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 Direct Install Program

Final

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CADMUS

NAVIGANT

MichaelsEnergy

Opinion Dynamics

Contributors

Hannah Arnold
Managing Director, Opinion Dynamics

Chelsea Petrenko
Managing Consultant, Opinion Dynamics

Dan Hudgins
Senior Consultant, Opinion Dynamics

Mallorie Gattie-Garza
Managing Consultant, Engineering, Opinion Dynamics

Marion Cundari
Consultant, Engineering, Opinion Dynamics

Opinion Dynamics

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1. Executive Summary

This report presents results from the evaluation of the Small Business Direct Install (SBDI) Program implemented by Franklin Energy, 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 SBDI Program is designed specifically to overcome barriers unique to small business customers including the lack of access to capital, time required to investigate energy saving opportunities, and the split incentive challenge faced by leased properties. The program provides small businesses (DS-2 electrical accounts) with a free energy assessment, free directly-installed energy-saving products,[1] a Customer Recommendation Report detailing additional energy-saving opportunities, and discounted pricing for qualified interior and exterior lighting, as well as refrigeration motor improvements. Participants in the program receive an assessment, as well as free direct install measures, and/or additional incentivized measures whereas assessment-only participants choose to not receive any free or incentivized measures.

The PY9 SBDI Program functioned similarly to PY8 in terms of design and delivery, but a few changes were made such as increasing incentives for exterior lighting measures, capping incentives for occupancy sensors, implementing bonus incentives on select lighting measures, and increasing the number of post-inspections conducted. Over the course of PY9, 868 eligible customers completed 919 projects through the program and achieved 8,410 MWh in net ex post energy savings, which represented 80% of its goal (11,642 MWh). Program implementation staff attribute the savings shortfall to increased competition from other small business programs adopted through the IPA procurement process.

The evaluation of the PY9 SBDI 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 and demand impacts from the PY9 SBDI Program. The program achieved ex ante gross savings of 10,505 MWh and ex post gross savings of 12,030 MWh, which resulted in a 115% 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 10,707 MWh for energy savings and 2.25 MW for demand savings.

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[1] Free direct install measures include: CFLs, faucet aerators, pre-rinse sprayers, and vending machine and cooler controls.

Table 1. PY9 Gross and Net SBDI Program Impacts

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net
Energy Savings (MWh)					
Total MWh	10,505	115%	12,030	0.89	10,707
Demand Savings (MW)					
Total MW	2.09	121%	2.53	0.89	2.25

Key Findings and Recommendations

In PY9, the SBDI Program fell short of its energy savings goal. Program staff attribute this shortfall to increased competition from other IPA small business programs, which ultimately led to lower customer participation than needed to meet the program goal. The following are the supporting findings and recommendations based on the PY9 evaluation:

- **Key Finding #1**: Program performance continued to rely on energy efficient lighting measures, which accounted for nearly 100% of ex post net energy savings in PY9. The majority of this savings (64%) came from linear fluorescent measures. Further, the lighting market has undergone significant changes due to increased LED market penetration and demand. Our evaluation of the PY9 SBDI program shows alignment with this trend as the percentage of ex post net energy savings from LED measures has doubled from 16% in PY8 to 33% in PY9.
  - **Recommendation**: Going forward, AIC and their implementation partners should look for ways to diversify program offerings in order to stabilize program savings. In addition, AIC and their implementation partners should continue to monitor the lighting market in terms of product availability and pricing, and adjust measure offerings and incentives to align with market trends.
- **Key Finding #2**: The evaluation team determined that discrepancies between ex ante and ex post savings values were partially due to different assumptions such as lighting wattages, in-service rates (ISRs), and misapplication of variables, such as effective flow rate for aerator measures, from the IL-TRM V5.0.
  - **Recommendation:** To minimize discrepancies between ex ante gross and ex post gross savings estimates for future program measures, the evaluation team recommends the use of primary data collected by the implementer for such things as actual installed wattage, whether space cooling is present in the facility, heating fuel types, vending machine type, etc., so that variables within the algorithms are more reflective of the installed measures instead of assumed averages based on general assumptions. If primary data is unavailable, the evaluation team recommends applying the assumptions provided in the IL-TRM.

2. Evaluation Approach

The evaluation of PY9 SBDI 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 SBDI 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 SBDI Program.

Table 2. PY9 Evaluation Activities

Activity	PY9 Process	PY9 Impact	Forward Looking	Details
Program Staff Interviews	✓		✓	Explored changes made since PY8 and gathered information about program marketing and implementation.
Program Materials Review	✓	✓		Conducted comprehensive review of all program materials and tracking database to document program design and changes.
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 Franklin Energy (implementation staff) in June 2017. These interviews explored implementation changes, 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 SBDI 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 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 SBDI Program began as a pilot in PY5, and PY9 was its fourth full year of operation. Franklin Energy delivered the program for the last two years (PY8 and PY9). The program was designed specifically to overcome barriers unique to small business customers including the lack of access to capital, time required to investigate energy saving opportunities, and the split incentive challenge faced by leased properties. The program provides small businesses (DS-2 electrical accounts) with a free energy assessment to identify direct install and additional electrical savings opportunities, free directly installed energy-saving products, a Customer Recommendation Report detailing additional energy-saving opportunities, and discounted pricing on these additional energy-saving measures (Table 4). Participants in the program receive an assessment, as well as free direct install measures, and/or additional incentivized measures whereas assessment-only participants choose to not receive any free or incentivized measures.

Table 4. PY9 SBDI Measure Offerings

Offering	Measures
Free Direct Install	High-efficiency faucet aerators
	High-efficiency pre-rinse spray valves
	CFLs
	Vending and cooling misers
Additional Electrical Savings Opportunities	T12 to T8 fluorescent retrofits
	LED screw-in or high-bay lighting retrofits
	Outdoor lighting retrofits
	Lighting controls
	EC motors

There were several changes to incentive levels in PY9. The main changes include:

- Increasing incentives for exterior lighting measures
- Implementing an incentive cap of $50 per occupancy sensor
- Implementing measure-based bonuses in December 2016 to encourage participation. The bonuses were offered for delamping measures, LED screw-ins, and high performance T8s (HPT8s) replacing 400W high-intensity discharge (HID) lamps. Implementation staff felt that these bonuses were successful in increasing program uptake.

As in PY8, the program relied on a network of SBDI Program Allies (SBPAs) to act as the face of the program and guide participants through the participation process from start to finish. SBPA responsibilities included promoting the program to customers, checking program eligibility and submitting program paperwork on the participant's behalf, completing the energy assessment, providing the Customer Recommendation Report, and installing free and incentivized recommended measures. In PY9, the SBDI Program recruited 45 SBPAs to help deliver the program and 32 SBPAs (71%) completed at least one project. Of the 32 active allies, 15 were new to the program in PY9.

As in previous years, the implementer also utilized two Small Business Energy Advisors (SBEAs) to generate leads, manage and train SBPAs, conduct Quality Assurance/Quality Control (QA/QC) inspections, and on some occasions, perform energy assessments. Program QA/QC processes remained largely similar to PY8, with all projects over $10,000 in incentives requiring a post-inspection. For projects under $10,000, the program doubled its post-inspection target from 5% in PY8 to 10% in PY9. During the post inspection, the SBEA ensured that the SBPA installed all the correct measures and that the customer was satisfied with the project. As part of the implementation process in PY9, the SBEAs took on the additional role of conducting joint assessments with SBPAs to ensure that assessments were conducted properly.

In PY9, SBPAs continued to use a dedicated Excel tool to generate the Customer Recommendation Report that was delivered by email, mail, or fax, at the customer's request. A key improvement made to the tool was the integration of the program application with the Customer Recommendation Report. The SBDI Program continued to use Franklin Energy's Efficiency Manager as the main tracking database.

