



Opinion **Dynamics**

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451



Impact and Process Evaluation of the 2016 Illinois Power Agency Small Business Lit Signage Program

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CADMUS

NAVIGANT



MichaelsEnergy

Contributors

Hannah Howard
Managing Director, Opinion Dynamics

Chelsea Petrenko
Managing Consultant, Opinion Dynamics

Dan Hudgins
Senior Consultant, Opinion Dynamics

Marion Cundari
Consultant, Engineering, Opinion Dynamics

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1. Executive Summary

This report presents results from the evaluation of the Small Business Lit Signage Program implemented by GDS Associates, which is one of 13 stand-alone Illinois Power Agency (IPA) programs implemented from June 1, 2016 to May 31, 2017 (Program Year [PY] 9). The program offers incentives to small business customers in Ameren Illinois Company (AIC)'s DS-2 rate class to upgrade their existing signage and exterior lighting to more energy efficient options. Program measures include replacements and retrofits for high-intensity discharge (HID) fixtures, incandescent/halogen spotlights, and fluorescent fixtures. The program targets chain restaurants, banks, small retail and services, offices, gas stations and convenience stores, among others.

The participation process begins with a free lighting assessment conducted by a trained program ally (PA). PAs use Energy Snapshot, an electronic web or iPad-based assessment tool, to gather information about the business and identify lighting opportunities and potential energy savings. After the assessment is complete, the customer receives a report that includes a list of recommended program measures. If a customer chooses to complete a project, the program provides incentives that cover a portion of the project costs.

Overall, the Lit Signage Program operated smoothly and effectively in PY9. Over the course of PY9, 524 eligible customers completed 541 projects through the program and achieved 8,233 MWh in ex post net energy savings, which represents 97% of its goal (8,507 MWh).

The evaluation of the PY9 Lit Signage Program involved both process and impact assessments. However, given Illinois' passage of the Future Energy Jobs Bill (SB 2814), which brings an end to IPA funding of energy efficiency programs after PY9, the evaluation team conducted a limited process evaluation, which included a review of program-tracking data and program materials, and interviews with program administrators and implementation staff. Our impact evaluation research efforts involved applying savings algorithms and assumptions from the Illinois Statewide Technical Reference Manual for Energy Efficiency (IL-TRM), and the application of Illinois Stakeholder Advisory Group (SAG)-approved net-to-gross ratios (NTGR).

Program Impacts

Table 1 summarizes the electric energy savings from the PY9 Lit Signage Program. The program achieved ex ante gross savings of 9,197 MWh and ex post gross savings of 9,251 MWh, which resulted in a 101% gross realization rate. The evaluation team then applied the SAG-approved NTGR of 0.89 to the ex post gross impacts to estimate the ex post net impacts of 8,233 MWh for electric energy savings.

Table 1. PY9 Gross and Net Lit Signage Program Impacts*

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)	9,197	101%	9,251	0.89	8,233

^a Note: The program did not claim any demand savings because all measures were installed in exterior locations.

Key Findings and Recommendations

The Lit Signage Program performed well in PY9, achieving 97% of its net electric energy savings goal. Program staff attributed the slight savings shortfall to measure caps¹ on high-demand measures. The following are the supporting findings and recommendations based on the PY9 evaluation:

- **Key Finding #1:** The evaluation team determined that discrepancies between ex ante and ex post savings values were due to different assumptions for efficient and baseline lighting wattages.
 - **Recommendation:** In order to minimize discrepancies between ex ante and ex post savings estimates for future program measures, the evaluation team recommends applying the assumptions provided in the IL-TRM. More specifically, when baseline and efficient wattage of the actual install is unavailable, the TRM should be referenced.
- **Key Finding #2:** Some small business customers have multiple accounts (DS-2 and DS-3 rate codes) with AIC. As a result, PAs installed some measures on DS-3 accounts, which were later deemed ineligible for program participation, and savings from those measures were not credited to the program.
 - **Recommendation:** While this error had a relatively small impact on the program's overall goal attainment, the evaluation team recommends that AIC provide guidelines to help their implementation partners better-determine customer eligibility for future small business offerings. Additionally, the evaluation team recommends that AIC's implementation partners train PAs to identify DS-3 meters onsite.

¹ AIC set incentive budgets or caps that established the maximum amount of total incentives paid for a given measure during a given program year. GDS Associates then managed the program to these measure caps.

