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NAVIGANT

EM&V Report for the Small Business Energy Saver Program

Duke Energy Progress and Duke Energy Carolinas

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Duke Energy

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September 27, 2016
Revised June 6, 2017

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1. EVALUATION SUMMARY

1.1 Program Summary

The Small Business Energy Saver (SBES) Program is part of a portfolio of energy efficiency programs operated by Duke Energy. Duke Energy selected Lime Energy to implement the SBES program again in the Duke Energy Progress (DEP) jurisdiction, as well as the Duke Energy Carolinas (DEC) jurisdiction for this evaluation cycle. The program caters specifically to small business customers and offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation, on high-efficiency lighting and refrigeration equipment.

The SBES Program generates energy savings and peak demand reductions by offering eligible customers a streamlined service including marketing outreach, technical expertise, and performance incentives to reduce equipment and installation costs from market rates on high-efficiency lighting, refrigeration, and HVAC equipment. The SBES Program seeks to bundle all eligible measures together and sell them as a single project in order to maximize the total achievable energy and demand savings, while working with customers to advise equipment selection to meet their unique needs.

1.2 Evaluation Objectives and High Level Findings

Evaluation, Measurement, and Verification (EM&V) involves the use of a variety of analytic approaches, including on-site verification of installed measures and application of engineering models. EM&V also encompasses an evaluation of program processes and customer feedback, typically conducted through participant surveys and program staff interviews. This report details the EM&V activities that Navigant Consulting, Inc. (Navigant) performed on behalf of Duke Energy for the SBES Program.

This report covers EM&V activities performed for projects covering the following periods, referenced simply as PY2015 for the remainder of this report:

- January 1, 2015 through February 29, 2016 (DEP)
- August 1, 2014 (program start) through February 29, 2016 (DEC)

The primary purpose of the evaluation assessment is to estimate net annual energy and peak demand impacts associated with SBES activity. Net savings are calculated as the reported “gross” savings from Duke Energy, verified and adjusted through EM&V, and netted for free ridership (i.e., savings that would have occurred even in the absence of the program) and spillover (i.e., additional savings attributable to the program but not captured in program records).

The EM&V assessment of the SBES program included impact and process evaluations.

- The impact evaluation consisted of engineering analysis and on-site field verification and metering to validate energy and demand impacts of reported measure categories, as well as a customer survey to assess net impacts.
- The process evaluation used customer surveys with 151 participants and interviews with program staff and the implementation contractor to characterize the program delivery and identify opportunities to improve the program design and processes. The customer survey data also formed the basis of the evaluation team’s estimation of free ridership and spillover, used to calculate an NTG ratio.

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The evaluation team verified gross energy savings at 111 percent of deemed reported energy savings for DEP and 112 percent for DEC, and gross peak demand reductions at 96 percent for DEP and DEC. A net-to-gross (NTG) ratio was estimated at 1.03, yielding total verified net energy savings of 55,947 megawatt-hours (MWh) for DEP and 89,506 MWh for DEC, and net peak demand reductions of 11.5 megawatts (MW) for DEP and 20.4MW for DEC (Table 1-1 through Table 1-4).

Table 1-1. Program Claimed and Evaluated Gross Energy Impacts

	Jurisdiction	Claimed	Evaluated	Realization Rate
Gross Energy Impacts (MWh)	DEP	48,772	54,318	1.11
Gross Energy Impacts (MWh)	DEC	77,269	86,899	1.12

Source: Navigant analysis and Duke Energy tracking data.

Table 1-2. Program Claimed and Evaluated Gross Peak Demand Impacts

	Jurisdiction	Claimed	Evaluated	Realization Rate
Gross Summer Peak Demand Impacts (MW)	DEP	11.7	11.2	0.96
Gross Winter Peak Demand Impacts (MW)	DEP	11.7	6.2	0.53
Gross Summer Peak Demand Impacts (MW)	DEC	20.5	19.8	0.96
Gross Winter Peak Demand Impacts (MW)	DEC	20.5	10.9	0.53

Source: Navigant analysis and Duke Energy tracking data.

Table 1-3. Program Net Energy Impacts

	Jurisdiction	MWh
Net Energy Impacts (MWh)	DEP	55,947
Net Energy Impacts (MWh)	DEC	89,506

Source: Navigant analysis.

Table 1-4. Program Net Peak Demand Impacts

	Jurisdiction	MW
Net Summer Peak Demand Impacts (MW)	DEP	11.5
Net Winter Peak Demand Impacts (MW)	DEP	6.4
Net Summer Peak Demand Impacts (MW)	DEC	20.4
Net Winter Peak Demand Impacts (MW)	DEC	11.2

Source: Navigant analysis.

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1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Navigant performed a variety of primary and secondary research activities including:

- Engineering review of measure savings algorithms
- Field verification and metering to assess installed quantities and characteristics
- Participant surveys with customers to assess satisfaction and decision-making processes.

Table 1-5 summarizes the evaluated parameters. The targeted sampling confidence and precision for both DEP and DEC was 90 percent ± 10 percent, and the achieved was 90 percent ± 7.0 percent for energy savings, 8.5 percent for summer and 12.4 percent for winter peak demand reductions.[1]

Table 1-5. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. Lighting wattage 2. Operating hours 3. Coincidence factors 4. HVAC interactive effects 5. Baseline characteristics
In-Service Rates	The percentage of program measures in use as compared to reported	1. Measure quantities found onsite
Satisfaction	Customer satisfaction with various stages of their project	1. Overall satisfaction with program 2. Satisfaction with implementation and installation contractors 3. Satisfaction with program equipment
Free Ridership	Fraction of reported savings that would have occurred in the absence of the program	
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	

Source: Navigant analysis

[1] Navigant designed the impact sample to achieve 90/10 confidence and precision using the industry-standard coefficient of variation of 0.5 and results from previous (PY2013 and PY2014) SBES program evaluations in the DEP jurisdiction. The sample quotas were met as planned, and the final precision was different due to natural variation in individual site level characteristics.

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This evaluation covers program participation from August 2014 through February 2016. Table 1-6 shows the start and end dates of Navigant's sample period for evaluation activities.

Table 1-6. Sample Period Start and End Dates

Activity	Start Date	End Date
Field Verification and metering	March 15, 2016	April 22, 2016
Participant Phone Surveys	May 3, 2016	May 5, 2016

Source: Navigant analysis

1.4 Recommendations

The evaluation team recommends five discrete actions for improving the SBES Program, based on insights gained through the comprehensive evaluation effort. These recommendations provide Duke Energy with a roadmap to fine-tune the SBES Program for continued success and include the following broad objectives. Table 1-7 summarizes these program recommendations.

Table 1-7. Summary of PY2015 SBES Recommendations

	Increasing Program Participation
1.	**Continue to emphasize non-energy benefits** of program participation, such as increased lighting quality, comfort for both business employees and customers, environmental benefits, and reduced maintenance. Now that the program has transitioned primarily to LED measures, increased education on the benefits that LED measures offer should enhance participation.
	Increasing Customer Satisfaction
2.	**Continue to prioritize customer satisfaction through installation contractor training and customer follow-up services**. The IC has improved in this area from PY2014, but a minority of customers are still reporting issues with installation and communication. Additionally, some customers are not perceiving savings on their electric bill, so managing this expectation would enhance customer satisfaction.
3.	**Phase out fluorescent T8 lighting systems**. Linear LED lighting offers substantial savings above high-performance/reduced wattage T8 lamps and ballasts, which may be perceived as outdated.
	Improving Accuracy of Reported Savings
4.	**Add HVAC interactive effects and update coincidence factors for lighting measures**. This is the key impact finding to improve the accuracy of savings estimates. The IC should apply relevant HVAC interactive effects and coincidence factors to lighting measures as is appropriate, and ensure that outdoor lighting measures on daylight sensors do not accrue peak demand reductions during summer daylight hours.
5.	**Ensure that efficient lighting power ratings for linear LED systems are accurate**. Navigant did not perform live measurements of connected linear LED systems to determine power draw, and upon review of manufacturer specifications for lighting power there are different wattages that the system may draw depending on the specific configuration. As the share of savings attributed to linear LED systems grow, this should be quantified to reduce EM&V risk in future years.