According to program staff, program ally outreach was the most effective form of marketing. The program supported SBPAs by providing training, technical expertise, and promotional materials such as a program summary sheet and measure catalog.

3.2 Program Performance and Participation

3.2.1 Program Performance

Over the course of PY9, 868 eligible customers completed 919 projects through the SBDI Program. As seen in Table 5, the program achieved 10,707 MWh in ex post net energy savings which accounted for 80% of its goal.

Table 5. PY9 Program Performance against Energy Savings Goal

Metric	MWh
Goal	11,642
Ex Post Net Savings	10,707
% of Goal	92%

Table 6 provides a high-level comparison of various program performance and participation metrics in PY8 and PY9. The program increased its savings goal by 17%, from 9,933 MWh in PY8 to 11,642 MWh in PY9. While the number of program participants and completed projects increased in PY9, ex post net energy savings decreased by 4%, indicating that per-project savings has decreased by 31%. Additionally, the number of SBPAs who completed projects decreased by 11% from 36 in PY8 to 32 in PY9.

Table 6. SBDI Program Performance and Participation

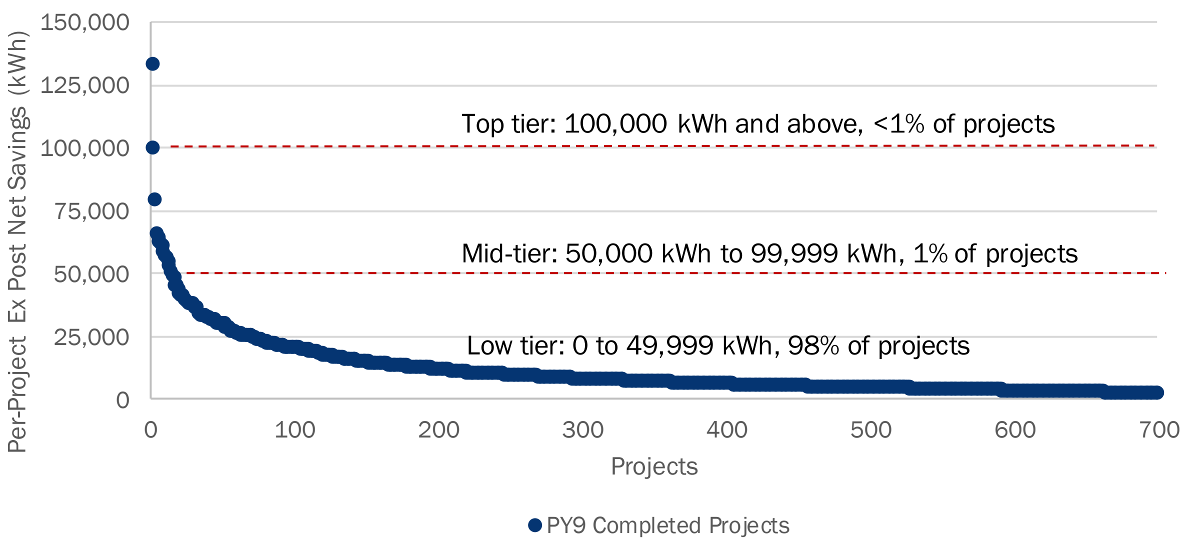
Metric	PY8 Outcome	PY9 Outcome	Percent Change*
PY Energy Savings Goal (MWh)	9,933	11,642	+17%

Metric	PY8 Outcome	PY9 Outcome	Percent Change*
Ex Post Net Savings (MWh)	11,202	10,707	-4%
Program Participants	649	868	+34%
Projects Completed	671	919	+37%
Ex Post Net MWh Savings Per Project	17	12	-31%
Participating SBPAs	36	32	-11%

*Note: Values are rounded for reporting purposes.

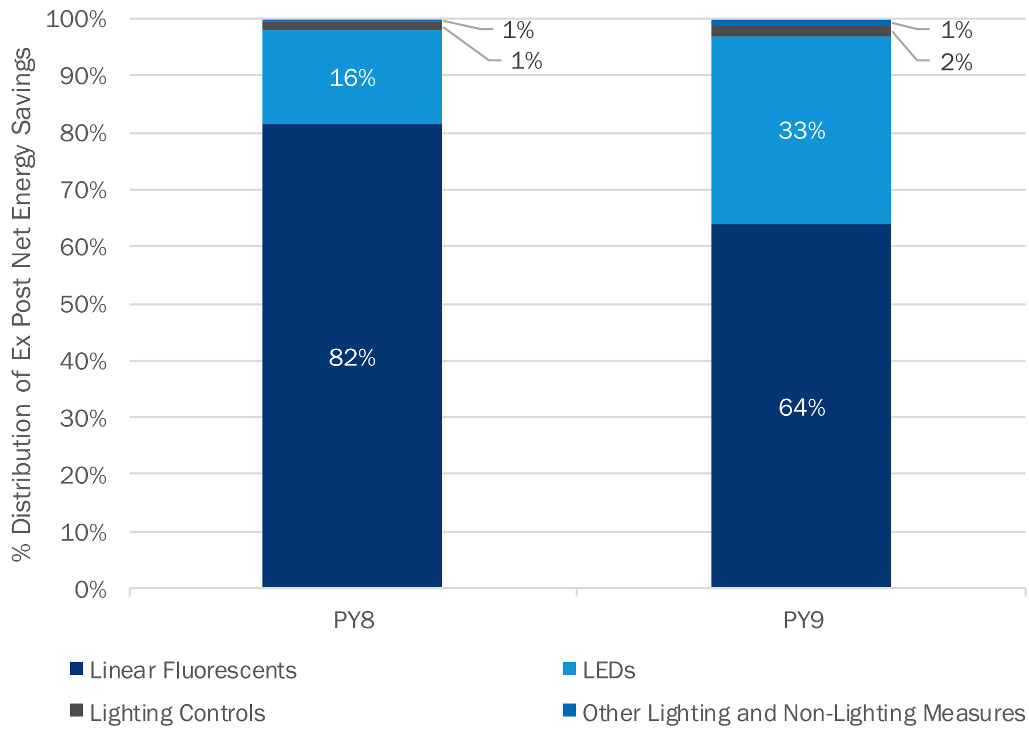
In looking more closely at project savings, the evaluation team classified projects into three tiers (Figure 1). The top tier includes projects that achieved ex post net savings of 100,000 kWh and above. This tier accounted for approximately 3% of program savings and less than 1% of completed projects. The mid-tier includes projects achieving between 50,000 kWh and 99,999 kWh ex post net savings; mid-tier projects accounted for 9% of program savings and 1% of completed projects. Finally, the low tier projects achieved ex post net savings from 0 kWh to 49,999 kWh, and accounted for 89% of program savings and 98% of completed projects. These trends in project size are similar to those seen in the PY8 program and are consistent with the SBDI Program's mandate to serve small business customers.

Figure 1. PY9 SBDI Per-Project Savings



Consistent with PY8, the SBDI Program continued to focus largely on energy efficient lighting, which accounted for nearly 100% of program savings. Linear fluorescent projects continued to be the primary source of ex post net energy savings, accounting for 64% of program savings in PY9. LED lighting increased in prominence in PY9, primarily at the expense of linear fluorescent lighting measures. As shown in Figure 2, LEDs grew from 16% of ex post net savings in PY8 to 33% in PY9.