2. Evaluation Approach

The evaluation of PY9 Lit Signage Program involved both process and impact assessments. The specific research objectives and evaluation activities conducted are outlined below.

2.1 Research Objectives

This evaluation addresses program performance in PY9 and the overall objective of the evaluation is to provide estimates of gross and net electric savings associated with the program. As such, the PY9 impact evaluation answers the following questions:

- What were the estimated gross electric and demand impacts from this program?
- What were the estimated net electric and demand impacts from this program?

Given that this is the last year of the Lit Signage Program, the evaluation team conducted a limited process assessment to answer the following questions:

- Program Participation
 - What were the characteristics of participating customers? How many projects were completed? By how many different customers? What types of projects?
 - Did customer participation meet expectations? If not, how different was it and why?
- Program Design and Implementation
 - Was the program implemented as planned? If not, what changes were made, and why?
 - What, if any, implementation challenges occurred in PY9, and how were they overcome?

2.2 Evaluation Tasks

Table 2 summarizes the PY9 evaluation activities conducted for the Lit Signage Program.

Table 2. PY9 Evaluation Activities

Activity	PY9 Process	PY9 Impact	Forward Looking	Details
Program Staff Interviews	✓			Gathered information about program marketing and implementation.
Program Materials Review	✓	✓		Reviewed program data to assess program operations in PY9.
Impact Analysis		✓		Calculated gross and net impacts using the IL-TRM V5.0 and SAG-approved NTGR values for PY9.

2.2.1 Program Staff Interviews

The evaluation team completed in-depth interviews with AIC program administrators, Leidos (IPA Oversight), and GDS Associates (implementation staff) in June 2017. These interviews explored implementation challenges, program performance, program participation, and marketing and outreach during PY9.

2.2.2 Program Materials Review

The evaluation team conducted a comprehensive review of all tracking data and program materials, including the program implementation plan, program marketing materials, and the PY9 program-tracking database.

2.2.3 Impact Analysis

The evaluation team used the IL-TRM V5.0 to calculate ex post gross savings associated with the measures installed through the program. For net impacts, the evaluation team applied the SAG-approved NTGR of 0.89 to ex post gross savings.

2.3 Sources and Mitigation of Error

Table 3 provides a summary of possible sources of error associated with research tasks conducted for the Lit Signage Program. The sources of error below are outlined below.

Table 3. Possible Sources of Error

Research Task	Survey Errors		Non-Survey Errors
	Sampling Errors	Non-Sampling Errors	
Impact Analysis	N/A	N/A	Analysis errors

Non-Survey Errors

- **Analysis Errors**
 - **Impact Analysis:** The evaluation team applied IL-TRM V5.0 assumptions and algorithms to the participant data in the tracking database to calculate gross impacts and applied the SAG-approved NTGR to calculate net impacts. To minimize analysis error, the evaluation team had all calculations reviewed by a separate team member to verify that calculations were performed accurately.

3. Detailed Evaluation Findings

The following section of the report provides detailed findings related to program processes and program impacts.

3.1 Program Design and Implementation

The PY9 Lit Signage Program was implemented by GDS Associates from June 1, 2016 to May 31, 2017. The program offers incentives to small business customers in Ameren Illinois Company (AIC)’s DS-2 rate class to upgrade their existing signage and exterior lighting to more energy efficient options. Program measures include replacements and retrofits for high-intensity discharge (HID) fixtures, incandescent/halogen spotlights, and fluorescent fixtures. The program targets chain restaurants, banks, small retail and services, offices, gas stations and convenience stores, among others.

The participation process begins with a free lighting assessment conducted by a trained program ally (PA). PAs use Energy Snapshot, an electronic web or iPad-based assessment tool, to gather information about the business and identify lighting opportunities and potential energy savings. After the assessment is complete, the customer receives a report that includes a list of recommended program measures. If a customer chooses to complete a project, the program provides incentives that cover a portion of the project costs.

The implementer also utilized two Energy Advisors (EAs) to verify customer eligibility, manage and train PAs, and conduct Quality Assurance/Quality Control (QA/QC) inspections. As part of the training process, EAs shadowed PAs in the field to ensure that allies conducted assessments properly. EAs also conducted post-inspections for the first ten projects completed by each PA. For subsequent projects, EAs inspected a random project for every 15 projects, all projects with an incentive change greater than \$500 from the work order, and all projects with incentives greater than \$5,000. Over the course of PY9, the program completed 328 QA/QC inspections including 66 pre-inspections and 262 post-inspections.

