



ComEd Strategic Energy Management Impact Evaluation Report

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

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1. Introduction

This report presents the results of the impact evaluation of the CY2021 Strategic Energy Management (SEM) 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) analysis inputs. CY2021 covers January 1, 2021 through December 31, 2021.

2. Program Description

The goal of the SEM Program is to train participating sites in how to apply a process of continuous energy management improvements that result in energy savings and demand reduction. The program trains participants to identify low-cost and no-cost measures, improve process efficiency, and reduce energy usage and demand through behavioral changes. In CY2021, ComEd, Nicor Gas, Peoples Gas, and North Shore Gas managed the SEM Program.

The program achieves energy savings through operational and maintenance (O&M) improvements, incremental increases in capital energy efficiency projects, and the identification of additional capital projects that would not otherwise have been considered (e.g., process changes, consideration of energy efficiency in all capital efforts). The program provides training and implementer support to identify O&M improvements. This training usually lasts for 1 year and occurs monthly or bimonthly.

Ex ante savings for the SEM Program are calculated using site-specific models using built-in statistical regression analysis and developed by the three implementation contractors (Cascade Energy, Inc., CLEARResult, and Graphet). The energy model uses 2 years of utility data prior to program participation. This data is associated with site information such as production and temperature to create baseline models that estimate a site’s baseline usage based on these variables. After program participation begins, the model compares actual energy consumption to modeled energy consumption. The difference between the modeled energy consumption and actual billing data is the savings claimed by the SEM Program.

The program had 169 electric participants in CY2021 (see Table 2-1).

Table 2-1. Number of Participants and Projects

Participation	Cascade Energy, Inc.	CLEARResult	Graphet	Total
Electric Participants	47	111	11	169

Source: ComEd tracking data and evaluation team analysis

The program has only one installed measure type: the whole building measure.

3. Program Savings Detail

Table 3-1 summarizes the incremental energy and demand¹ savings the SEM Program achieved in CY2021. The gas utilities are claiming all gas savings for this program and their savings are documented in separate evaluation reports.

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 - Direct	kWh	34,128,723	1.00	34,145,568	1.00	N/A	N/A	34,145,568
Electric Energy Savings - Converted from Gas	kWh	0	N/A	0	N/A	N/A	N/A	0
Total Electric Energy Savings	kWh	34,128,723	1.00	34,145,568	1.00	N/A	N/A	34,145,568
Summer Peak§ Demand Savings	kW	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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.

The “Verified Net Savings” in row one (Electric Energy Savings – Direct) 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.

Source: ComEd tracking data and evaluation team analysis

¹ The current SEM models do not estimate demand savings, so Guidehouse does not evaluate claimed reductions in demand. The behavioral and custom nature of the SEM program would require analysis of hourly facility data to accurately verify demand savings.

4. Cumulative Persisting Annual Savings

Table 4-1 and Figure 4-1 show the measure-specific and total verified gross savings for the SEM 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 CY2018. The Program Total Electric CPAS is the sum of the CY2021 contribution and the historic contribution. Figure 4-1 shows the savings across the effective useful life (EUL) of the measures.

The gas utilities are claiming all gas savings, 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		
Whole Building	SEM	7.0	34,145,568	1.00	239,018,974				34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	
CY2021 Program Total Electric Contribution to CPAS			34,145,568		239,018,974				34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	34,145,568	
Historic Program Total Electric Contribution to CPAS‡						14,039,833	37,336,439	70,918,544	70,918,544	70,918,544	56,878,711	33,582,105				
Program Total Electric CPAS						14,039,833	37,336,439	70,918,544	105,064,112	105,064,112	91,024,279	67,727,673	34,145,568	34,145,568	34,145,568	
CY2021 Program Incremental Expiring Electric Savings§																
Historic Program Incremental Expiring Electric Savings											14,039,833	23,296,606	33,582,105			
Program Total Incremental Expiring Electric Savings											14,039,833	23,296,606	33,582,105			