Source: Navigant analysis

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2. PROGRAM DESCRIPTION

The Small Business Energy Saver (SBES) Program is part of a portfolio of energy efficiency programs operated by Duke Energy. The program began as a pilot in early 2013 in South Carolina before expanding into the remainder of the Duke Energy Progress (DEP) jurisdiction. The program further expanded into the Duke Energy Carolina (DEC) jurisdiction in August 2014. In 2015, the program showed continued growth compared to 2014 measured by both participant count and claimed energy savings and peak demand reductions.

2.1 Program Design

The SBES Program is available to qualifying commercial customers with less than 100 kilowatts (kW) demand service. The SBES Program recognizes that customers with lower savings potential may benefit from a streamlined, one-stop, turnkey delivery model and relatively high incentives to invest in energy efficiency. Additionally, small businesses may lack internal staffing dedicated to energy management and can benefit from energy audits and installations performed by an outside vendor.

The program offers incentives in the form of a discount for the installation of measures, including high-efficiency lighting and refrigeration equipment. These incentives increase adoption of efficient technologies beyond what would occur naturally in the market. In PY2015, the SBES Program (IC) achieved the majority of program savings from lighting measures, which tend to be the most cost-effective and easiest to market to potential participants. The IC also achieved program savings from refrigeration measures at a similar level to PY2014.

The program offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation. Multiple factors drive the total project cost, including selection of equipment and unique installation requirements.

2.2 Reported Program Participation and Savings

Duke Energy maintains a tracking database that identifies key characteristics of each project, including participant data, installed measures, and estimated energy and peak demand reductions based on assumed (“deemed”) savings values. In addition, the IC maintains a tracking database that contains additional measure level details that are useful for EM&V activities. For PY2015 Navigant only reviewed the IC database. Duke Energy ensured that the IC database savings accurately represent all claimed program savings.

Table 2-1 provides a summary of the gross reported energy and demand savings and participation for PY2013 through PY2015. Note the significant year over year growth for PY2015, along with an increase in average measures installed per project and average savings per project.

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Table 2-1. Reported Participation and Gross Savings Summary

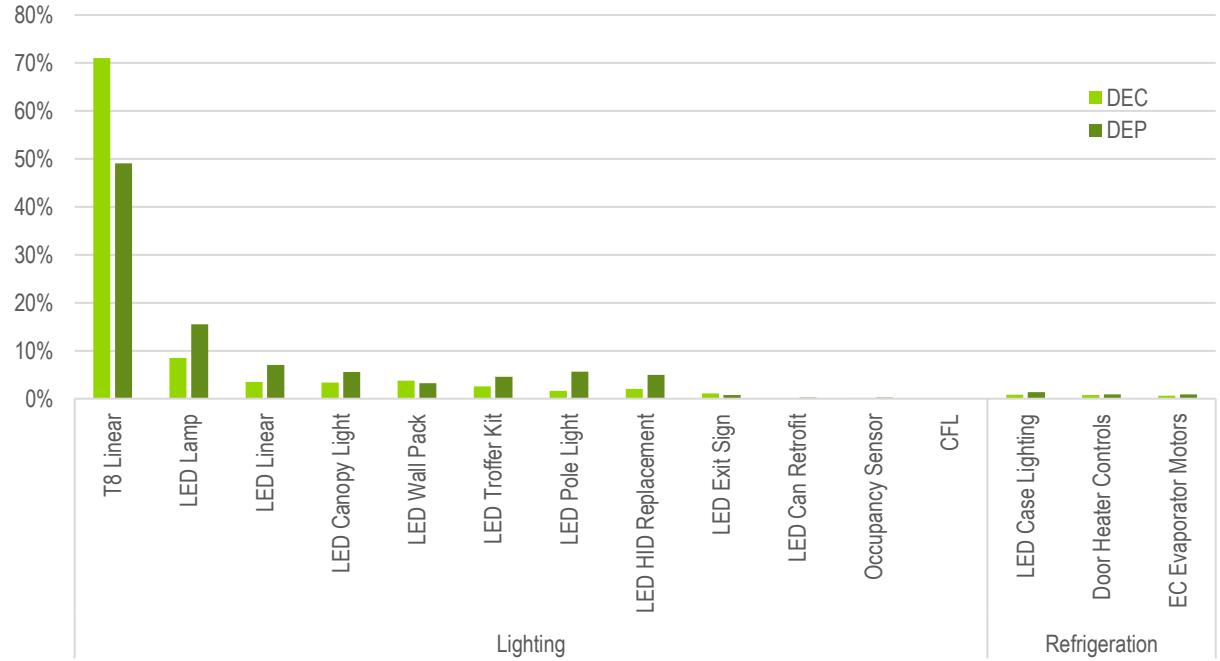
Reported Metrics	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP)	PY2015 (DEC)
Participants	675	1,759	1,790	3,080
Measures Installed	42,537	108,816	132,977	234,788
Gross Annual Energy Savings (MWh)	14,242	38,665	48,772	77,269
Average Quantity of Measures per Project	63	62	74	76
Average Gross Savings Per Project (MWh)	21.1	22.0	27.2	25.1

Source: SBES Tracking Database

2.2.1 Program Summary by Measure

Efficient T8 lighting retrofits were the highest contributor to program energy savings in PY2015 across both jurisdictions, followed by a variety of LED lighting measures. In addition, refrigeration measures, compact fluorescent lamps (CFLs), and occupancy sensors also contributed to savings. Navigant found a higher share of savings from T8 fluorescent retrofits in the DEC jurisdiction, likely due to the fall and winter 2014 projects that were part of this evaluation cycle. The SBES program has rapidly adopted LED lighting products in PY2015. Figure 2-1 shows the reported gross savings by measure category as reported by Duke Energy.

Figure 2-1. Reported Gross Energy Savings by Measure Category and Jurisdiction



Source: SBES Tracking Database

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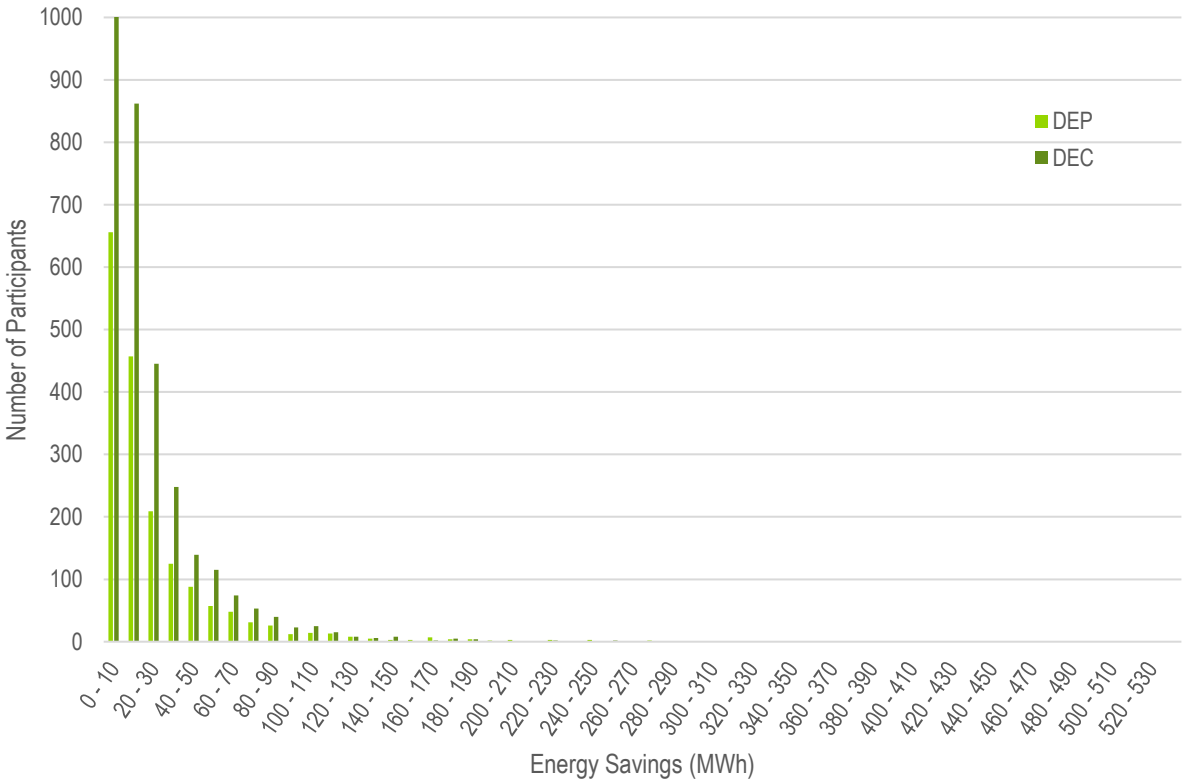
2.2.2 Savings by Project

Because the SBES program is limited to small business customers only, the variations in project energy and peak demand savings and the quantity of measures installed exhibit less spread than typical large business program offerings. Nevertheless, there is still a mix of various project sizes, as shown in Figure 2-2, with very few project sites reporting savings over 200 MWh per year. The largest site reported savings of over 500 MWh per year.