Program marketing and outreach efforts in PY9 included in-person visits from PAs and community meetings with Chambers of Commerce, rotary clubs, and industry associations. Program staff we interviewed are satisfied with the level of marketing and outreach, and indicated that PA outreach was the most effective form of marketing. PAs leveraged existing relationships with local businesses to promote the program among potential customers. The program supported PAs by providing training, technical expertise, and promotional materials such as flyers, brochures, and customer fact sheets.

3.2 Program Performance and Participation

3.2.1 Program Performance

As seen in Table 4, the program achieved 8,233 MWh in ex post net energy savings, which accounted for 97% of its goal, and spent 97% of its PY9 budget.

Table 4. PY9 Program Performance against Energy Savings Goal

Metric	Goal	Actual or Ex Post Net	Percentage of Goal
Energy Savings (MWh)	8,507	8,233	97%
Budget	\$1,999,995	\$1,942,489	97%

Table 5 provides a high-level comparison of various program performance and participation metrics in PY9. Over the course of PY9, 524 eligible customers completed 541 projects through the Lit Signage Program. The program recruited 48 PAs to help deliver the program and 19 allies (40%) completed at least one project.

Table 5. Lit Signage Program Performance and Participation

Metric	PY9 Outcome
PY Energy Savings Goal (MWh)	8,507
Ex Post Net Savings (MWh)	8,233
Program Participants	524
Projects Completed	541
Participating PAs	19

3.2.2 Program Participation Analysis

The Lit Signage Program served small business customers from throughout AIC’s service territory as shown in Figure 1. Overall, program activity was greater in urban areas such as Peoria, Decatur, and St. Louis, and lower in the southeastern and southern portion of AIC’s territory, particularly in Effingham, Mattoon, and Mount Vernon. Additionally, PAs were distributed across the AIC service territory with the exception of two allies who were located near Chicago.