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Whole Building	SEM	34,145,568											
CY2021 Program Total Electric Contribution to CPAS		34,145,568	-	-	-	-	-	-	-	-	-	-	-
Historic Program Total Electric Contribution to CPAS‡													
Program Total Electric CPAS		34,145,568	-	-	-	-	-	-	-	-	-	-	-
CY2021 Program Incremental Expiring Electric Savings§		-	34,145,568	-	-	-	-	-	-	-	-	-	-
Historic Program Incremental Expiring Electric Savings		-	-	-	-	-	-	-	-	-	-	-	-
Program Total Incremental Expiring Electric Savings		-	34,145,568	-	-	-	-	-	-	-	-	-	-

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: the Illinois Stakeholder Advisory Group (SAG) website: <https://www.ilsag.info/evaluator-ntg-recommendations-for-2021>.

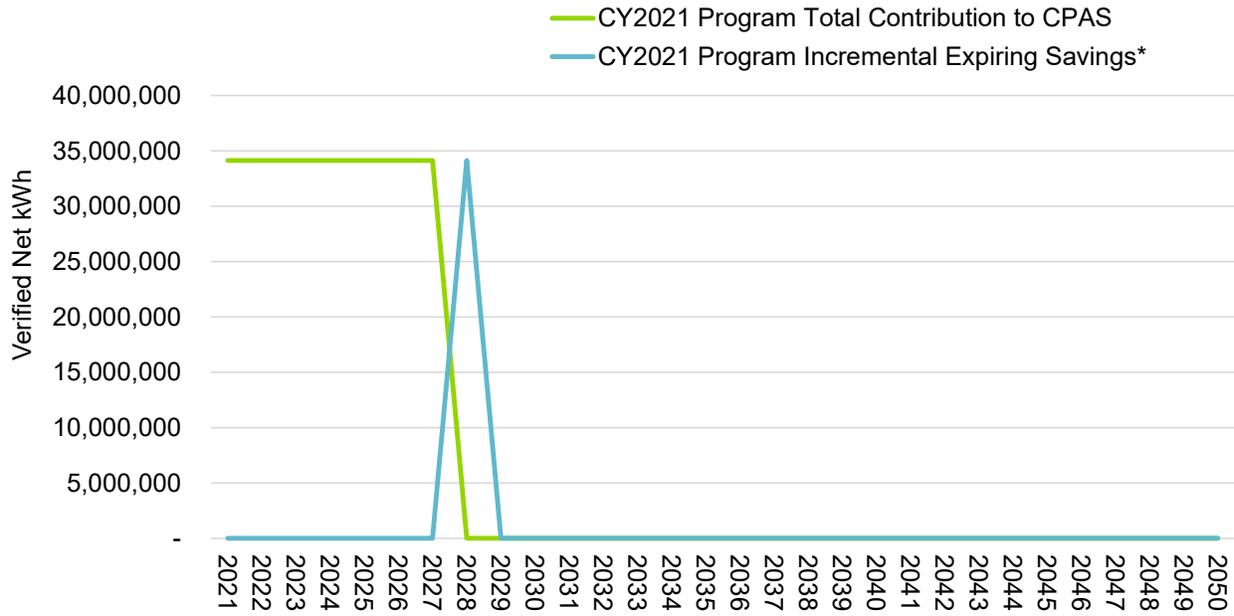
† Lifetime savings are the sum of CPAS savings through the EUL.

‡ Historic 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

This program has only one measure, so measure-level results are the same as the program-level results discussed in the previous section.

6. Impact Analysis Findings and Recommendations

The issue that had the largest effect on adjusting ex ante gross savings was a weather-sensitive refrigerated warehouse that used 6 months of post-period data to extrapolate a full year of savings. The impacts of weather on this type of site causes too much variability in the SEM model to extrapolate 6 months of savings.