Figure 2. % Distribution of Ex Post Net Energy Savings by Technology and Program Year



In terms of the types of measures installed, the evaluation team found that all linear fluorescent measures decreased in prominence with the exception of HPT8 replacing T12 measures. The percentage of projects that involved HPT8 replacing T12 measures increased by 121%, from 33% in PY8 to 73% in PY9. While reduced wattage T8 (RWT8) measures replacing T12 measures were included in over three-fourth of PY8 projects, this measure was included in a very small portion of PY9 projects (3%). The least popular measures were pre-rinse spray valves and LED fixtures, which were collectively installed in less than 1% of projects in both PY8 and PY9. Table 7 presents the installed measures by participants over time.

Table 7. Measures Installed by Participant by Program Year

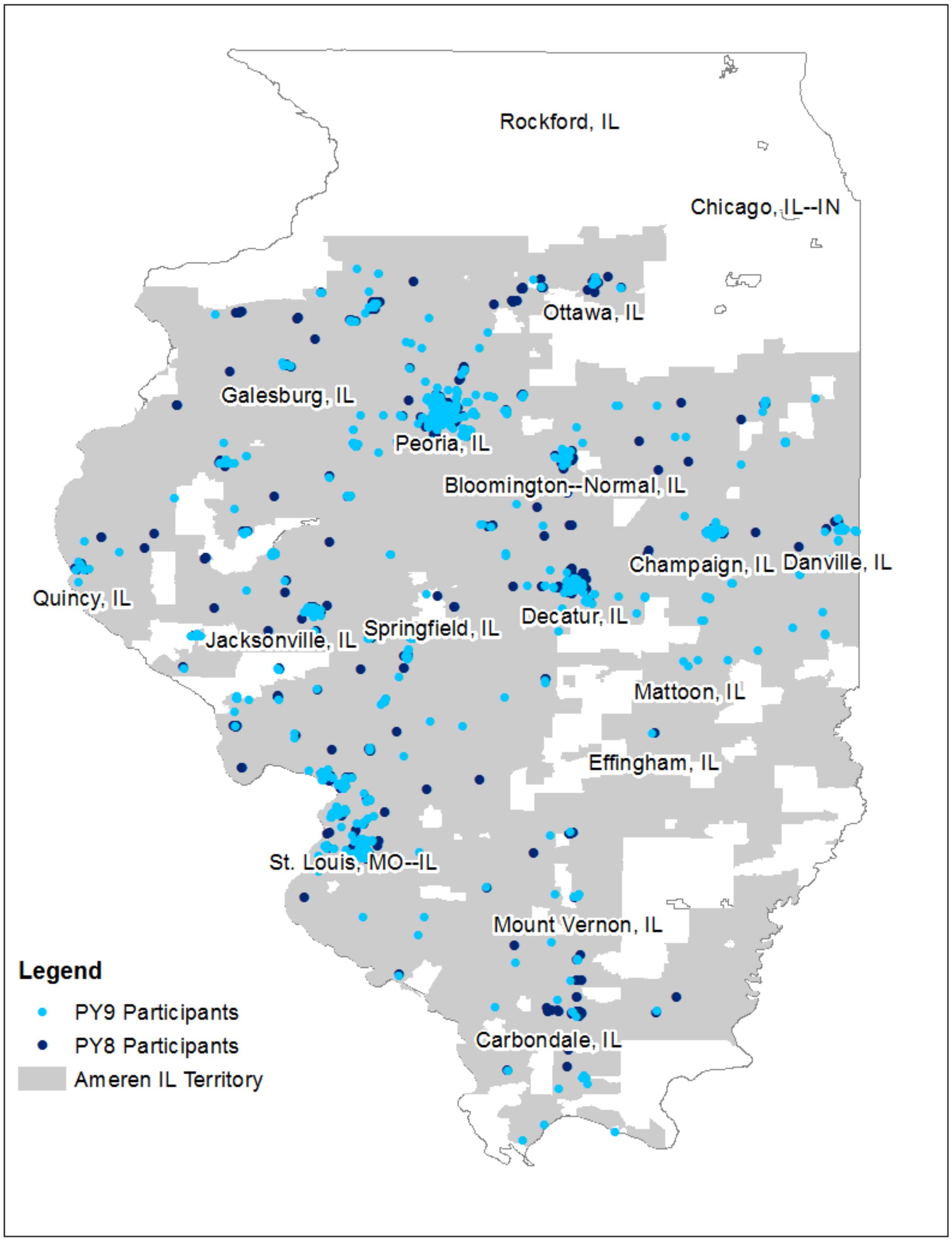
Measure	Percent of PY8 Projects (N=671)	Percent of PY9 Projects (N=919)	Percent Difference
HPT8 replacing T12	33%	73%	+120%
LED Bulbs	44%	40%	-9%
HPT8 replacing HID	18%	17%	-9%
LED Exit Sign	23%	14%	-39%
Delamping	20%	13%	-33%
Occupancy Sensors	3%	4%	58%
CFL	8%	3%	-65%
RWT8 replacing T12	76%	3%	-97%
Vending Controls	0%	3%	+1,652%
Aerator	1%	0%	-69%
LED Fixture	0%	0%	10%
Pre-Rinse Spray valve	0%	0%	N/A

Note: Most projects contained multiple measure types and values are rounded for reporting purposes

3.2.2 Program Participation Analysis

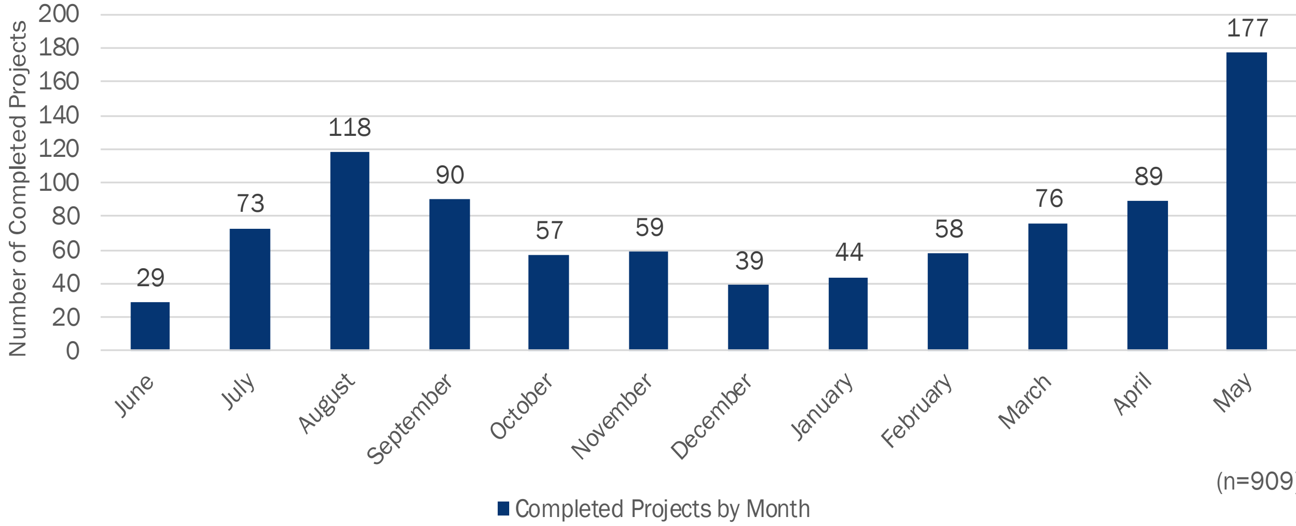
The SBDI Program continued to serve small business customers from throughout AIC's service territory as shown in Figure 3. Overall, program activity continued to be greater in urban areas such as Peoria, Decatur, and St. Louis, and lower in the southeastern portion of AIC's territory, particularly in Effingham and Mattoon.

Figure 3. SBDI Participation by Program Year



As seen in Figure 4, program activity varied over the course of PY9 with the lowest activity in June and December 2016. As discussed above, the program implemented measure-based bonus incentives in December 2016 to boost participation. The additional incentives were successful as program activity started to pick up in January 2017.