Figure 1. Lit Signage Customer and PA Participation in PY9

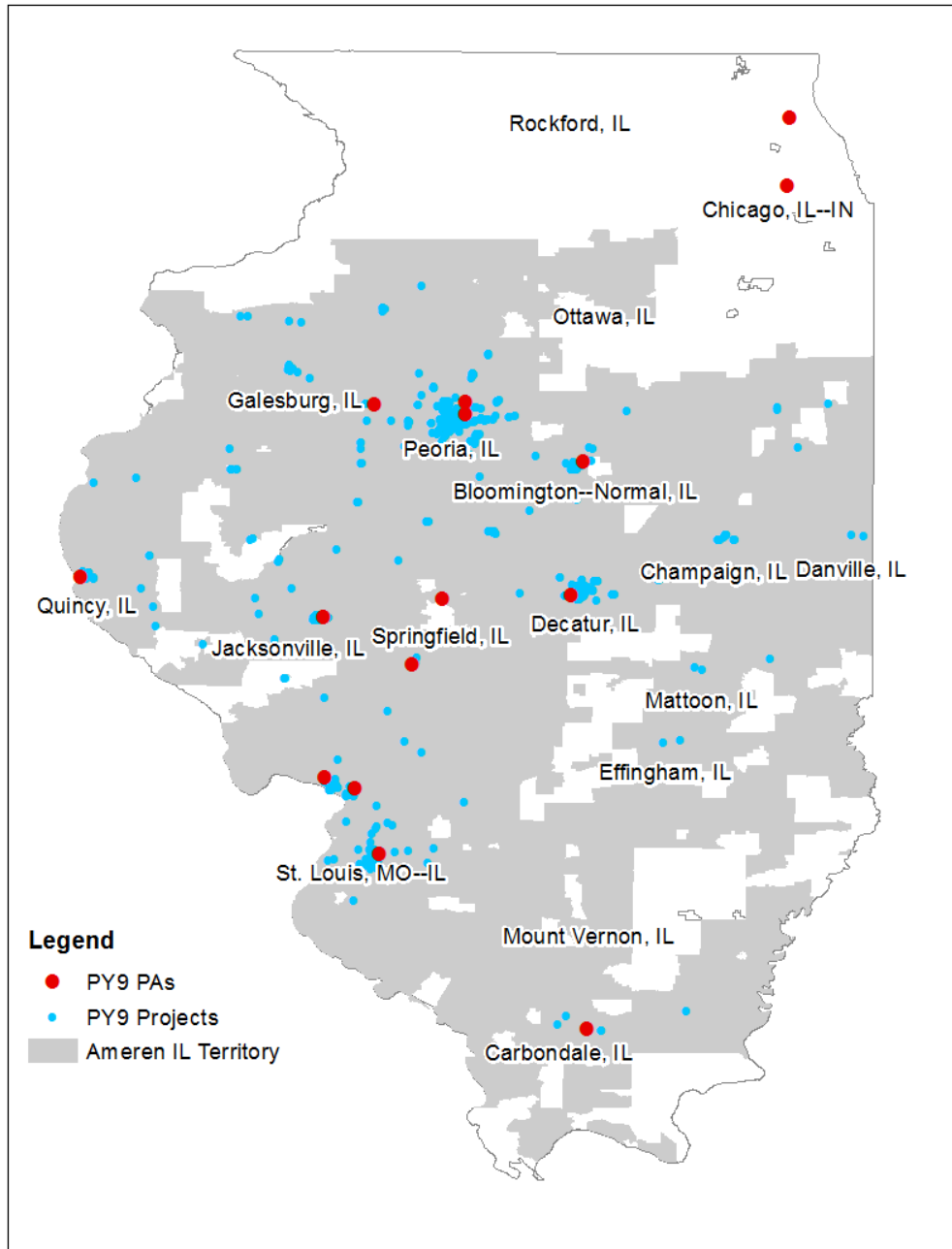
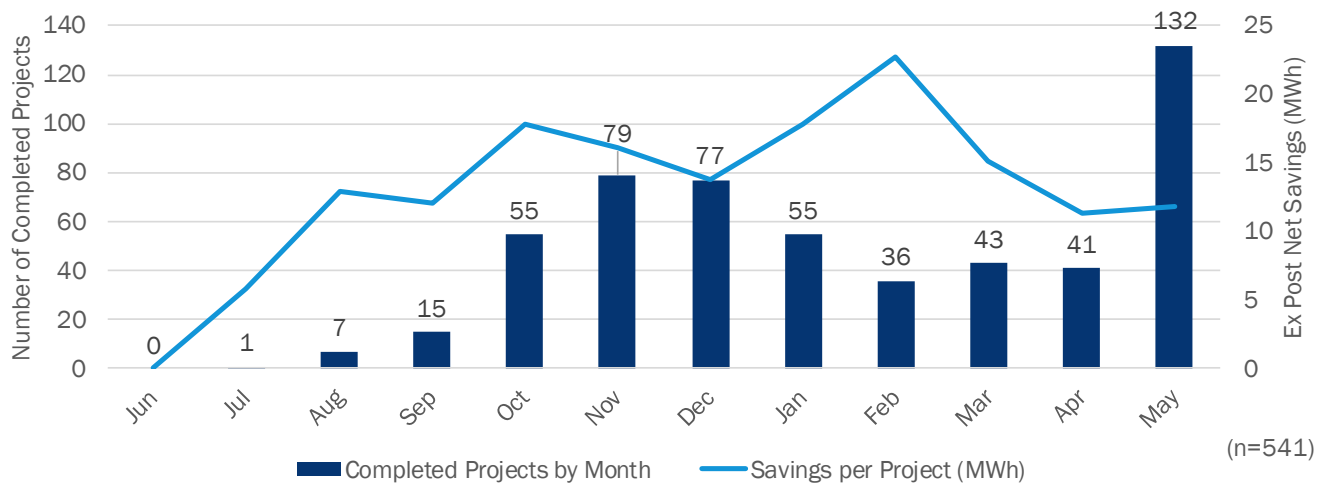


Figure 2 presents the number of completed projects and per-project ex post net energy savings by month. According to program staff, program uptake was slow at the beginning of PY9 because the implementation plan was not approved until mid-July 2016. In particular, only 4% of PY9 projects were completed in the first four months of the program year, and program activity did not start to take off until October. Additionally, program staff mentioned that when funding for the most profitable measures (measures with the highest deemed savings) ran out, PAs were less motivated to complete projects through the program. To boost participation, implementation staff created a friendly competition among PAs where allies could win tickets to

a St. Louis Cardinals baseball game if the projects they completed from April 14, 2017 to May 31, 2017 resulted in the highest energy savings. This strategy was successful in increasing program activity through smaller projects, as evidenced by the lower per-project ex post net energy savings in May (12 MWh).