The evaluation team developed the following recommendations based on findings from the CY2021 evaluation.

Finding 1. Guidehouse found multiple models with incorrect accounting for capital project savings, including incorrect distribution of savings over the post-period, annualization of capital savings, and discrepancies between the model and savings summary tabs.

Recommendation 1. Ensure capital project savings are accurately accounted for in the models. When removing capital savings incrementally within the regression model, take care not to exclude these savings during periods that have already been removed for major changes in site-level energy consumption such as shutdown periods.

Finding 2. Guidehouse found data outliers in many SEM models that showed abnormal savings, especially in the daily models. Without proper documentation on why these outliers should be allowed, Guidehouse removed them and re-annualized savings to make the models more consistent over the post-period.

Recommendation 2. Review all models to identify outliers in model variables that deviate more than 10% from the min/max values in the baseline period. For these identified outliers where the residual savings appear to be 200-300% of the average, remove those outliers and re-annualize results.

Appendix A. Impact Analysis Methodology

A.1 Verified Gross Program Savings Analysis Approach

The evaluation team calculated verified gross savings from the CY2021 SEM Program using implementer-provided statistical models grounded in site-specific data. These multi-variable regression models draw on site data, including energy usage, production, weather data, and seasonality effects (including holidays or shutdowns).

Guidehouse's review of the models was driven by a site-specific analysis approach. Because this program contains primarily behavioral-based changes, the team used the International Performance Measurement and Verification Protocol (IPMVP) Option C (billing or metered data regression) as its primary approach for impact evaluation.

The data collection focused on verifying and updating the assumptions that feed into the implementer's energy model for each site. This data included program tracking data and supporting documentation (project specifications, invoices, etc.), utility billing and interval data, Guidehouse-calibrated building automation system trend logs, and telephone conversations with onsite staff.

For each site, the evaluation team reviewed and updated the statistical models provided by the implementer. The team generally followed the following process for this review:

- **Step 1:** Recreated the energy models to ensure they aligned with the provided data.
- **Step 2:** Confirmed the model's savings calculations accounted for all capital projects. Savings from capital projects were subtracted from total measurement period savings.
- **Step 3:** Identified and accounted for any short-term effects that were occurring outside of the SEM Program influence. Telephone interviews with the site staff confirmed these changes.
- **Step 4:** Made additional changes to the models as needed. Changes included excluding outlier data points or including additional variables. Outlier points above 110% or below 90% of baseline period variables were excluded if the residual was out of line with other residuals in the measurement period.

Guidehouse identified several changes at the site that had short- or long-term effects on the statistical model. The changes that could affect the model savings include the following:

- Change in hours of operation
- Change in numbers of employees at the site
- Change in production
- Other capital measures installed at the site implemented through other utility energy efficiency and demand response programs or outside of the ComEd or Nicor Gas programs

A.2 Verified Net Program Savings Analysis Approach

The evaluation team calculated the verified net energy and demand savings by multiplying the verified gross savings estimates by a deemed net-to-gross (NTG) ratio. The deemed NTG values of 1.00 for electric savings and 1.00 for gas savings were agreed to by stakeholders in discussions with the Illinois SAG.

Appendix B. Impact Findings Detailed Results

Table B-1. Impact Findings Detailed Results.

