[6] The R^2 value, or the coefficient of determination, is a measurement of the degree of interrelation and dependance between the independent and dependent variables. A higher R^2 value represents a smaller difference between observed data and fitted values.

- The second change had to do with the measure that was calculated using a bottom-up calculation approach. The measure involved taking pumps and blowers permanently offline. The documentation noted the pump was running at full speed except for a few hours a week. However, as Figure B-1 shows, the week of metered data provided showed very different findings. Through discussions with the customer, the evaluation team received confirmation and additional data demonstrating that the week of meter data was atypical and should not be used in the calculations. Revising the calculations based on this information increased savings for the measure by 20%.

Figure B-1. Metered Amp Data for Site 3

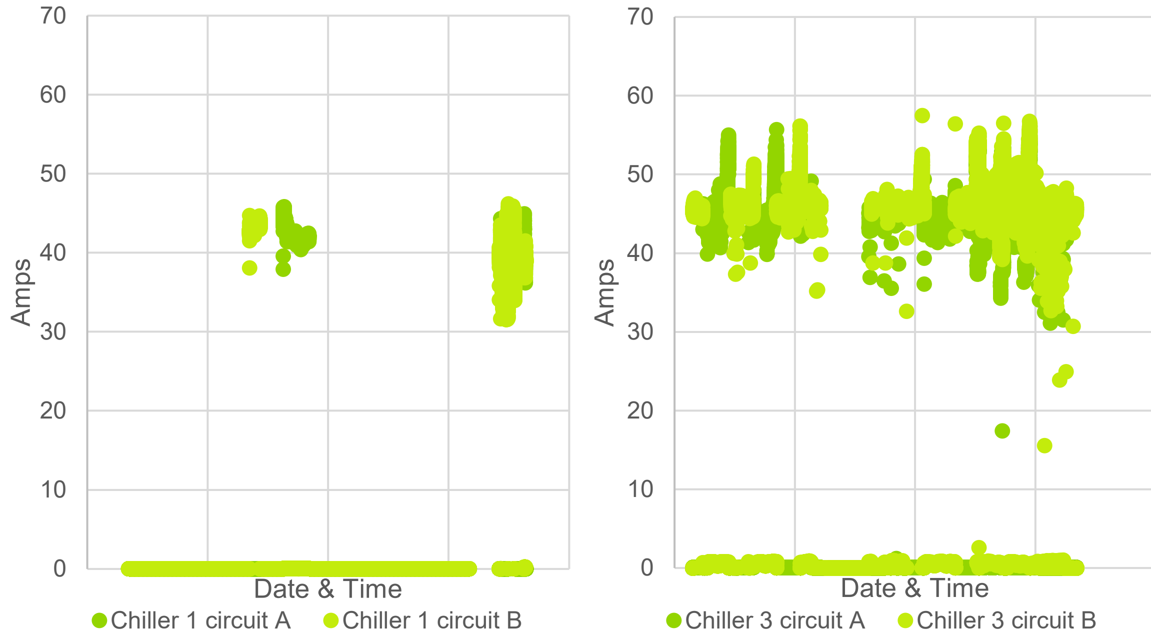


Source: ComEd project documentation for Site 3

Participant 7: Multiple measures are implemented at this facility. One measure involved decreasing the use of the four chillers at the facility due to disabling the hot gas bypass, which created an artificial load on the chillers.

- Three of the four chillers had their amps logged between August 5, 2020, at 2:15 p.m. through August 27, 2020, at 11:05 p.m. However, the average amps, which was used to determine the baseline energy consumption, only used logging data through August 6, 2020, at 3:30 p.m. The evaluation team recalculated the baseline average amps using the full period of logger data. The team removed zeros at the beginning of the logging period and zeros at the end of the logging period but kept the data in the middle that showed a day and a half of downtime. This decreased the overall average amps for the chillers, decreasing the baseline usage by 3% and the savings for that measure by 10%.
- For the post case, the energy consumption for the same measure was again based on logged amp data but using only two of the four chillers (chillers 1 and 3). The ex ante calculations assumed chillers 2 and 4 had a similar operation to chillers 1 and 3. The problem is that chillers 1 and 3 have very different operation, as Figure B-2 shows. There is no documentation suggesting chillers 2 and 4 operate similarly to chillers 1 and 3. The evaluation team tried to verify the operation of chillers 2 and 4 but was unsuccessful.