Figure 2. PY9 Lit Signage Projects Completed by Month



3.2.3 Barriers to Program Implementation

The PY9 Lit Signage Program achieved 8,233 MWh in ex post net energy savings, reaching 97% of its goal (8,507 MWh). Program staff attributed the slight savings shortfall to the following factors:

- **Measure Caps² that Limited High-Demand Measures:** Program implementation staff mentioned that funding for high-demand measures such as LEDs replacing 1000 watt HID's ran out quickly due to program measure caps. Since these measures were the most profitable for PAs, the implementation staff experienced challenges in motivating allies to continue completing projects through the program. As mentioned previously, the program overcame this challenge by using baseball tickets to engage allies in a friendly competition that increased program participation through smaller projects.
- **Program Measures Installed on DS-3 Meters:** The program implementation staff noticed mid-way through the program that that some small business customers have multiple accounts (DS-2 and DS-3 rate codes) with AIC. As a result, PAs installed some measures on DS-3 accounts, which were later deemed ineligible for program participation, and savings from those measures were not credited to the program. Implementation staff resolved the issue by working with Leidos to verify that projects were completed with DS-2 electrical accounts. The program implementation staff also developed training to help PAs identify DS-3 meters onsite.
- **Program Allies (PAs) Installed Un-Approved Measures:** PAs were initially advised by the implementer that linear LEDs replacing linear fluorescent lamps and HID fixtures were eligible program measures. However, the implementer realized toward the end of the program year that these measures had not

² AIC set incentive budgets or caps that established the maximum amount of total incentives paid for a given measure during a given program year. GDS Associates then managed the program to these measure caps.

been approved through the program. As a result, savings from these measures were not credited to the program and the implementer absorbed the incentives paid to PAs.

3.3 Impact Results

The following sections outline the results of the gross and net impact analysis for the PY9 Lit Signage Program. Overall, the program fell slightly short of its goal and achieved a 101% net realization rate for electric energy savings.

3.3.1 Measure Verification

For PY9, the evaluation team applied the in-service rate (ISR) from the IL-TRM V5.0 to develop a verified measure quantity. Table 6 summarizes install quantities by measure type.

Table 6. PY9 Lit Signage Verified Measure Quantities

Measure Category	Ex Ante Measure Quantity ^a (a)	Ex Post ISR ^b (b)	Verified Measure Quantity (a * b)
LED Fixture	4,934	100%	4,934
LED Fixture Retrofit	1,259	100%	1,259
LED Lamp	710	100%	710
T8 Replacing T12	57	100%	57
LED Replacing Neon Letter	10	100%	10
Total	6,970	100%	6,970

^a Source: PY9 Final Program Tracking Database

^b Ex post ISRs are from the IL-TRM V5.0 and consistent with ex ante ISRs. The ISR is 100% as this is a direct-install program with the customers completing a sign-off form.

3.3.2 Ex Post Gross Impact Results

The overall ex post gross energy impact savings for the PY9 Lit Signage Program is 9,251 MWh with a realization rate of 101%, as seen in Table 7. The evaluation team calculated ex post savings using inputs and algorithms from the IL-TRM V5.0.

Table 7. PY9 Lit Signage Program Gross Impacts^a

Program	Ex Ante Gross MWh ^b	Ex Post Gross MWh
Lit Signage	9,197	9,251
Gross Realization Rate^c		101%

^a Note: The program did not claim any demand savings because all measures were installed in exterior locations.

^b Source: PY9 Lit Signage Final Program Tracking Database

^c Gross realization rate = ex post gross value ÷ ex ante gross value

Table 8 summarizes the ex post gross impact results by measure type. Measure categories are sorted from largest to smallest based on ex ante energy savings. The evaluation team presents potential reasons for differences between ex ante and ex post gross impacts following the table and provides specific inputs for all ex post savings estimates in Appendix A.