Figure 4. PY9 SBDI Projects Completed by Month



Note: Figure does not include 10 projects that did not have project complete dates.

3.2.3 Barriers to Program Implementation

The PY9 SBDI Program achieved 10,707 MWh in ex post net energy savings which accounted for 92% of its goal (11,642 MWh). Program staff attribute this shortfall to the following factors:

- **Increased Competition from Other IPA Small Business Programs**: The majority of SBDI Program offerings are linear fluorescent retrofits. According to the program implementation staff, this program design was consistent with lighting market trends in 2013, which was when the program was first proposed. However, the lighting market has undergone significant changes due to increased LED market penetration and demand. The SBDI Program was not able to change its measure mix in PY9 and faced competition from other IPA small business programs that offered a variety of LED measures such as the Small Business Linear LED Program and the Small Business Lit Signage Program.

- **Measure Caps[2] that Limited High-Demand Measures:** Program implementation staff also mentioned that funding for high-demand measures such as HPT8 replacing HIDs and LEDs ran out quickly due to program measure caps.

3.3 Impact Results

The following sections outline the results of the gross and net impact analysis for the PY9 SBDI Program. Overall, the program fell short of its goal and achieved realization rates of 115% and 121% for energy and demand savings respectively.

The PY9 SBDI Program measures were similar to that of PY8. Five measures were not consistent through both program years as seen in Table 8 below.

[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. Franklin Energy then managed the program to these measure caps.

Table 8. Program Year Measure Comparison

Measure	PY8 Only	PY9 Only
Cooling Miser		✓
Pre-Rinse Sprayer - Low Flow		✓
23W PAR (Directional) CFL replacing 100W Incandescent	✓	
De-Lamping 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	✓	
De-Lamping w/Refl 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	✓	

3.3.1 Measure Verification

In contrast to the PY8 evaluation, the evaluation team did not conduct any field research for the development of ISRs specific to the program participants. For PY9, the evaluation team utilized the IL-TRM V5.0 to develop a verified measure quantity from measure specific ISRs as seen below in Table 9.

Table 9. PY9 SBDI Verified Measure Quantities

Measure Category	Ex Ante Measure Quantity[1] (a)	Ex Post ISR[2] (b)	Verified Measure Quantity (a*b)
Occupancy Sensors	188,306	100.00%	188,306
HPT8 replacing T12	20,930	98.00%	20,511
LED Bulbs	15,134	98.00%	14,831
Delamping	3,450	100.00%	3,450
HPT8 replacing HID	2,213	98.00%	2,169
LED Exit Sign	562	100.00%	562
RWT8 replacing T12	390	98.00%	382
CFL	387	98.00%	379
Vending Controls	42	100.00%	42
LED Fixture	38	98.00%	37
Aerator	11	95.00%	10
Pre-Rinse Spray Valve	1	100.00%	1
Total	**231,464**	N/A	**230,681**

[1] Source: Franklin Energy – AIC SBDI IPA Program Results PY9 - (Final Program Tracking Database)

[2] Ex post ISRs are from the IL-TRM V5.0. When applicable, the evaluation team applied the final lifetime ISR rather than first-year year ISR as this is a direct install program, and the evaluation team assumed that no bulbs are placed in storage.

3.3.2 Ex Post Gross Impact Results

Table 10 summarizes the PY9 ex post gross impacts associated with the SBDI Program. The overall ex post gross impact savings for the PY9 SBDI Program are 12,030 MWh and 2.53 MW, as seen in Table 10. The gross realization rates are 115% for energy savings and 121% for demand savings. The evaluation team calculated ex post savings using inputs and algorithms from the IL-TRM V5.0 and applied the ISRs summarized above in Table 9.

Table 10. PY9 SBDI Program Gross Impacts

Program	Ex Ante Gross Impacts[a]		Ex Post Gross Impacts	
	MW	MWh	MW	MWh
SBDI	2.09	10,505	2.53	12,030
Gross Realization Rate[b]			121%	115%

[a] Source: Franklin Energy – AIC SBDI IPA Program Results PY9 - (Final Program Tracking Database)
[b] Gross realization rate = ex post gross value ÷ ex ante gross value

Table 11 summarizes the gross impact results by measure. Measure categories are sorted from largest to smallest based on ex ante energy savings.

Table 11. PY9 SBDI Ex Post Gross Impacts

Measure Category	Verified Measure Quantity	Ex Ante Gross		Ex Post Gross		Realization Rate	
		MW	MWh	MW	MWh	MW	MWh
HPT8 replacing T12	20,511	0.96	4,790	0.98	4,872	102%	102%
HPT8 replacing HID	2,169	0.41	2,222	0.40	2,156	98%	97%
LED Bulbs	14,831	0.40	1,881	0.68	3,013	169%	160%
Delamping	3,450	0.23	1,117	0.31	1,489	132%	133%
Occupancy Sensors	188,306	0.04	199	0.11	162	249%	81%
LED Exit Sign	562	0.02	118	0.02	118	100%	100%
RWT8 replacing T12	382	0.01	46	0.02	96	210%	209%
Vending Controls	42	-	63	-	63	-	100%
CFL	379	0.01	45	0.01	44	98%	98%
LED Fixture	37	0.01	19	0.003	12	62%	62%
Pre-Rinse Spray Valve	1	-	3	-	3	-	105%
Aerator	10	0.000	2	0.000	2	6990%	100%
Total	230,681	2.09	10,505	2.53	12,030	121%	115%

Differences in ex ante and ex post gross savings stem from differences in input values to the savings algorithms for each measure. The evaluation team reviewed the differences between ex ante and ex post variable assumptions for all program measures. Table 12 summarizes these findings with additional descriptions provided below. Specific inputs for all ex post savings estimates are available in Appendix A.

Table 12. Reasons for Differences in Realization Rates per Measure

Measure Category	Realization Rate		Source of Discrepancies		
	MW	MWh	Baseline and Efficient Wattages	ISR	Other (Specified)
HPT8 replacing T12	102%	102%	✓	✓	
HPT8 replacing HID	98%	97%		✓	
LED Bulbs	169%	160%	✓	✓	
Delamping	132%	133%	✓		
Occupancy Sensors	249%	81%			• Energy Savings Factor (ESF) • Miscalculated Demand

Measure Category	Realization Rate		Source of Discrepancies		
	MW	MWh	Baseline and Efficient Wattages	ISR	Other (Specified)
LED Exit Sign	100%	100%			
RWT8 replacing T12	210%	209%	✓	✓	
Vending Controls	-	100%			
CFL	98%	98%		✓	
LED Fixture	62%	62%	✓	✓	
Pre-Rinse Spray Valve	-	105%			• Efficient flow rate for pre-rinse spray valve
Aerator	6990%	100%			• Misapplied deemed demand (kW) savings

It is important to note that Table 12 is organized such that the measures appear in descending order by savings contribution to the overall program. The first four measures listed in Table 12 account for about 95% of all program energy savings. Differences within these four measures significantly affect program savings and have the largest impact on overall realization rates. Note that while certain inputs may increase savings, others decrease savings. The combination of all inputs brings about the overall realization rate for a specific measure. We describe the differences in the ex ante and ex post savings calculations in detail below.

- **Baseline and Efficient Wattage Discrepancies**: Ex ante and ex post baseline and efficient lighting wattage assumptions vary. The majority of ex post wattage assumptions are from the IL-TRM V5.0, but in some rare instances where the IL-TRM does not provide wattages (such as 8 ft. T12s) the evaluation team looked to other resources such as the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs (V3.0) (see Appendix A.4 for more details). Ex ante wattage assumptions also reference the IL-TRM V5.0, along with a 2013 XCEL Energy Lighting Efficiency Guide and a Howard HID to Watt table[3]. Additionally, ex ante assumptions are often weighted (using values from the TRM) for measures that fall under multiple categories within the IL TRM V5.0. The evaluation team is unable to assess the weighted values since the original source of the weights is unknown. A further breakdown of all lighting measures affected by variation of wattages is presented in Table 13 and Table 14 below.