Figure 2-2. Histogram of Reported Energy Savings per Project



Source: SBES Tracking Database

The evaluation team reviewed the business type data in the tracking database as well, but found that there was not a facility type field that could be easily mapped to deemed savings values for HVAC interactive effects and coincidence factors, which will be explored further in this report.

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3. KEY RESEARCH OBJECTIVES

As outlined in the Statement of Work (SOW), the primary purpose of the EM&V activities is to estimate verified net annual energy and peak demand impacts associated with program activity for PY2015. Additional research objectives include the following:

3.1 Impact Evaluation

The impact evaluation focuses on quantifying the magnitude of verified energy savings and peak demand reductions. Objectives include:

- Verify deemed savings estimates through review of measure assumptions and calculations.
- Perform on-site verification of measure installations, and collect data for use in an engineering analysis.
- Estimate the amount of observed energy and peak demand savings (both summer and winter) by measure via engineering analysis.

3.2 Net-to-Gross Analysis

The net-to-gross analysis focuses on estimating the share of energy savings and peak demand reductions that can be directly attributed to the SBES program itself. Objectives include:

- Assess the Net-to-Gross ratio by addressing spillover and free-ridership in customer surveys.

3.3 Process Evaluation

The process evaluation focuses on the program implementation and the customer experience. Objectives include:

- Perform interviews with program management and Implementation Contractor.
- Perform participant surveys with customers.
- Identify barriers to participation in the program, and how the program can address these barriers.
- Identify program strengths and the potential for introducing additional measures.

3.4 Evaluation Overview

Figure 3-1 outlines the high-level approach used for evaluating the SBES Program, which is designed to address the research objectives outlined above. The impact, net-to-gross, and process sections provide further detail for each of the individual EM&V activities.

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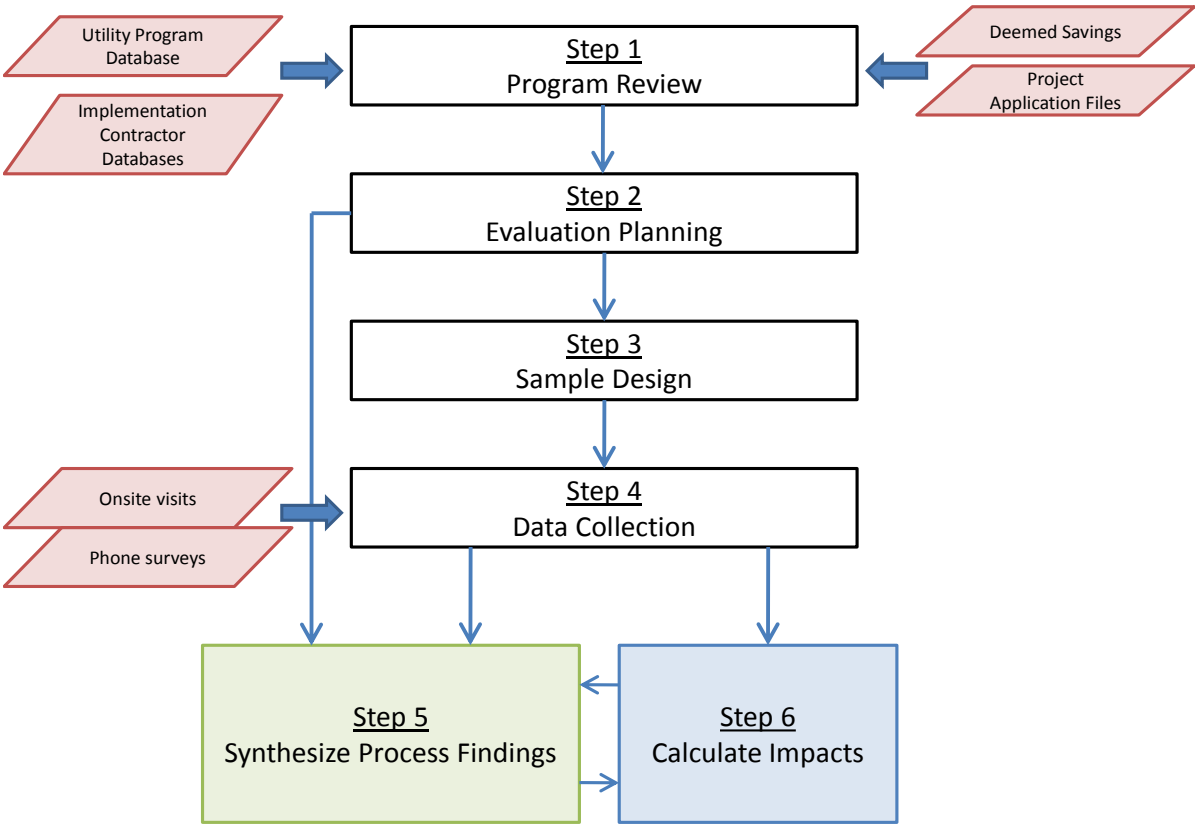
Figure 3-1. Evaluation Process Flow Diagram



Source: Navigant

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4. IMPACT EVALUATION

The purpose of this impact evaluation is to quantify the verified energy and demand savings estimates for the SBES Program in both the DEP and DEC jurisdictions. Table 4-1 and Table 4-2 show high-level program results of Navigant's impact analysis. Ultimately, Duke Energy can use these results as an input to system planning.

Table 4-1. PY2015 SBES Summary of Program Impacts for DEP

DEP	Energy Savings (MWh)	Summer Peak Demand Reductions (MW)	Winter Peak Demand Reductions (MW)
Reported Gross Savings	48,772	11.7	11.7
Realization Rate	1.11	0.96	0.53
Verified Gross Savings	54,318	11.2	6.2
NTGR	1.03	1.03	1.03
Verified Net Savings	55,947	11.5	6.4

Source: Navigant analysis

Table 4-2. PY2015 SBES Summary of Program Impacts for DEC

DEC	Annual Energy Savings (MWh)	Summer Peak Demand Reductions (kW)	Winter Peak Demand Reductions (kW)
Reported Gross Savings	77,269	20.5	20.5
Realization Rate	1.12	0.96	0.53
Verified Gross Savings	86,899	19.8	10.9
NTGR	1.03	1.03	1.03
Verified Net Savings	89,506	20.4	11.2

Source: Navigant analysis

4.1 Impact Methodology

The methodology for assessing the gross energy savings and peak demand reductions follows IPMVP Option A (Retrofit Isolation: Key Parameter Measurement). This involves an engineering-based approach for estimating savings, supplemented by key parameter measurements. This included using time-of-use lighting loggers to directly measure operating hours and coincidence factors for program- incented lighting measures. Note that for the limited set of refrigeration measures, verification activities were performed on-site to assess installation and operation.

The evaluation team employed the following steps to conduct the impact analysis:

1. **Review Field Data and Design Sample** – First, the team analyzed the tracking data to determine the most appropriate sampling methodology. The team created four strata (small, medium, and large lighting, and refrigeration) to ensure that a variety of different businesses and

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measures were captured in the site visits. A subset of each strata was selected for more detailed logging (19 of 57 total sites visits were logged).