Table 8. PY9 Lit Signage Ex Post Gross Impacts

Measure Type	Verified Measure Quantity	Ex Ante Gross MWh	Ex Post Gross MWh	MWh Gross Realization Rate
LED Fixture	4,934	7,235	7,295	101%
LED Fixture Retrofit	1,259	1,668	1,661	100%
LED Lamp	710	280	281	100%
T8 Replacing T12	57	13	13	100%
LED Replacing Neon Letter	10	1	1	100%
Total	6,970	9,197	9,251	101%

Differences in ex post and ex ante gross savings stem from differences in input values for the savings algorithms for each measure. The evaluation team reviewed all ex ante assumptions and identified the main sources of these differences. Table 9 summarizes these findings at the measure level with additional descriptions provided below.

Table 9. Reasons for Differences in Realization Rates per Measure

Measure	Gross MWh Realization Rate	Source of Discrepancy
		Baseline and Efficient Wattages
LED Fixture <=65W Replacing 250-320W HID	106%	✓
LED Fixture <=350W Replacing 1000W HID	103%	✓
LED Fixture Replacement Retro <=125W Replacing 400W HID	103%	✓
LED Fixture Retrofit <=45W Replacing 70W-150W HID	102%	✓
LED Fixture <=19W Replacing 70W-150W HID	102%	✓
LED Lamp <=14.5W Replacing 75W Incand. Spot	101%	✓
LED Fixture Retrofit <=155W Replacing 250-320W HID or 250W Fixture	100%	
LED Lamp >20W Replacing 100W Incand. Spot	100%	
LED Box sign Retrofit (Per sign)	100%	
LED Lamp <31W Replacing 150W Spot	100%	
LED Lamp <=20W Replacing 85-99W Flood	100%	
LED Lamp >14.5W Replacing 75W Incand. Spot	100%	
T8HO 4', 2L or T8HO 8', 1L Replacing T12HO 8', 1L	100%	
T8HO 4', 1L Replacing T12HO 4', 1L	100%	
LED Channel Letter Replacing Neon Letter	100%	
LED Fixture <=125W Replacing 400W HID	100%	
LED Fixture Retrofit <=155W Replacing 400W HID	100%	
LED Lamp <=20W Replacing 100W Incand. Spot	100%	
LED Lamp <=14.5W Replacing 60W Incand. Spot	100%	
LED Lamp >20W Replacing 85-99W Flood	100%	
LED Fixture <=55W Replacing 250W Fixture	98%	✓
LED Fixture <=35W Replacing 175W HID	91%	✓

Measure	Gross MWh Realization Rate	Source of Discrepancy
		Baseline and Efficient Wattages
LED Fixture <=35W Replacing 100W HID Area Light	87%	✓
LED Fixture Retrofit <=120W Replacing 175W HID	83%	✓
Total	101%	N/A

■ **Baseline and Efficient Wattage Discrepancies:**

- **Baseline Wattage:** For measures where the IL-TRM V5.0 does not provide baseline wattage assumptions, the evaluation team reviewed ex ante baseline wattage assumptions for accuracy through comparisons with other TRMs and references. For LEDs replacing high-intensity discharge (HID) measures, the evaluation team applied an average of TRM values³ instead of assuming a singular wattage for the entire measure category. For most measures, the discrepancy only resulted in a small difference (one to ten watts) between ex ante and ex post assumptions.
- **Efficient Wattage:** There were a handful of measures with efficient wattage discrepancies. For example, the evaluation team adjusted the efficient wattage for the LED Fixture <=350W Replacing 1000W HID measure. The wattage assumed by the implementer was 320, while the evaluation team assumed 300 watts, which was more representative of the replacement fixtures for 1000 watt HID's on the market today. The decrease in efficient wattage contributes to the overall realization rate of 103% for this measure (Table 9).

3.3.3 Net Impacts

In determining the overall net electric energy savings associated with the Lit Signage Program, the team applied the SAG-approved NTGR of 0.89, which is based on research conducted in PY6 for other AIC small business programs. The implementation team applied a NTGR of 0.89 as well. As a result, the program achieved net ex post energy savings of 8,233 MWh and a 101% realization rate, seen in Table 10.

Table 10. Lit Signage Program Net Impacts

Program	Ex Ante NTGR	Ex Post NTGR	Ex Ante Net MWh	Ex Post Net MWh
Lit Signage	0.89	0.89	8,185	8,233
Net Realization Rate^a				101%

^a Net realization rate = ex post net value ÷ ex ante net value.

³ For HID baseline wattages that are not represented in the IL-TRM V5.0 (1000W HID and 70W HID), HID equivalent wattages were calculated by taking an average of equivalent wattages from the Arkansas TRM Version 4 due to its geographic proximity to Illinois.