Figure B-2. Metered Amp Data for Participant 7



Source: ComEd project documentation for Participant 7

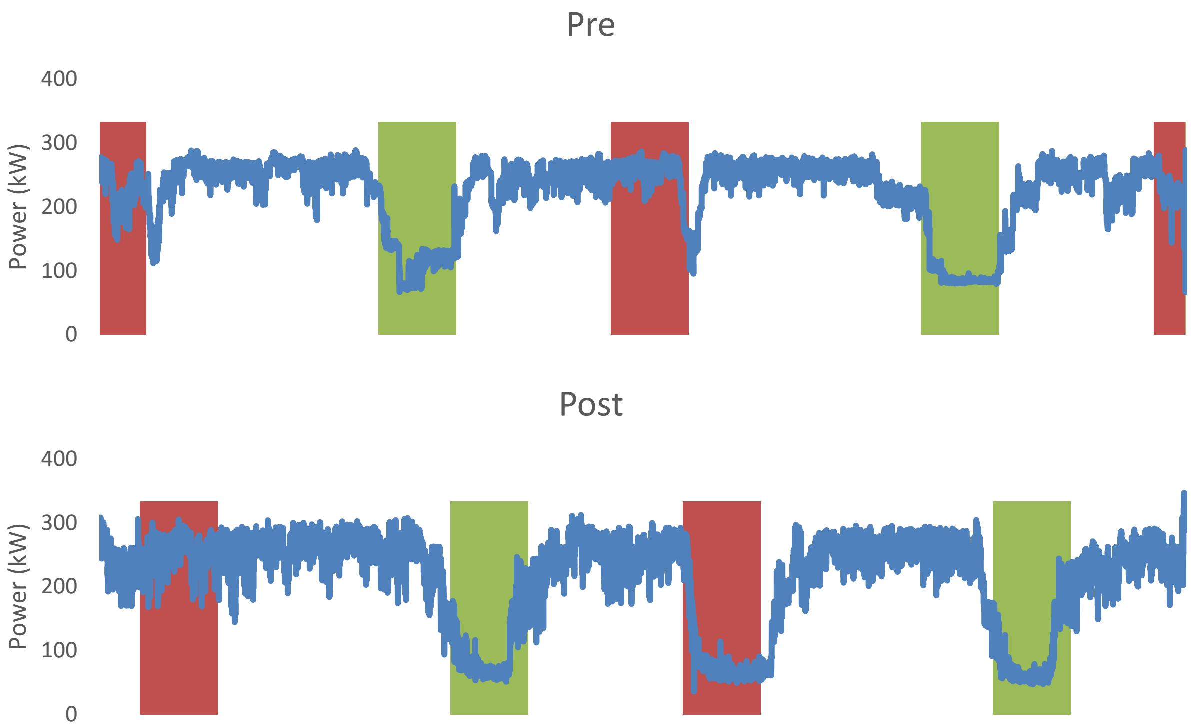
Participant 14: The facility installed an air compressor sequencer, which, according to the Final Energy Report, was designed to efficiently stage the facility's four air compressors. There were five total compressors at the facility, but the documentation states that one failed in late June 2020, prior to installation of the sequencer. Notes state that it may be replaced, but discussions with the Compressed Air Contractor revealed that the compressor was never replaced.

The baseline operation for these compressors appeared to be established using metered data from all five compressors. Two in the boiler room, one on the fourth floor, and two in the RO room. The data loggers monitored the amps for each compressor, along with the total discharge pressure for each of the three rooms. This data was then aggregated into groups by flow rate. However, the final calculations were hardcoded, and it wasn't completely clear how the final numbers were calculated.

The evaluation team attempted to replicate the savings, which increased the overall savings for this capital measure, which increased savings for the overall project by 2%.