2. **Pull Sample** – Next, the team pulled a sample from the four strata and scheduled site visits, including several backup sites in the event that a visitation could not be arranged.
3. **Perform Participant Site Visits** – The evaluation team used an electronic data collection system in the field to ensure consistency and decrease data processing time. For all site visits, Navigant field technicians uploaded all collected site data to the online system as soon as they were completed. Navigant performed quality control verifications for all field data collection forms and online data entry. This included a thorough inspection of each site's building characteristic inputs, operating schedules, measure-level in-service rates, and descriptions. The following steps were taken at each participant site:
    a. At each customer site, the team first determined the in-service rate (ISR) of the equipment for each measure found. The field technicians accomplished this by visually verifying and counting all equipment included in the project documentation at each site.
    b. The team then calculated the difference in watts between the base-case fixtures and the energy-efficient fixtures for each fixture type installed on-site. The team verified efficient fixture wattage through visual inspection, while deriving base-case fixture wattage from customer-provided data found in the documentation review, if available, or from information found by field technicians during the site visits. There is typically little to no information about the specifications of base-case equipment that has been removed from a site. If both customer data and field data were insufficient, the team utilized the IC tracking data and assessed the reasonableness of their assumptions.
    c. Operating hours were determined from a detailed customer interview for each unique lighting schedule in the building, and adjusted for holiday building closures. For the subset of sites that received logging, the EM&V team left time-of-use loggers in place for roughly three weeks and then returned to retrieve the logging equipment.
    d. Coincidence factors were taken from prior EEB program findings[2] and previous SBES reports[3] for similar building types for the verification only sites. For logged sites, the team calculated both summer and winter coincidence factors from the logger data.
4. **Calculate Site-Level Savings** – The team calculated site-level energy and demand savings for each site in the sample based on operational characteristics found on site and engineering-based parameter estimates.
5. **Calculate Program-Level Savings** – The team calculated verification rates for all sites and applied a ratio, representing the adjustment based on the logger data, resulting in final verified savings for each sampled site. Lastly, the team calculated stratum-level realizations rates, applied those realization rates to the projects that fell into their respective strata, and arrived at final program-level realization rates. Navigant utilized the stratified ratio estimation method to determine program-level verified gross savings for each jurisdiction by applying strata-level realization rates to the projects within each jurisdiction.

[2] PY2013 DEP EEB EM&V Report

[3] PY2013 and PY2014 DEP SBES EM&V Report

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4.2 Sample Design

After reviewing the Duke Energy and IC tracking data, the evaluation team opted to split up the population of projects into four strata based on the projects' estimated energy savings to ensure that the sample represented both small, medium and large customers, and that field verification assessed a large percentage of program savings. The strata were designed according to the following guidelines:

1. First, all projects with refrigeration measures were assigned to a single stratum.
2. The remaining projects were sorted from highest claimed savings to lowest claimed savings.
3. The team then examined the reported savings and selected criteria that would result in three strata, each containing an approximately equal share of total claimed savings:
    - Lighting Large – greater than 65,000 kWh reported savings;
    - Lighting Medium – between 25,000 kWh and 65,000 kWh reported savings;
    - Lighting Small – less than 25,000 kWh savings;
    - Refrigeration – all projects with refrigeration savings.

Note that the stratum cutoff points for PY2015 are higher than in PY2014 due to the larger average per-project savings in this evaluation. The limits in PY2014 were 20,000 kWh and 40,000 kWh.

In order to achieve a 10 percent relative precision at a 90 percent confidence interval, the evaluation team targeted 57 total sites, which were spread roughly equally among the three lighting strata and a smaller refrigeration stratum.

The evaluation team conducted on-site verification at 57 sites during the summer of 2016. While on-site, the team conducted customer interviews and visual verification to collect data on building operation, HVAC system details, and seasonal and holiday schedules. Key evaluation parameters came primarily from on-site data; however, where this data was lacking or was deemed unusable, customer application data was used in its place. As there are many parameter inputs to the savings calculation for each site, this approach ensures that the best available data are used for each site's savings estimation. Table 4-3 below details the final site visit disposition.

Table 4-3. Onsite Sample Summary

Strata	Population Size	Onsite Verification Sample Size	Onsite Metering Sample Size (Subset of Verification Sample)
Lighting Large	328	16	6
Lighting Medium	1025	18	7
Lighting Small	3,327	17	6
Refrigeration	195	6	0
Total	**4,875**	**57**	**19**

Source: Navigant analysis

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4.3 Algorithms and Parameters

Navigant used data collected from the field and the engineering review to calculate site-level energy and demand savings, using the following algorithms. Table 4-4 shows the algorithms that the evaluation team used to calculate verified savings for lighting measures. The impact evaluation effort focused on verifying the inputs for these algorithms.

Table 4-4. Verified Savings Algorithms for Lighting Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Lighting Measures	kWh_Verified = Qty_Verified x HOU x Verified_Watts_Reduced x IF_Energy	kW_Verified = Verified x CF x Verified_Watts_Reduced x IF_Demand
Refrigeration	kWh_Verified = Unit_Savings x Qty_Verified	kW_Verified = Unit_Savings x Qty_Verified

ISR = in-service rate (not in calculation, calculated to provide context)
Fixture_Quantity_Verified = quantity of equipment verified on-site
HOU = verified operating hours
CF = coincidence factor
IF_Energy = heating, ventilating, and air conditioning (HVAC) interaction factor for energy savings calculations
IF_Demand = interaction factor for demand savings calculations
Verified Watts Reduced = watts of baseline equipment - watts of energy-efficient equipment.
Unit_Savings = deemed per unit savings appropriate for measure.

Source: Navigant analysis

The detailed description of each parameter and any related assumption are as follows:

4.3.1 Fixture Quantity Verified and In-Service Rate (ISR)

The Navigant evaluation team visually counted fixtures on-site to quantify the quantity and type of lighting equipment installed. The team calculated the ISR as the ratio between the findings from the on-site verification compared to the quantity reported in the program-tracking databases. On-site verifications determined the total number of installed measure-level equipment.

4.3.2 Verified Watts

The team calculated base and efficient watts at the measure level. Efficient nameplate wattages were determined using manufacturer specifications based on fixture-level data collected on-site. The project documentation contained in the IC tracking database determined base wattages. In the cases where efficient fixture data were unavailable, due to inaccessible fixtures, the wattages found in the IC database values were applied.

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4.3.3 HVAC Interactive Effects

Reductions in lighting energy generally increase a building's heating requirements (load) and decrease cooling requirements. The HVAC interactive effects accounts for these secondary effects on the HVAC system energy use and acts as a multiplier in the energy savings algorithms. The team applied the HVAC interactive effects used in prior EEB and SBES program evaluations (both 2013 and 2014) for consistency, which were sourced from a 2011 Navigant study (including over 120 buildings) in Maryland that used building energy models of field-verified building characteristics (i.e., HVAC, lighting, and envelope) and actual billing data to assess the interactive effects of lighting energy reductions on HVAC system energy use. The resulting interaction factors are specific to both building type (e.g., office, warehouse) and heating/cooling systems.

4.3.4 Annual Operating Hours

Measure-level annual operating hours were determined from a detailed interview with the SBES customer. Hours used per day or week were rolled up to annual hours of use and corrected for holidays, seasonal variations in use, and any other change in operating characteristics. For logged sites, the team extrapolated the time of use logger data to develop annual hours of operation.

4.3.5 Coincidence Factor (CF)

Coincidence factors represent the portion of installed lighting that is operational during the utility peak performance hours. These were determined similarly to HVAC interactive effects by using deemed values by building type in addition to data collected on-site. For example, light-emitting diode (LED) exit signs that are on all day receive a CF on 1.0, while exterior lights on daylight sensors receive a CF of 0.0. For logged sites, the team extrapolated the time of use logger data to develop coincidence factors.

4.3.6 Unit Savings

For refrigeration measures, the engineering analysis follows a deemed savings methodology based on the NY Technical Reference Manual (TRM) unit savings. The assumptions and parameters used to estimate reported energy savings and peak demand reductions were deemed appropriate by the evaluation team. The team verified that the measures were installed and operational during on-site visits to projects that installed efficient refrigeration equipment.

4.4 Key Impact Findings

The energy realization rates by strata are shown in Table 4-5. This shows the verification realization rate, the metering realization rate, and the final realization rate by strata. Note that strata-level realization rates are derived from both DEP and DEC projects, and are applied to each jurisdiction separately to calculate program level verified energy savings and peak demand reductions.