Site Identifier	Ex Ante kWh	Verified kWh	RR for kWh Savings	Comments on kWh
Site A	493,856	494,178	100.1%	No issues.
Site B	526,683	526,725	100.0%	Guidehouse could not quite align to the implementer's regression model. The regression's cumulative sum (CUSUM) does not zero out in baseline model.
Site C	1,221,168	1,220,775	100.0%	It looks as though the implementer annualized the capital project savings value and the SEM value in the savings summary. Guidehouse did not annualize the capital savings in the verification results.
Site D	1,069,388	1,075,550	100.6%	Capital project savings not included in the year 1 electricity savings summary in the model. The capital project savings looks to be removed from the final savings in the tracker; however, the entire lifetime savings from the capital project savings was removed, not just the portion occurring in the reporting period. Guidehouse only removed the impacts of the capital project for the reporting period in the verified results.
Site E	2,569,343	2,537,645	98.8%	Guidehouse's regression model results were different from the implementer's model.
Site F	2,590,726	2,518,020	97.2%	Guidehouse removed data points that looked to be outliers.
Site G	581,237	716,873	123.3%	Guidehouse removed two variables in the verified model: one that was statistically insignificant and the other that was significantly different in the post-period as compared to the baseline period. The implementer's model was also incorrectly removing the impacts of capital projects during shutdown days and double-counting the energy consumption removed from SEM savings. Guidehouse added back in energy consumption from capital projects during the shutdown periods.
Site H	1,025,783	996,569	97.2%	In one of the site-specific models, Guidehouse removed additional outliers: one that appeared to be a shutdown (showing half of the energy use and 10 times the savings compared to the average savings per day). Other outlying data points appeared to be quite sensitive to the daily dry-bulb temperature changes, so Guidehouse removed them and re-annualized to get more consistent estimates of savings.
Site I	483,814	464,135	95.9%	Guidehouse removed an outlier that showed half of the demand and four times the savings compared to the average savings per day and re-annualized.

Site Identifier	Ex Ante kWh	Verified kWh	RR for kWh Savings	Comments on kWh
Site J	1,452,957	1,428,343	98.3%	One site-specific model had two data points at the end of the model that should be removed as outliers. Guidehouse removed these data points and re-annualized.
Site K	1,140,032	1,178,172	103.3%	Guidehouse removed the capital project savings from the shutdown periods so as to not double count the removed savings against the SEM model. Guidehouse also removed the shutdown period days prior to annualizing to a full year of savings. (Ex ante model annualized to 161 days and the Verified model annualized to 153 days)
Site L	509,914	357,778	70.2%	Guidehouse re-annualized after removing all of the non-routine shutdown weeks and outlier data points that had a significant impact on the single variable model.
Site M	664,834	666,829	100.3%	Model did not annualize to 365 days, so Guidehouse made that minor correction.
Site N	542,015	567,328	104.7%	Not clear why certain data points were removed. Guidehouse left in the data points for all 365 days. Guidehouse did not feel that the residual was impacted enough by the invalid Raw Temperature periods to require removal from the post period. Guidehouse left these data points in for all 365 days.
Site O	2,379,012	2,380,923	100.1%	Custom calculators were well documented and easy to review. Guidehouse has no issues with the bottom-up claimed savings estimates. One site-specific model had a different claimed savings value for the prior program year in the summary than the value removed in final estimate of savings for the reporting period.
Site P	1,384,392	1,376,836	99.5%	Could not align the regression model variables. CUSUM of implementer's model does not zero out in the baseline period.
Site Q	908,677	908,677	100.0%	No issues.
Site R	639,586	639,585	100.0%	No issues.
Site S	1,040,884	1,040,884	100.0%	No issues.
Site T	1,677,134	1,695,449	101.1%	Guidehouse could not align our regression model with the original model.
Site U	513,807	513,807	100.0%	Only 6 months of data was collected, but Guidehouse was okay with the extrapolation to a full year since the energy consumption for this site did not appear to be weather-sensitive and had consistent energy use throughout the year.
Site V	577,520	577,520	100.0%	No issues. The implementer's bottom-up calculators looked good and provided great detail.

Source: Evaluation team analysis

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)
Whole Building	SEM	Project	169	7.0	NO	34,145,568	0.00	0	0	0	0	1.00	1.00	1.00	34,145,568	0.00	0	0	0	0
Total				7.0		34,145,568	0	0	0	0	0				34,145,568	0	0	0	0	0

* 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