4. Key Findings and Recommendations

The Small Business Lit Signage Program performed well in PY9, achieving 97% of its net electric energy savings goal. Program staff attributed the slight savings shortfall to measure caps⁴ on high-demand measures. The following are the supporting findings and recommendations based on the PY9 evaluation:

- **Key Finding #1:** The evaluation team determined that discrepancies between ex ante and ex post savings values were due to different assumptions for efficient and baseline lighting wattages.
 - **Recommendation:** In order to minimize discrepancies between ex ante and ex post savings estimates for future program measures, the evaluation team recommends applying the assumptions provided in the IL-TRM. More specifically, when baseline and efficient wattage of the actual install is unavailable, the TRM should be referenced.
- **Key Finding #2:** Some small business customers have multiple accounts (DS-2 and DS-3 rate codes) with AIC. As a result, PAs installed some measures on DS-3 accounts, which were later deemed ineligible for program participation, and savings from those measures were not credited to the program.
 - **Recommendation:** While this error had a relatively small impact on the program's overall goal attainment, the evaluation team recommends that AIC provide guidelines to help their implementation partners better-determine customer eligibility for future small business offerings. Additionally, the evaluation team recommends that AIC's implementation partners train PAs to identify DS-3 meters onsite.

⁴ AIC set incentive budgets or caps that established the maximum amount of total incentives paid for a given measure during a given program year. GDS Associates then managed the program to these measure caps.

Appendix A. Lit Signage Program Assumptions and Algorithms

In PY9, the impact evaluation efforts estimated gross impact savings for the Small Business Lit Signage Program by applying savings algorithms from the IL-TRM V5.0⁵ to the information provided in the program-tracking database.

The following section present the algorithms used to calculate all evaluation program savings below, along with all input variables.

A.1 Light Emitting Diode (LED) Fixtures

The evaluation team determined ex post lighting savings for LED fixtures using the algorithms below.

Equation 1. LED Fixture Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000} \right) * Hours * WHFe$$

Where:

Watts_{Base} = Wattage of existing HID lamp (see Table 11)

Watts_{LED} = Wattage of installed LED (see Table 11)

Table 11. LED Fixtures Baseline and Efficient Wattages by Measure

Measure Description	Watts _{Base}	Watts _{LED}	Notes/Reference
LED Fixture <=125W Replacing 400W HID	451	120	HID baseline wattages calculated as an average between IL-TRM V5.0 equivalent wattages
LED Fixture <=19W Replacing 70W-150W HID	130	18	HID baseline wattages calculated as an average between IL-TRM V5.0 and Arkansas TRM V4 adjusted wattages ^a
LED Fixture <=350W Replacing 1000W HID	1,082	300	HID baseline wattages calculated as an average between IL-TRM V5.0 equivalent wattages
LED Fixture <=35W Replacing 100W HID Area Light	121	30	
LED Fixture <=35W Replacing 175W HID	201	30	
LED Fixture <=55W Replacing 250W Fixture ^b	287	50	
LED Fixture <=65W Replacing 250-320W HID	317	60	

^a For measures that do not have HID equivalent wattages in the IL-TRM V5.0, the evaluation team took an average of HID equivalent wattages from the Arkansas TRM Version 4.

^b Ex post analysis assumed that a 250W fixture is an HID which is consistent with the ex ante assumption.

⁵ Illinois Statewide Technical Reference Manual for Energy Efficiency V5.0. Effective June 1, 2016.

Hours = Annual operating hours = 4,903⁶

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting = 1⁷

A.2 LED Fixture Retrofits

The evaluation team determined ex post lighting savings for LED fixture retrofits using the algorithms below.