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Table 4-5. Energy Impacts by Strata

Strata	Verification Realization Rate (kWh)	Metering Realization Rate Adjustment (kWh)	Total Realization Rate (kWh)
Lighting Large	0.94	1.12	1.06
Lighting Medium	1.09	1.03	1.12
Lighting Small	1.20	1.00	1.20
Refrigeration	1.05	n/a	1.05
Total	**1.08**	**1.04**	**1.12**

Source: Navigant analysis

The summer and winter peak demand reductions are shown in Table 4-6 and Table 4-7. Contrary to the energy adjustments based on metering, there is a more substantial reduction in the realization due to application of measure-specific coincidence factors based on logger data for both the summer and winter periods. A winter coincidence factor was calculated based on the logged data, with the summer coincidence factors used as the basis for statistical comparison given the lack of more appropriate parameters.

Table 4-6. Summer Peak Demand Impacts by Strata

Strata	Verification Realization Rate (kW)	Metering Realization Rate Adjustment (kW)	Total Realization Rate (kW)
Lighting Large	1.09	1.01	1.11
Lighting Medium	1.04	0.93	0.96
Lighting Small	1.27	0.72	0.91
Refrigeration	0.58	n/a	0.58
Total	**1.10**	**0.87**	**0.96**

Source: Navigant analysis

Table 4-7. Winter Peak Demand Impacts by Strata

Strata	Verification Realization Rate (Winter kW)	Metering Realization Rate Adjustment (Winter kW)	Total Realization Rate (Winter kW)
Lighting Large	0.83	0.70	0.58
Lighting Medium	0.77	0.72	0.56
Lighting Small	0.94	0.50	0.47
Refrigeration	0.47	n/a	0.47
Total	**0.82**	**0.64**	**0.53**

Source: Navigant analysis

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Overall, the verification realization rates are slightly above 1.0 for energy savings and summer peak demand reduction. This indicates that the program is accurately reporting impacts at the aggregate program level, despite varying realization rates for each individual stratum. The winter peak demand reductions were not characterized specifically by Duke Energy, so in turn Navigant compared verified winter savings with deemed reported summer savings.

4.5 Detailed Impact Findings

This section examines findings from the evaluation of lighting measures in order to identify the main drivers of the verified savings values. The evaluation team uses the Field Verification Rate (FVR) to describe the overall verified savings relative to the reported savings for each measure. FVRs reflect differences between the quantity of equipment installed on-site and the quantity reported in the tracking database, as well as differences between operating characteristics verified in the field and assumed operating characteristics in the program deemed savings estimates. The team calculates the field verification rate as the verified savings divided by the reported savings by measure, which is driven by a combination of the in-service rate, the hours of use adjustment rate, the lighting power adjustment rate, the HVAC interactive effect adjustment rate, and the coincidence factor, described as follows:

1. **In-Service Rate**[4] **(ISR)** is the ratio of the verified (i.e., installed) quantity to the reported quantity.
2. **Hours of Use (HOU) Adjustment Rate** reflects discrepancies between reported and verified operating hours.
3. **Lighting Power Adjustment Rate** is a ratio of the verified wattage difference between the efficient and baseline equipment to the reported wattage difference between the efficient and baseline equipment.
4. **HVAC Interactive Effect (IE) Adjustment Rate** is a multiplier that reflects HVAC interactive effects due to space heating and cooling loads due to a reduction in heat output from efficient lighting. Note that the IC did not deem HVAC IE for any measures so this adjustment is equal to the average HVAC IE itself. There are separate adjustments for energy savings and peak demand reduction.
5. **Coincidence Factor** represents the portion of installed lighting that is on during the peak utility hours. This affects only summer and winter peak demand reductions, not energy savings.

Figure 4-1 below shows the relative effect of each of the aforementioned adjustment rates on the measure-level FVR for energy savings, which the following subsections describe in further detail. Note that FVR cannot be used to derive program level realization rates. This is because the contributions of each parameter update are described relative to their reported value, while the program analysis was structured to stratify savings by participant energy savings per site rather than by individual measures.

[4] In-Service Rate is an industry-standard term that describes verified quantities of installed equipment relative to reported quantities.

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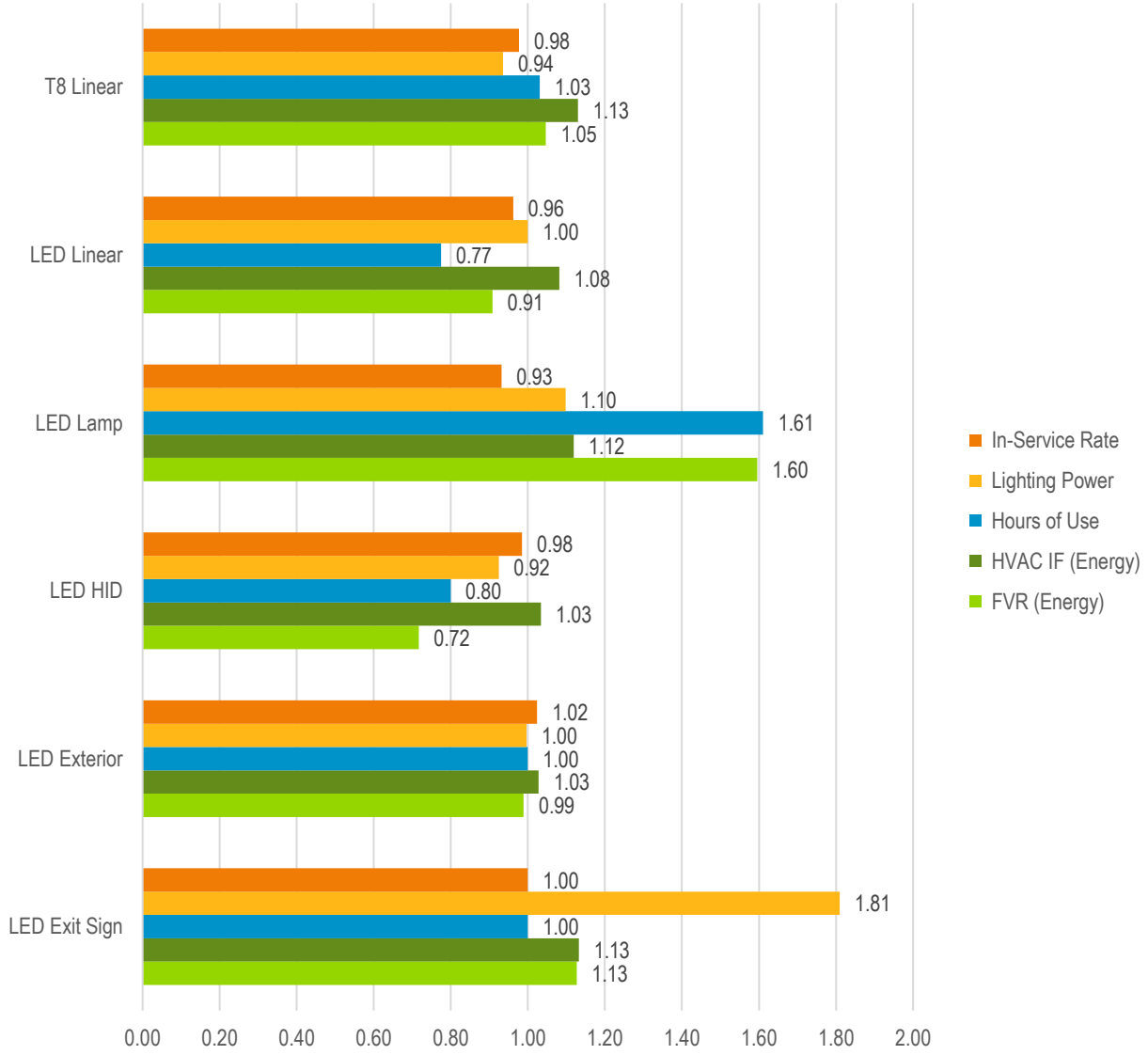
Figure 4-1. Gross Energy Savings Field Verification Rates



Source: Navigant analysis

Figure 4-2 below shows the relative effect of each of the aforementioned adjustment rates on the measure-level FVR for summer peak demand reductions, which the following subsections describe in further detail.