Table 13. Baseline Wattage Discrepancies by Measure

Variable	Measure Category	Ex Ante Baseline Wattage[a]	Ex Post Baseline Wattage[a]	Δ wattage	Percent Change
Baseline Wattage	LED Bulbs	79	101	22	Ex post is 28.2% greater than ex ante
	Delamping	135	162	27	Ex post is 19.5% greater than ex ante
	RWT8 replacing T12	128	173	45	Ex post is 34.8% greater than ex ante
	LED Fixture	295	295	-	No discrepancy
	HPT8 replacing T12	131	140	9	Ex post is 6.7% greater than ex ante

[a] Baseline and efficient wattages are a weighted average to account for the multiple measure types captured by each measure category
Note: Values are rounded for reporting purposes.

[3] XCEL Energy Lighting Efficiency guide and Howard HID to Watt table provided to the evaluation team within ex ante spreadsheet detailing all input assumptions (File name: "PY9 Ameren Electric Master Measure Database with Errata")

Table 14. Efficient Wattage Discrepancies by Measure

Variable	Measure Category	Ex Ante Efficient Wattage[a]	Ex Post Efficient Wattage[a]	Δ wattage	Percent Change
Efficient Wattage	LED Bulbs	41	37	-3	Ex post is 7.9% smaller than ex ante
	Delamping	50	50	-0.6	Ex post is 1.2% smaller than ex ante
	RWT8 replacing T12	101	114	13	Ex post is 13.3% greater than ex ante
	LED Fixture	128	189	62	Ex post is 48.5% greater than ex ante
	HPT8 replacing T12	75	82	7	Ex post is 8.6% greater than ex ante

[a] Baseline and efficient wattages are a weighted average to account for the multiple measure types captured by each measure category
Note: Values are rounded for reporting purposes.

- **In-Service Rate (ISR) Discrepancies:** All ex post lighting measure ISRs are based on the IL-TRM V5.0 (Table 9). Ex ante savings assume ISRs of 100%. As a result, ex post savings are slightly less than ex ante savings.

- **Occupancy Sensor ESF Discrepancies:** Ex ante implemented a custom energy savings factor (ESF) of 29.7%[4]. This method deviates from the IL TRM V5.0. The evaluation team adhered to the algorithms and values presented in the TRM (applying an ESF of 24%[5]). As a result, ex post energy savings are lower than ex ante savings.

- **Miscalculated Demand (kW) Savings for Occupancy Sensors:**

  - **ESF:** The Implementer included the aforementioned custom ESF value within their calculations for occupancy sensor demand. This is a deviation from the algorithm presented in the IL TRM V5.0. Ex post does not include ESF and therefore estimates higher demand savings.

  - **Coincidence factor for Occupancy Sensors**: The implementation team also did not account for the coincidence factor (CF) for the installed occupancy sensor within their algorithm. The evaluation team applied the appropriate CF value of 0.15 per the IL TRM V5.0.

- **Efficient Flow Rate for Pre-Rinse Spray Valves:** The ex ante assumed value for the flow rate of a high efficiency pre-rinse spray valve was slightly higher (1.1 gallons per minute [gal/min]) than the IL-TRM V5.0 recommended value of 1.06 gal/min. As a result, ex post savings are slightly greater than ex ante savings.

- **Misapplied Deemed Demand (kW) Savings for Aerators:** The ex ante deemed demand savings for low-flow faucet aerators summarized in secondary documentation provided by the implementer are aligned with the ex post demand savings values. However, the program-tracking database includes a different value that is an order of magnitude greater than the expected demand savings value. Had the original ex ante value been used, demand realization rates would be close to 1.0.

[4] The custom ESF value was provided to the evaluation team within the ex ante spreadsheet detailing all input assumptions ("PY9 Ameren Electric Master Measure Database with Errata"). The custom ESF was based on an average project installing an occupancy sensor to control 1,125 watts and the kW controlled values presented in the IL TRM V5.0. The evaluation team was unable to locate the source of the assumed 1,125 watts controlled.

[5] IL TRM V5.0 ESF value for wall, ceiling, or fixture mounted occupancy sensors.

3.3.3 Ex Post Net Impact Results

In determining the overall net savings associated with the SBDI Program, the evaluation team applied the SAG-approved NTGR of 0.89, which is based on research conducted in PY6. As a result, the program achieved net realization rates of 115% for electric energy and 121% for demand savings.

Table 15. SBDI Program Net Impacts

Program	Ex Ante Net Impacts		Ex Ante NTGR	Ex Post NTGR	Ex Post Net Impacts	
	MW	MWh			MW	MWh
SBDI	1.86	9,350	0.89	0.89	2.25	10,707
				Net Realization Rate[a]	**121%**	**115%**

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

4. Key Findings and Recommendations

In PY9, the SBDI Program fell short of its energy savings goal. Program staff attribute this shortfall to increased competition from other IPA small business programs, which ultimately led to lower customer participation than needed to meet the program goal. The evaluation team presents supporting findings and recommendations based on the PY9 evaluation below:

- **Key Finding #1**: Program performance continued to rely on energy efficient lighting measures, which accounted for nearly 100% of ex post net energy savings in PY9. The majority of this savings (64%) came from linear fluorescent measures. Further, the lighting market has undergone significant changes due to increased LED market penetration and demand. Our evaluation of the PY9 SBDI program shows alignment with this trend as the percentage of ex post net energy savings from LED measures has doubled from 16% in PY8 to 33% in PY9.
  - **Recommendation**: Going forward, AIC and their implementation partners should look for ways to diversify program offerings in order to stabilize program savings. In addition, AIC and their implementation partners should continue to monitor the lighting market in terms of product availability and pricing, and adjust measure offerings and incentives to align with market trends.
- **Key Finding #2**: The evaluation team determined that discrepancies between ex ante and ex post savings values were partially due to different assumptions such as lighting wattages, in-service rates, and misapplication of variables, such as effective flow rate for aerator measures, from the IL-TRM V5.0.
  - **Recommendation:** To minimize discrepancies between ex ante and ex post gross savings estimates for future program measures, the evaluation team recommends the use of primary data collected by the implementer for such things as actual installed wattage, whether space cooling is present in the facility, heating fuel types, vending machine type, etc., so that variables within the algorithms are more reflective of the installed measures instead of assumed averages based on general assumptions. If primary data is unavailable, the evaluation team recommends applying the assumptions provided in the IL-TRM.

Appendix A. SBDI Program Assumptions and Algorithms

In PY9, the impact evaluation efforts estimated gross impact savings for the SBDI Program by applying savings algorithms from the Illinois Statewide Technical Reference Manual (TRM) V5.0 (2016)[6] 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 Compact Fluorescent Lighting (CFLs)

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

Equation 1. CFL Algorithms

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

$$Demand\ Savings\ (\Delta kW) = \left(\frac{Watts_{Base} - Watts_{CFL}}{1000}\right) * ISR * CF * WHFd$$

Where:

$Watts_{Base}$ = Wattage of existing incandescent lamp (or halogen equivalent wattage for those that are not EISA exempt)

Table 16. Baseline Wattages for CFLs

Measure Description	EISA Adjusted[a]	$Watts_{Base}$	Notes/Reference
General Purpose CFL (14W replacing 60W incandescent)	Yes	43	Halogen equivalent from IL-TRM V5.0 Section 4.5.1
General Purpose CFL (19W replacing 75W incandescent)	Yes	53	
General Purpose CFL (23W replacing 100W incandescent)	Yes	72	
23W PAR (Directional) CFL replacing 100W Incandescent	No	100	Assumed wattage from measure description in database
15W PAR (Directional) CFL replacing 75W Incandescent	No	75	

[a] The EISA schedule requires baseline adjustments to standard screw-based lighting with incandescent baseline wattages of 100W (as of June 2012), 75W (as of June 2013), and 60W (as of June 2014).