Equation 2. LED Fixture Retrofit Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000} \right) * Hours * WHFe$$

Where:

Watts_{Base} = Wattage of existing HID lamp (see Table 12)

Watts_{LED} = Wattage of installed LED fixture (see Table 12)

Table 12. LED Fixture Retrofits Baseline and Efficient Wattages by Measure

Measure Description	Watts _{Base}	Watts _{LED}	Notes/Reference
LED Box sign Retrofit (Per sign)	53	22	Ex ante wattage assumptions provided by the implementer
LED Fixture Replacement Retro <=125W Replacing 400W HID	451	120	HID baseline wattages calculated as an average between IL-TRM V5.0 equivalent wattages
LED Fixture Retrofit <=120W Replacing 175W HID	201	120	
LED Fixture Retrofit <=155W Replacing 250-320W HID or 250W Fixture	311	150	
LED Fixture Retrofit <=155W Replacing 400W HID	451	130	
LED Fixture Retrofit <=45W Replacing 70W-150W HID ^a	130	45	HID baseline wattages calculated as an average between IL-TRM V5.0 and Arkansas TRM V4 adjusted wattages

^a For measures that do not have HID equivalent wattages in the IL-TRM V5.0, the evaluation team took an average of HID equivalent wattages from the Arkansas TRM Version 4.

Hours = Annual operating hours = 4,903⁸

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting = 1⁹

⁶ All installed measures are exterior and therefore utilize the IL-TRM V5.0 value for exterior lighting in section 4.5

⁷ Illinois Statewide Technical Reference Manual for Energy Efficiency V5.0. Effective June 1, 2016.

⁸ *ibid.*

⁹ *ibid.*

A.3 LED Lamps

The evaluation team determined ex post savings for LED lamps using the algorithms below.

Equation 3. LED Lamp Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000} \right) * Hours * WHFe$$

Where:

Watts_{Base} = Wattage of existing incandescent bulb (see Table 13)

Watts_{LED} = Wattage of installed LED bulb (see Table 13)

Table 13. LED Lamp Baseline and Efficient Wattages by Measure

Measure Description	Watts _{Base}	Watts _{LED}	Notes/Reference
LED Lamp <=14.5W Replacing 60W Incand. Spot	60	12	Ex ante wattage assumptions provided by the implementer
LED Lamp <=14.5W Replacing 75W Incand. Spot	75	13	
LED Lamp <=20W Replacing 100W Incand. Spot	100	17	
LED Lamp <=20W Replacing 85-99W Flood	90	18	
LED Lamp <31W Replacing 150W Spot	150	28	
LED Lamp >14.5W Replacing 75W Incand. Spot	75	16	
LED Lamp >20W Replacing 100W Incand. Spot	100	21	

Hours = Annual operating hours = 4,903¹⁰

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting = 1¹¹

A.4 LED Replacing Neon Letter

The evaluation team determined ex post lighting savings for LEDs replacing neon letters using the algorithms below.

Equation 4. LEDs Replacing Neon Letter Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000} \right) * Hours * WHFe$$

Where:

Watts_{Base} = Wattage of existing neon letter (see Table 14)

¹⁰ ibid.

¹¹ ibid.

Watts_{LED} = Wattage of installed LED (see Table 14)

Table 14. LED Replacing Neon Baseline and Efficient Wattages by Measure

Measure Description	Watts _{Base}	Watts _{LED}	Notes/Reference
LED Channel Letter Replacing Neon Letter	25	5	Ex ante wattage assumptions provided by the implementer

Hours = Annual operating hours = 4,903¹²

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting = 1¹³

A.5 T8 Replacing T12

The evaluation team determined ex post savings for T8s replacing T12 measures using the algorithms below.

Equation 5. T8s Replacing T12s Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{base} - Watts_{EE}}{1000} \right) * Hours * WHFe$$

Where:

Watts_{Base} = Wattage of existing T12 fixture (see Table 15)

Watts_{EE} = Wattage of installed T8 fixture (see Table 15)

Table 15. T8 Replacing T12s Baseline and Efficient Wattages by Measure

Measure Description	Watts _{Base}	Watts _{EE}	Notes/Reference
T8HO 4', 2L or T8HO 8', 1L Replacing T12HO 8', 1L	125	73	Ex ante wattage assumptions provided by the implementer
T8HO 4', 1L Replacing T12HO 4', 1L	67	37	

Hours = Annual operating hours = 4,903¹⁴

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting = 1¹⁵

¹² *ibid.*

¹³ *ibid.*

¹⁴ *ibid.*

¹⁵ *ibid.*

For more information, please contact:

Hannah Howard
Managing Director

510 444 5050 tel
510 444 5222 fax
hhoward@opiniondynamics.com

1 Kaiser Plaza, Suite 445
Oakland, CA 94612



Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451

San Francisco Bay

510 444 5050 tel
510 444 5222 fax

1 Kaiser Plaza, Suite 445
Oakland, CA 94612