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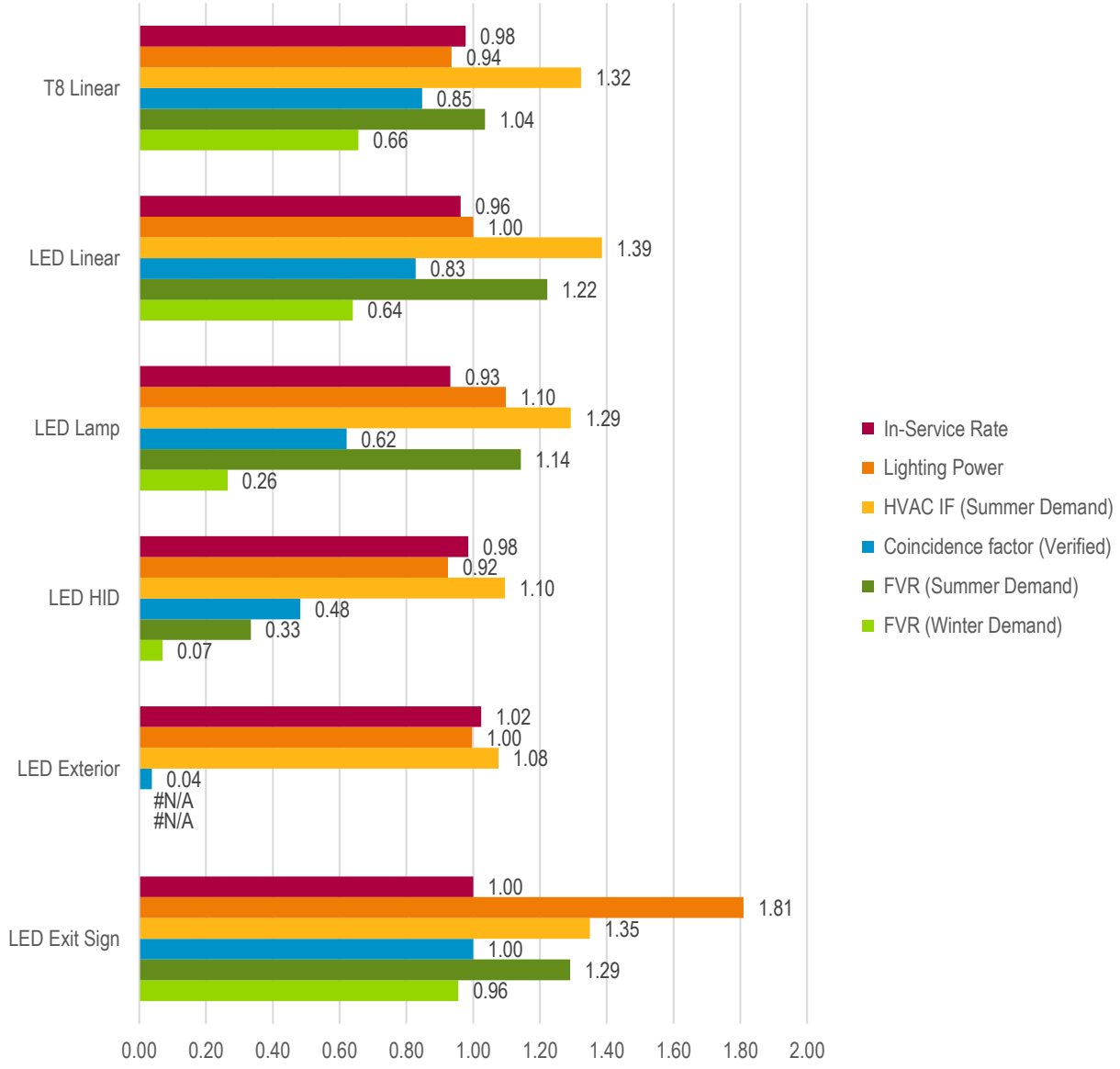
Figure 4-2. Gross Peak Demand Reductions Field Verification Rates



Source: Navigant analysis

The final adjustment to develop site-specific verified gross savings is the ratio of metered HOU and CF compared to estimated (or deemed) HOU and CF used for verification. The results of these adjustments, analogous to FVR, are shown in Figure 4-3 below. The metered data results in a downward adjustment for both HOU and CF, but this effect is more pronounced for CF due to the high rigor of the HOU estimates compared to the CF estimates in the tracking data.

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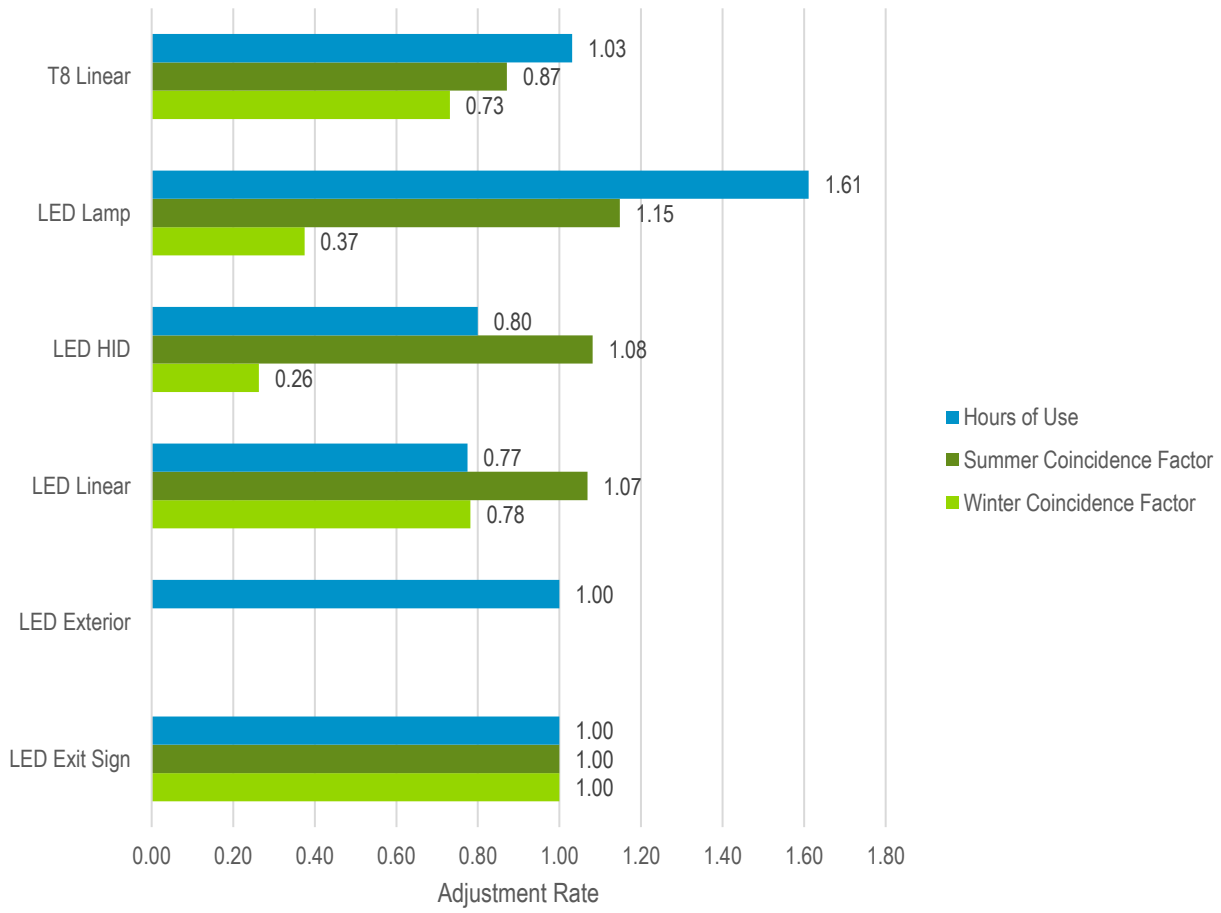
Figure 4-3. HOU and CF Adjustments from Metered Data



Source: Navigant analysis

The remainder of this section discusses in more detail the parameters that are part of the energy and peak demand savings algorithms: ISR, HOU, lighting power, HVAC interactive effects and coincidence factors.

4.5.1 In-Service Rates

One of the primary functions of evaluation, particularly for lighting measures, is to verify the quantity of the installed equipment relative to the reported quantity. The resulting ratio is the ISR. As shown in Figure 4-1 above, the ISR for each measure varies from 0.93 for LED screw-in lamps and 1.02 for LED exterior fixtures.

4.5.2 Hours-of-Use Adjustments

HOU is another key parameter for estimating lighting energy savings. The evaluation team estimated this parameter through customer interviews for each unique lighting schedule, similar to the approach taken by the IC. During the on-site customer interviews, the team found that the hours of use that site technicians reported was very close to the HOU reported in the tracking database. The team notes that

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overall the IC is accurately characterizing hours of use based on both customer interviews and, the metered data.