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

$Watts_{CFL}$ = Wattage of installed CFL (actual wattage from measure label used)

ISR = In-service rate or the percentage of lamps rebated that get installed = 98%[7]

Hours = Annual operating hours (varies by building type per IL-TRM V5.0 Section 4.5)

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

WHFd = Waste heat factor for demand that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

CF = Summer Peak Coincidence Factor (varies by building type per IL-TRM V5.0 Section 4.5)

A.2 Lighting Emitting Diodes (LEDs)

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

Equation 2. LED Algorithms

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

$$Demand\ Savings\ (\Delta kW) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000}\right) * ISR * CF * WHFd$$

Where:

$Watts_{Base}$ = Wattage of existing incandescent lamp (or halogen equivalent wattage for those that are not EISA exempt)

Table 17. Baseline Wattages for LEDs

Measure Description	EISA Adjusted[a]	$Watts_{Base}$	Notes/Reference
LED screw-in lamps replacing <65W Incandescent	Yes	38	Average EISA adjusted baseline wattage (25W - 53W) for omnidirectional lamps with incandescent equivalent of 65W or less from IL-TRM V5.0 Section 4.5.4
LED screw-in lamps replacing ≥65W Incandescent	Yes (100W equivalent) No (>100W equivalent)	181	Average baseline wattage (72W - 300W) for omnidirectional lamps with incandescent equivalent greater than 65W from IL-TRM V5.0 Section 4.5.4
LED PAR38 replacing ≥65W Incandescent PAR38	No	122	Average baseline wattage (65W - 200W) for all screw-in lamps with diameter >2.25" and wattage >65W from IL-TRM V5.0 Section 4.5.4
DLC-listed High Bay LED replacing 250W HID	No	295	

[7] In-service rate from the IL-TRM V5.0 section 4.5.1. The evaluation team applied the final lifetime ISR rather than first-year ISR as this is a direct install program and the evaluation team assumed that no bulbs are placed in storage.

Measure Description	EISA Adjusted[a]	Watts Base	Notes/Reference
			Metal Halide 250W CWA Pulse Start wattage from IL-TRM V5.0 Section 4.5.3 Table A-2
Outdoor LED replacing existing HID ≤175W	No	156	Average wattage for 100W and 175W HID from IL-TRM V5.0 Section 4.5.4 Table A-2; Set minimum wattage to 100W based on secondary research
Outdoor LED replacing existing HID 176-250W	No	284	Average wattage for 250W HID from IL-TRM V5.0 Section 4.5.4 page 380
Outdoor LED replacing existing HID 251-400W	No	455	Average wattage for 400W HID from IL-TRM V5.0 Section 4.5.4 page 380
Outdoor LED replacing Fluorescent T12HO 176-250W	No	211	Average wattage across 9 different T12HO fixtures with fixture wattages between 176W to 250W from NYS Ngrid Fixture Wattage Table

[a] The EISA schedule requires baseline adjustments to standard screw-based lighting with incandescent baseline wattages of 100W (as of June 2012), 75W (as of June 2013), and 60W (as of June 2014).

$Watts_{LED}$ = Wattage of installed LED

Table 18. Wattages for Installed LEDs

Measure Description	$Watts_{LED}$	Notes/Reference
LED screw-in lamps replacing <65W Incandescent	14	Average LED wattage (5.6W -23.1W) for omnidirectional lamps with incandescent equivalent of 65W or less from IL-TRM V5.0 Section 4.5.4
LED screw-in lamps replacing ≥65W Incandescent	67	Average LED wattage (37.2W - 104.4W) for omnidirectional lamps with incandescent equivalent greater than 65W from IL-TRM V5.0 Section 4.5.4
LED PAR38 replacing ≥65W Incandescent PAR38	40	Average LED wattage (21W - 75W) for all screw-in lamps with diameter >2.25" with incandescent equivalent 65W or greater from IL-TRM V5.0 Section 4.5.4
DLC-listed High Bay LED replacing 250W HID	189	Average wattage for High Bay LED fixtures from IL-TRM V5.0 Section 4.5.4 –Table A-2
Outdoor LED replacing existing HID ≤175W	55	Average LED wattage equivalent to 100W and 175W HID from IL-TRM V5.0 Section 4.5.4 Table A-2
Outdoor LED replacing existing HID 176-250W	123	Average LED wattage equivalent to 250W HID from IL-TRM V5.0 sec 4.5.4 page 380
Outdoor LED replacing existing HID 251-400W	215	Average LED wattage equivalent to 400W HID from IL-TRM V5.0 sec 4.5.4 page 380
Outdoor LED replacing Fluorescent T12HO 176-250W	54	LED 2x4 Recessed Light Fixture from IL-TRM V5.0 Section 4.5.4 Table A-1

ISR = In-service rate or the percentage of lamps rebated that get installed = 98%[8]

[8] In-service rate from IL-TRM V5.0 section 4.5.4. The evaluation team applied the final lifetime ISR rather than first-year ISR as this is a direct install program and the evaluation team assumed that no bulbs are placed in storage.

Hours = Annual operating hours (varies by building type per IL-TRM V5.0 Section 4.5)

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

WHFd = Waste heat factor for demand that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

CF = Summer Peak Coincidence Factor (varies by building type per IL-TRM V5.0 Section 4.5)

A.3 LED Exit Signs

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

Equation 3. LED Exit Sign Algorithms

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

$$Demand\ Savings\ (\Delta kW) = \left(\frac{Watts_{Base} - Watts_{LED}}{1000}\right) * ISR * CF * WHFd$$

Where:

$Watts_{Base}$ = Wattage of existing exit sign (applied $Watts_{Base}$ from IL-TRM V5.0 for unknown baseline type) = 23 Watts

$Watts_{LED}$ = Wattage of installed LED Exit sign from IL-TRM V5.0 = 2 Watts

ISR = In-service rate or the percentage of lamps rebated that get installed = 100%[9]

Hours = Annual operating hours per IL-TRM V5.0 = 8,766 hours/yr

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

WHFd = Waste heat factor for demand that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

CF = Summer Peak Coincidence Factor per IL-TRM V5.0 = 1.0

[9] In-service rate from IL-TRM V5.0 section 4.5.5.