Participant 29: This site installed a central management control system on its compressed air system. The documentation stated that prior to the controls, all four air compressors ran continuously to provide system reliability and redundancy, but not all of them were required to meet system demand most of the time. The control system was designed to start and stop the compressors and adjust the capacities to deliver air based on a single setpoint using the minimum number of compressors. The issue the evaluation team uncovered is in terms of seasonal runtimes. The total compressor power during the pre- and post- periods, based on the logger data, is shown in Figure B-3. The periods highlighted in red are Tuesdays and highlighted in green are Saturdays. The site contact confirmed the facility experiences a lower production on Saturdays and occasionally on Tuesdays, especially after Labor Day, as this facility produces hot dogs and hamburgers. Both the pre- and the post-data shows a reduction in power usage on Saturdays. The pre- data shows small dips in Tuesday production, while the post- data shows one Tuesday with a clear reduction, but the other Tuesday as normal production. No normalization to production was performed to ensure these savings are due to the compressed air controls and not just based on changes in operation on Tuesdays.

Figure B-3. Metered Power Data for Participant 29



Source: ComEd project documentation for Participant 29

The evaluation team received weekly production data from the site contact. The data confirmed a reduction in production during the post-metering period production compared to the pre-metering period. However, the weekly data provided was not granular enough to normalize the energy consumption based on this production data. Therefore, the evaluation team did not make any adjustments to the ex ante savings estimate, but crafted Recommendation 1 in Section 6 based on the findings for this site.

Participant 32: This facility installed VFDs on RTU supply fans. The baseline energy usage was established using metered amperage data on each of the 4 RTUs for most of April 2021. The post-installation energy usage was established using approximately two weeks of metered amperage data in early December 2021. Energy savings were calculated using a binned analysis. The project savings calculations accounted for the fact that the site contact informed the implementation team that RTU #1 and #3 would be shut off until spring, and RTU #2 could be shut down when temperatures are consistently below freezing. The ex ante calculations assumed the following shut down and start up dates for each RTU, as shown below in Table B-2.

When the evaluation team verified these shut off and start up dates with the customer, the customer noted that the dates looked reasonable, but that RTU #2 was still running. Based on the reminder, they went ahead and shut it off manually and planned on starting it back up again on March 1st. The evaluation team revised the savings estimates to account for only 8 days of downtime for RTU #2, rather than the estimated 45 days. This reduced the measure's savings by just over 2%, but only affected the entire project by about 1%.

Table B-2. Participant #32 RTU Shut-off and Start-Up Assumptions

RTU #	Shut-off Date	Start-up Date	Total Days Off
RTU-1	12/23/2021	3/1/2021	68
RTU-2	1/15/2021	3/1/2021	45
RTU-3	12/23/2021	3/1/2021	68
RTU-4	N/A	N/A	0

Source: ComEd project documentation for Participant 32

Appendix C. Total Resource Cost Detail

Table C-1 shows the TRC cost-effectiveness analysis inputs available at the time of finalizing this impact evaluation report. This table does not include additional required cost data (e.g., measure costs, program-level incentives, and non-incentive costs). ComEd will provide this data to the evaluation team later.

Table C-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	Participant	35	5.0	NO	10,036,668	0.00	0	0	0	0	1.00	1.00	N/A	10,036,668	0	0	0	0	0
Capital	Refrigeration	Participant	1	20.0	NO	310,333	0.00	0	0	0	0	0.77	0.78	N/A	238,957	0	0	0	0	0
Capital	VSD	Participant	1	15.0	NO	161,519	0.00	0	0	0	0	0.77	0.78	N/A	124,370	0	0	0	0	0
Capital	Compressed Air	Participant	2	13.0	NO	103,082	0.00	0	0	0	0	0.77	0.78	N/A	79,373	0	0	0	0	0
Capital	Economizer	Participant	1	10.0	NO	56,794	0.00	0	0	0	0	0.77	0.78	N/A	43,731	0	0	0	0	0
	Total			**5.7**		**10,668,396**	**0**	**0**	**0**	**0**	**0**				**10,523,099**	**0**	**0**	**0**	**0**	**0**

Note: To avoid double counting, the verified gross kWh and net kWh used in the TRC analysis exclude secondary energy savings from water reduction measures.
* The total of the EUL column is the weighted average measure life (WAML) and is calculated as the sum product of 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