4.5.3 Lighting Power

The evaluation team based the lighting power parameter on the actual power draw of the baseline and efficient equipment. The baseline equipment is assumed to be as-found lighting installed and in use at the time of the audit; however, because the baseline equipment was no longer present at the participant sites, the team could not verify the baseline power draw and defaulted to the IC-provided value.

The evaluation team verified the efficient equipment wattage from manufacturer specification sheets to provide a more accurate lighting power figure than the deemed values that the IC used. Overall lighting power level differences were minor across the measure categories, between 0.92 for LED HID replacements and 1.81 for LED Exit Signs. This is an improvement from PY2014 and contributes to a higher realization rate for PY2015. The high wattage adjustment resulted overall in a small increase in savings due to the relative contributions of this measure.

The evaluation team would like to note that newer linear LED systems can be configured in a variety of ways, including with or without an electronic ballast. The manufacturer specifications for these systems typically do not account for every installation scenario with different ballast brands, models, and configurations possible. The team did not perform power measurements as part of this evaluation, but encourages the IC team to ensure that the power consumption of these systems is accurately characterized as their contribution to total program savings grows.

4.5.4 HVAC Interactive Effects

The evaluation team applied HVAC interactive effects for both energy, summer and winter peak demand. The deemed values are based on the building type and the heating and cooling system types as verified in the field for the sample sites. However, the IC did not apply HVAC IE for any of the lighting measures claimed in PY2015, as in previous evaluations. This adjustment is between 1.03 and 1.13 for energy and 1.08 and 1.39 for summer peak demand. Deemed values are described in Section 9 below for energy and summer peak demand; winter peak demand interactive effects were assumed to be 1.0 for all measures.

4.5.5 Coincidence Factors

Similar to the HVAC interactive effects, the team applied coincidence factors consistent with the deemed values used in the EEB Program. This factor takes into account that not all lights are on for the duration of the peak demand period. Coincidence factors range from 0.42 to 0.99, based on building type. The IC applied a coincidence factor of 1.0 for all lighting measures with the exception of occupancy sensors. Deemed values are shown in Section 8 below. The metered data further validates the deemed coincidence factors, but a sufficient sample size was not developed to determine new deemed coincidence factors at this time.

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5. NET-TO-GROSS ANALYSIS

The impact analysis described in the preceding sections addresses *gross program savings*, based on program records, modified by an engineering review, field verification, and metering of measure installations. *Net savings* incorporate the influence of free ridership (savings that would have occurred even in the absence of the program) and spillover (additional savings influenced by the program but not captured in program records) and are commonly expressed as a NTG ratio applied to the verified gross savings values.

Table 5-1 shows the results of Navigant's NTG analysis. Navigant anticipated low free ridership and spillover based on previous findings from the PY2013 and PY2014 SBES evaluations. The estimated free-ridership and spillover shown for PY2015 are slightly higher than thefindings from the previous evaluations

Table 5-1. Net-to-Gross Results

	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP & DEC)
Estimated Free Ridership	0.04	0.04	0.06
Estimated Spillover	0.02	0.07	0.09
Estimated NTG	0.98	1.03	1.03

Source: Navigant analysis

The results are consistent with the program theory and delivery model, whereby the Implementation Contractor (IC) actively recruits participants and presents a suite of energy efficiency measures to potential customers. Customers are not eligible to retroactively claim incentives under this program, which reduces the potential for free ridership significantly.

This report provides definitions, methods, and further detail on the analysis and findings of the net savings assessment. The discussion is divided into the following three sections:

- Defining free ridership, spillover, and net-to-gross (NTG) ratio
- Methods for estimating free ridership and spillover
- Results for free ridership, spillover, and NTG ratio

5.1 Defining Free Ridership, Spillover, and Net-to-Gross Ratio

The methodology for assessing the energy savings attributable to a program is based on a NTG ratio. The NTG ratio has two main components: free ridership and spillover.

Free ridership is the share of the gross savings that is due to actions participants would have taken even in the absence of the program (i.e., actions that the program did not induce). This is meant to account for naturally occurring adoption of energy efficient technology. The SBES Program covers a range of energy efficient lighting and refrigeration measures and is designed to move the overall market for energy efficiency forward. However, it is likely that some participants would have wanted to install, for various reasons, some high efficiency equipment (possibly a subset of those installed under the SBES Program), even if they had not participated in the program or been influenced by the program in any way.

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Spillover captures program savings that go beyond the measures installed through the program. Also called "market effects," the term "spillover" is often used because it reflects savings that extend beyond the bounds of the program records. Spillover adds to a program's measured savings by incorporating indirect (i.e., non-incentivized) savings and effects that the program has had on the market above and beyond the directly incentivized or directly induced program measures.

Total spillover is a combination of non-reported actions to be taken at the project site itself (*within-facility spillover*) and at other sites (*outside-facility spillover*). Each type of spillover is meant to capture a different aspect of the energy savings caused by the program, but not included in program records.

The **overall NTG ratio** accounts for both the net savings at participating projects and spillover savings that result from the program but are not included in the program's accounting of energy savings. When the NTG ratio is multiplied by the estimated gross program savings, the result is an estimate of energy savings that are attributable to the program (i.e., savings that would not have occurred without the program).

The basic equation is shown in Equation 1.

Equation 1. Net-to-Gross Ratio

$$NTG = 1 - Free\ Ridership + Spillover$$

The underlying concept inherent in the application of the NTG formula is that *only* savings caused by the program should be included in the final net program savings estimate but that this estimate should include *all* savings caused by the program.

5.2 Methods for Estimating Free Ridership and Spillover

5.2.1 Estimating Free Ridership

Data to assess free ridership were gathered through the self-report method—a series of survey questions asked of SBES participants. Free ridership was asked in both direct questions, which aimed at obtaining respondent estimates of the appropriate free ridership rate that should be applied to them, and in supporting or influencing questions, which could be used to verify whether the direct responses are consistent with participants' views of the program's influence.

Respondents were asked three categories of program-influence questions:

- **Likelihood:** to estimate the likelihood that they would have incorporated lighting measures "of the same high level of efficiency," if not for the assistance of the SBES Program. In cases where respondents indicated that they might have incorporated some, but not all, of the measures, they were asked to estimate the share of measures that would have been incorporated anyway at high efficiency. This flexibility in how respondents could conceptualize and convey their views on free ridership allowed respondents to give their most informed response, thus improving the accuracy of the free-ridership estimates.
- **Prior planning:** to further estimate the probability that a participant would have implemented the measures without the program. Participants were asked the extent to which they had considered installing the same level of energy-efficient lighting prior to participating in the program. The general approach holds that if customers were not definitively planning to install all of the

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efficiency lighting prior to participation, then the program can reasonably be credited with at least a portion of the energy savings resulting from the high-efficiency lighting. Strong free ridership is reflected by those participants who indicated they had already allocated funds for the purchase and selected the lighting and an installer.

- **Program importance:** to clarify the role that program components (e.g., information, incentives) played in decision-making, and to provide supporting information on free ridership. Responses to these questions were analyzed for each respondent, not just in aggregate, and were used to identify whether the direct responses on free ridership were consistent with how each respondent rated the "influence" of the program.

Free-ridership scores were calculated for each of these categories[5] and then averaged and divided by 100 to convert the scores into a free-ridership percentage. Next, a timing multiplier was applied to the average of the three scores to reflect the fact that respondents indicating that their energy efficiency actions would not have occurred until far into the future may be overestimating their level of free ridership. Participants were asked, without the program, when they would have installed the equipment. Respondents who indicated that they would not have installed the lighting for at least two years were not considered free riders and had a timing multiplier of 0. If they would have installed at the same time as they did, they had a timing multiplier of 1; within one year, 0.67; and between one and two years, 0.33. Participants were also asked when they learned about the financial incentive; if they learned about it after the equipment was installed, then they had a free ridership ratio of 1.