A.4 Linear Fluorescent Fixtures

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

Equation 4. Linear Fluorescent Fixture Algorithms

$$Energy\ Savings\ (\Delta kWh) = \left(\frac{Watts_{Base} - Watts_{LFT8}}{1000}\right) * ISR * Hours * WHFe$$

$$Demand\ Savings\ (\Delta kW) = \left(\frac{Watts_{Base} - Watts_{LFT8}}{1000}\right) * ISR * CF * WHFd$$

Where:

$Watts_{Base}$ = Wattage of existing fixture

Table 19. Baseline Wattages for Linear Fluorescent Fixtures

Measure Description	EISA Adjusted[a]	$Watts_{Base}$	Notes/Reference
De-Lamping 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	No	84	Average wattage for 2-lamp F34T12 w/ EEMag Ballast (67W), 2-lamp F40T12 w/ EEMag Ballast (87W), 2-lamp F40T12 w/ Mag Ballast (97W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping w/Refl 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	No	84	Average wattage for 2-lamp F34T12 w/ EEMag Ballast (67W), 2-lamp F40T12 w/ EEMag Ballast (87W), 2-lamp F40T12 w/ Mag Ballast (97W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping w/Refl 2 Lamp 8ft T12 to 2 Lamp 4ft HPT8	No	173	Fluorescent 2 lamp 96" STD w/ Mag-STD ballast (F96T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 296
De-Lamping w/Refl 3 Lamp 4ft T12 to 2 Lamp 4ft HPT8	No	127	Average wattage for 3-lamp F34T12 w/ EEMag Ballast (104W), 3-lamp F40T12 w/ EEMag Ballast (135W), 3-lamp F40T12 w/ Mag Ballast (141W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping 4 Lamp 4ft T12 to 2 Lamp 4ft HPT8	No	164	Average wattage for 4-lamp F34T12 w/ EEMag Ballast (144W), 4-lamp F40T12 w/ EEMag Ballast (172W), 4-lamp F40T12 w/ Mag Ballast (175W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping 4 Lamp 4ft T12 to 3 Lamp 4ft HPT8	No	164	Average wattage for 4-lamp F34T12 w/ EEMag Ballast (144W), 4-lamp F40T12 w/ EEMag Ballast (172W), 4-lamp F40T12 w/ Mag Ballast (175W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping 4 Lamp 8ft T12 to 4 Lamp 4ft HPT8	No	346	Fluorescent 4 lamp 96" STD w/ Mag-STD ballast (F96T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 297

Measure Description	EISA Adjusted[a]	Watts Base	Notes/Reference
De-Lamping w/Refl 4 Lamp 4ft T12 to 2 Lamp 4ft HPT8	No	164	Average wattage for 4-lamp F34T12 w/ EEMag Ballast (144W), 4-lamp F40T12 w/ EEMag Ballast (172W), 4-lamp F40T12 w/ Mag Ballast (175W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping w/Refl 4 Lamp 4ft T12 to 3 Lamp 4ft HPT8	No	164	Average wattage for 4-lamp F34T12 w/ EEMag Ballast (144W), 4-lamp F40T12 w/ EEMag Ballast (172W), 4-lamp F40T12 w/ Mag Ballast (175W) from IL-TRM V5.0 Section 4.5.3 Table A-2
De-Lamping w/Refl 4 Lamp 8ft T12 to 4 Lamp 4ft HPT8	No	346	Fluorescent 4 lamp 96" STD w/ Mag-STD ballast (F96T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 297
De-Lamping w/Refl 2 Lamp U tube T12 to 2 Lamp 2ft T8	No	96	Fluorescent 2 lamp U-tube STD w/ Mag-STD ballast (FU40T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 298
1 Lamp 4ft HPT8/LWT8 L&B Retro	No	45	Average wattage for 1-lamp F34T12 w/ EEMag Ballast (41W), 1-lamp F40T12 w/ EEMag Ballast (42W), 1-lamp F40T12 w/ Mag Ballast (51W) from IL-TRM V5.0 Section 4.5.3 Table A-2
2 Lamp 4ft HPT8/LWT8 L&B Retro	No	84	Assumed baseline is a T12 fixture. Average wattage for 2-lamp F34T12 w/ EEMag Ballast (67W), 2-lamp F40T12 w/ EEMag Ballast (87W), 2-lamp F40T12 w/ Mag Ballast (97W) from IL-TRM V5.0 Section 4.5.3 Table A-2
2 Lamp tandem 4ft HPT8 replacing 1L 8ft T12 (Slimline, HO, or VHO)	No	97	Fluorescent 2-lamp 4 foot F40T12 w/ Mag Ballast. The IL-TRM does not provide 8ft T12 wattages, therefore the evaluation team used a 2 lamp 4ft T12 instead. IL-TRM V5.0 Section 4.5.3 Table A-2
2 Lamp 8ft RWT8 L&B Retro replacing 2L 8ft T12 Slimline	No	173	Fluorescent 2 lamp 96" STD w/ Mag-STD ballast (F96T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 296
2 Lamp T8 U HPT8/LWT8 Replacing 2-T12 U Lamp	No	96	Fluorescent 2 lamp U-tube STD w/ Mag-STD ballast (FU40T12) from New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs V3.0 – Appendix C – Standard Fixture Watts Table pg. 298
3 Lamp 4ft HPT8/LWT8 L&B Retro	No	127	Assumed baseline is a T12 fixture. Average wattage for 3-lamp F34T12 w/ EEMag Ballast (104W), 3-lamp F40T12 w/ EEMag Ballast (135W), 3-lamp F40T12 w/ Mag Ballast (141W) from IL-TRM V5.0 Section 4.5.3 Table A-2

Measure Description	EISA Adjusted[a]	Watts $_{Base}$	Notes/Reference
4 Lamp 4ft HPT8/LWT8 L&B Retro	No	164	Average wattage for 4-lamp F34T12 w/ EEMag Ballast (144W), 4-lamp F40T12 w/ EEMag Ballast (172W), 4-lamp F40T12 w/ Mag Ballast (175W) from IL-TRM V5.0 Section 4.5.3 Table A-2
4 Lamp tandem 4ft HPT8 replacing 2L 8ft T12 (Slimline, HO, or VHO)	No	175	Fluorescent 4-lamp 4 foot F40T12 w/ Mag Ballast. The IL-TRM does not provide 8ft T12 wattages, therefore the evaluation team used a 4 lamp 4ft T12 instead. IL-TRM V5.0 Section 4.5.3 Table A-2
4 Lamp 4ft HPT8 High bay Fluor replacing 250W HID	No	295	Metal Halide 250W CWA Pulse Start wattage from IL-TRM V5.0 Section 4.5.4 Table A-2
6 Lamp 4ft HPT8 High bay Fluor replacing 400W HID	No	455	Metal Halide 400W from IL-TRM V5.0 Section 4.5.3 Table A-2

[a] The EISA schedule requires baseline adjustments to standard screw-based lighting with incandescent baseline wattages of 100W (as of June 2012), 75W (as of June 2013), and 60W (as of June 2014).

$Watts_{LFT8}$ = Wattage of installed linear fluorescent T8

Table 20. Wattages for Installed Linear Fluorescent T8s

Measure Description	$Watts_{LFT8}$	Notes/Reference
De-Lamping 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	25	1-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 2 Lamp 4ft T12 to 1 Lamp 4ft HPT8	25	1-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 2 Lamp 8ft T12 to 2 Lamp 4ft HPT8	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 3 Lamp 4ft T12 to 2 Lamp 4ft HPT8	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping 4 Lamp 4ft T12 to 2 Lamp 4ft HPT8	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping 4 Lamp 4ft T12 to 3 Lamp 4ft HPT8	74	3-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping 4 Lamp 8ft T12 to 4 Lamp 4ft HPT8[b]	99	4-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 4 Lamp 4ft T12 to 2 Lamp 4ft HPT8	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 4 Lamp 4ft T12 to 3 Lamp 4ft HPT8	74	3-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
De-Lamping w/Refl 4 Lamp 8ft T12 to 4 Lamp 4ft HPT8	99	4-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2

Measure Description	$Watts_{LFT8}$	Notes/Reference
De-Lamping w/Refl 2 Lamp U tube T12 to 2 Lamp 2ft T8	30	F17T8 Standard Lamp - 2 foot from IL-TRM V5.0 Section 4.5.3 Table A-3
1 Lamp 4ft HPT8/LWT8 L&B Retro	25	1-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
2 Lamp 4ft HPT8/LWT8 L&B Retro	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
2 Lamp tandem 4ft HPT8 replacing 1L 8ft T12 (Slimline, HO, or VHO)	49	2-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
2 Lamp 8ft RWT8 L&B Retro replacing 2L 8ft T12 Slimline	114	RWT8 - F96T8 Lamp - 8 foot from IL-TRM V5.0 Section 4.5.3 Table A-3
2 Lamp T8 U HPT8/LWT8 Replacing 2-T12 U Lamp	56	F32T8 Standard u-tube Lamp from IL-TRM V5.0 Section 4.5.3. Table A-3
3 Lamp 4ft HPT8/LWT8 L&B Retro	74	3-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
4 Lamp 4ft HPT8/LWT8 L&B Retro	99	4-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
4 Lamp tandem 4ft HPT8 replacing 2L 8ft T12 (Slimline, HO, or VHO)[b]	99	4-Lamp Relamp/Reballast HPT8 from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
4 Lamp 4ft HPT8 High bay Fluor replacing 250W HID	147	4-Lamp HPT8 w/ High-BF Ballast High-Bay from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2
6 Lamp 4ft HPT8 High bay Fluor replacing 400W HID	221	6-Lamp HPT8 w/ High-BF Ballast High-Bay from IL-TRM V5.0 Errata Measures Memo Section 4.5.3 Table A-2

ISR = In-service rate or the percentage of lamps rebated that get installed = 98%[10]

Hours = Annual operating hours (varies by building type per IL-TRM V5.0 Section 4.5)

WHFe = Waste heat factor for energy that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

WHFd = Waste heat factor for demand that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)

CF = Summer Peak Coincidence Factor (varies by building type per IL-TRM V5.0 Section 4.5)

A.5 Occupancy Sensor

The evaluation team determined ex post savings for occupancy sensors using the algorithms below.

[10] In-service rate from IL-TRM V5.0 section 4.5.3. The evaluation team applied the final lifetime ISR rather than first-year ISR as this is a direct install program and the evaluation team assumed that no bulbs are placed in storage.

Equation 5. Occupancy Sensor Algorithms

$$Energy\ Savings\ (\Delta kWh) = kWControlled * ISR * Hours * ESF_{weighted} * WHFe$$

$$Demand\ Savings\ (\Delta kW) = kWControlled * ISR * WHFd * (CFbaseline - CFos)$$

Where:

kWcontrolled	= Total wattage connected to the sensor control in units of per 1,000 watts (kilowatts) (actual wattage controlled from program-tracking database)
ISR	= In-service rate or the percentage of occupancy sensors rebated that get installed = 100%[11]
Hours	= Annual operating hours (varies by building type per IL-TRM V5.0 Section 4.5)
ESF	= Energy Savings Factor (ESF) that represents the percentage of reduced operating hours from installing either wall mounted, ceiling mounted, or fixture mounted occupancy sensors = 24%
WHFe	= Waste heat factor for energy that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)
WHFd	= Waste heat factor for demand that accounts for cooling savings from efficient lighting (varies by building type per IL-TRM V5.0 Section 4.5)
CFbaseline	= Summer Peak Coincidence Factor for the lighting system without the installation of occupancy sensors (varies by building type per IL-TRM V5.0 Section 4.5)
CFos	= Summer Peak Coincidence Factor for the lighting system with the installation of occupancy sensors per IL-TRM V5.0 = 0.15

[11] The IL-TRM V5.0 does not provide an in-service rate, nor does it include it as part of the algorithm. The in-service rate is assumed to be 100%.

A.6 Low-Flow Faucet Aerators

The evaluation team determined ex post for low-flow faucet aerators using the algorithms below.

Equation 6. Low-flow Faucet Aerator Algorithms

$$Energy\ Savings\ (\Delta kWh) = \%ElectricDHW * \frac{GPM_{Base} - GPM_{LFA}}{GPM_{Base}} * Usage * EPG_{Electric} * \ ISR$$

$$Demand\ Savings\ (\Delta kW) = \frac{\Delta kWh}{Hours} * CF$$

Where:

%ElectricDHW	= 100% if electric water heater, 0% if gas water heater
GPM_{Base}	= Flow rate of the baseline faucet aerator per IL-TRM V5.0 = 1.39
GPM_{LFA}	= Flow rate of the low-flow faucet aerator per IL-TRM V5.0 = 0.94
Usage	= Estimated usage (gallons per year) of mixed water (varies by building type per IL-TRM V5.0 Section 4.3.2)
EPG_electric	= Energy per gallon of hot water supplied by electric water heater for bathroom faucets per IL-TRM V5.0 = 0.0795 (bathroom aerator); 0.0969 (kitchen aerator)
ISR	= In-Service Rate per IL-TRM V5.0 = 95%
Hours	= Annual electric DHW recovery hours for faucet use (varies by building type per IL-TRM V5.0 Section 4.3.2)
CF	= Coincidence Factor for electric load reduction (varies by building type per IL-TRM V5.0 Section 4.3.2)

A.7 High Efficiency Pre-Rinse Spray Valve

The evaluation team determined ex post for pre-rinse spray valves using the algorithms below.

Equation 7. Pre-Rinse Spray Valve Algorithms

$$Energy\ Savings\ (\Delta kWh) \ = \ \%ElectricDHW * \Delta Gallons \ * \ 8.33 \ * \ 1 \ * \ (Tout \ - \ Tin) * \frac{\left(\frac{1}{EFF_{Elec}}\right)}{3{,}413}$$

$$\Delta Gallons \ = \ (FLO_{Base} \ - \ FLO_{Eff}F) \ * \ 60 \ * \ Hours/day \ * \ Days/yr$$

Where:

%ElectricDHW	= 100% if electric water heater, 0% if gas water heater
ΔGallons	= Reduction of water used
8.33	= Specific mass in pounds of one gallon of water (lbm/gal)

1	= Specific heat of water (1 Btu/lbm/°F)
Tout	= Water Heater Outlet Water Temperature = Tin +70°F
Tin	= Inlet Water Temperature = 54.1°F
EFF_{Elec}	= Efficiency of electric water heater supplying hot water to pre-rinse spray valve = 97%
FLO_{Base}	= Base case flow rate in gallons per minute (= 1.90
FLO_{Eff}	= Efficient flow rate in gallons per minute= 1.06
Hours/day	= Hours per day that the pre-rinse spray valve is in use= 1.25[12]
Days/yr	= Number of days per year the pre-rinse spray valve is in use = 312[13]

A.8 Vending Controls

The evaluation team determined ex post savings for vending controls using the algorithms below.

Equation 8. Vending Control Algorithms

$$Energy\ Savings\ (\Delta kWh) = \frac{Watts_{base}}{1000} * Hours * ESF$$

$$Demand\ Savings\ (\Delta kW) = No\ demand\ savings\ for\ vending\ controls$$

Where:

$Watts_{base}$	= Total vending machine wattage connected to the sensor control (see Table 21)
Hours	= Annual operating hours per IL-TRM V5.0 = 8,766 hours/yr
ESF	= Energy Savings Factor (ESF) that represents the percentage of reduced operating hours (see Table 21)

Table 21. Vending/Cooling Miser Inputs

Measure Description	$Watts_{base}$	ESF	Notes/Reference
Refigerated Beverage Machine (Vending Miser)	400	0.46	IL-TRM V5.0 Section 4.6.2
Refigerated Glass Front Machine (Cooling Miser)	460	0.30	IL-TRM V5.0 Section 4.6.2
Non Refrigerated	85	0.46	IL-TRM V5.0 Section 4.6.2

12 Hours per day from IL-TRM V5.0 section 4.2.11 as an average between small quick service restaurants and medium sized casual restaurants. Large institutional establishments were omitted because the pre-rinse spray valve was only installed in restaurant settings according to PY9 program data

13 Based on IL-TRM V5.0 section 4.2.11 assumption of 6 days per week operation and 52 weeks per year

For more information, please contact:

Hannah Arnold
Managing Director

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

1 Kaiser Plaza, Suite 445
Oakland, CA 94612