5.2.2 Estimating Spillover

The basic method for assessing participant spillover (both within-facility and outside-facility) was an approach that asked a set of questions to determine the following:

- **Whether spillover exists at all.** These were yes/no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records. Questions related to extra measures installed at the project site (within-facility spillover) and to measures installed in non-program projects (outside-facility spillover) within the service territory.
- **The share of those savings that could be attributed to the influence of the program.** Participants were asked if they could estimate the energy savings from these additional extra

[5] Scores were calculated by the following formulas:

» Likelihood: The likelihood score is 0 for those that "definitely would NOT have installed the same energy efficient measure" and 1 for those that "definitely WOULD have installed the same energy efficient measure." For those that "MAY HAVE installed the same energy efficient measure," the likelihood score is their answer to the following question: "On a scale of 0 to 10 where 0 is DEFINITELY WOULD NOT have installed and 10 is DEFINITELY WOULD have installed the same energy efficient measure, can you tell me the likelihood that you would have installed the same energy efficient measure?" If more than one measure was installed in the project, then this score was also multiplied by the respondent's answer to what share they would have done.

» Prior planning: If participants stated they had considered installing the measure prior to program participation, then the prior planning score is the average of their answers to the following two questions: "On a scale of 0 to 10, where 0 means you 'Had not yet planned for equipment and installation' and 10 means you 'Had identified and selected specific equipment and the contractor to install it', please tell me how far along your plans were" and "On a scale of 0 to 10, where 0 means 'Had not yet budgeted or considered payment' and 10 means 'Already had sufficient funds budgeted and approved for purchase', please tell me how far along your budget had been planned and approved."

» Program importance: This score was calculated by taking the maximum importance on a 0 to 10 scale of the four program importance questions and subtracting from 10 (i.e., the higher the program importance, the lower the influence on free ridership).

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measures to be less than, similar to, or more than the energy savings from the SBES program equipment.

- **Program importance.** Estimates were derived from a question asking the program importance, on a 0 to 10 scale. Participants were also asked how the program influenced their decisions to incorporate additional energy efficiency measures.

If respondents said no, they did not install additional measures; they had a zero score for spillover. If they said yes, then the individual's spillover was estimated as the self-reported savings as a share of project savings, multiplied by the program-influence score. Then, a 50 percent discount was applied to reflect uncertainty in the self-reported savings and divided by 10 to convert the score to a spillover percentage.

5.2.3 Combining Results across Respondents

The evaluation team determined free ridership and spillover estimates for each of the following:

- Individual respondents, by evaluating the responses to the relevant questions and applying the rules-based approach discussed above
- Measure categories:
  - For free ridership: by taking the average of each respondent's score within each category
  - For spillover: by taking the sum of the individual spillover results for each measure category and weighting each category by the population
- The program as a whole, by combining measure-level results
  - For free ridership: measure category results were subsequently weighted by each category's share of total savings
  - For spillover: measure category results were summed and then weighted by the sum of the reported savings for the sample (which were also weighted by the population)

5.3 Results for Free Ridership, Spillover, and Net-to-Gross

This section presents the results of the attribution analysis for the SBES Program. Specifically, results are presented for free ridership and spillover (within-facility and outside-facility), which are used collectively to calculate an NTG ratio.

5.3.1 Review of Data Collection Efforts for Attribution Analysis

The EM&V team conducted 151 surveys with SBES participants to estimate free ridership, spillover, and NTG ratios. Table 5-2 shows the number of completions, by measure group.

Table 5-2. Attribution Survey Completes by Project Type

Measure Category	DEP Surverys	DEC Surveys	Total Surveys
Lighting	45	91	136
Refrigeration	7	8	15
Total	**52**	**99**	**151**

Source: Navigant analysis

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5.3.2 Free-Ridership Results

The evaluation team asked participants a series of questions regarding the likelihood, scope, and timing of the investments in energy-efficient lighting if the respondent had not participated in the program. The purpose of the surveys was to elicit explicit estimates of free ridership and perspectives on the influence of the program. The evaluation team estimates free-ridership for the SBES Program at 6 percent of program-reported savings.

5.3.3 Spillover Results

The SBES Program influenced approximately 15 percent of participants to install additional energy efficiency measures on-site (up from 9 percent in PY2014) and influenced 12 percent of participants (up from 6 percent in PY2014) to install additional measures at other locations. Based on the survey findings, the evaluation team estimates the overall program spillover to be 9 percent of program-reported savings. Participants reported a variety of spillover measures installed, including AC units, additional lighting, and appliances.

5.3.4 Net-to-Gross Ratio

As stated above, the NTG ratio is defined as follows in Equation 2 below.

Equation 2. Net-to-Gross Ratio

$$NTG = 1 - \text{free ridership} + \text{spillover}$$

Using the overall free ridership value of 6 percent and the overall spillover value of 9 percent, the NTG ratio is 1 – 0.06 + 0.09 = 1.03. The estimated NTG ratio of 1.03 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 103 MWh is attributable to the program.

Table 5-3. SBES Free Ridership, Spillover, and NTG Ratio

	Free Ridership	Spillover	NTG Ratio
SBES Program Total	0.06	0.09	1.03

Source: Navigant analysis

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6. SUMMARY FORM

Program Name

Completed EMV Fact Sheet

Description of program

Duke Energy's Small Business Energy Saver Program provides energy efficient equipment to eligible small business customer at up to an 80 percent discount. The program is delivered through an implementation contractor that coordinates all aspects of the program, from the initial audit, ordering equipment, coordinating installation, and invoicing.

The program consists of lighting and refrigeration measures.

- **Lighting measures:** LED lamps and fixtures, T8 fluorescent fixtures, occupancy sensors.
- **Refrigeration measures:** LED case lighting, EC motor upgrades, compressor and fan motor controls.

Date	July 15, 2016
Region(s)	Duke Energy Progress; Duke Energy Carolinas
Evaluation Period	DEP 1/1/15 – 2/29/16 DEC 8/1/14 – 2/29/16
Annual kWh Savings	DEP 55,947,456 kWh DEC 89,505,687 kWh
Per Participant kWh Savings	DEP 27,247 DEC 25,087
Coincident kW Impact	DEP 11,650 DEC 20,603
Net-to-Gross Ratio	1.03
Process Evaluation	Annual
Previous Evaluation(s)	2013 and 2014 (DEP)

Evaluation Methodology

The evaluation team used engineering analysis, onsite field inspections, and time-of-use metering as the primary basis for estimating program impacts. Additionally, telephone surveys were conducted with participants to assess customer satisfaction and determine a net-to-gross ratio. Interviews were conducted with program and implementation team staff to understand program operational changes and enhancements.

Impact Evaluation Details

- **Onsite visits were conducted at 57 participant sites, while 19 of those sites were logged.** The evaluation team inspected program equipment to assess measure quantities and characteristics to compare with the program tracking database, and installed lighting loggers to verify hours of use and coincidence factors.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 0.93 for LED screw-in lamps to 1.02 for exterior LED fixtures.
- **Participants achieved an average of 27,247 kWh of energy savings per year in DEP, and 25,087 kWh in DEC.** The program is accurately characterizing energy and demand impacts.

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7. PROCESS EVALUATION

The purpose of the process evaluation is to understand, document and provide feedback on the program implementation components and customer experience for the Small Business Energy Saver (SBES) Program in the DEP and DEC jurisdictions.

The feedback received indicates that **the SBES Program is a successful, mature program for PY2015, but could benefit from continuous improvements** as in previous years. Customer satisfaction with the implementer and contractor are very high, but there are instances where the installation contractor was responsible for a negative customer experience.

7.1 Process Methodology

The evaluation team conducted in-depth interviews with SBES Program staff, IC staff, and customer participant surveys, as noted previously. In addition, the team gathered information from interactions with participants during the site verification visits. The interviews with program and IC staff focused on program changes for PY2015 and included a review of program processes to provide the evaluation team with an understanding of the program's operations, nuances and qualitative and quantitative questions on customer satisfaction, participation, marketing, and outreach.

The process findings summarized in this document are based on the results of:

- Participant surveys with 151 program participants;
- Onsite visits at 57 program participant sites;
- Interviews with the Duke Energy Program Manager and the Implementation Contractor (IC) staff; and
- A review of the program documentation.

7.2 Sampling Plan and Achievements

The participant survey targeted a random sample of all PY2015 program participants broken out by measure family. The two measure families are lighting and refrigeration. Navigant weighed customer responses by their stratum savings for net-to-gross findings as described in the preceding section.

The survey effort targeted 150 participants and successfully completed surveys with 151 customers, of which 136 were participants that only installed lighting measures and 15 were participants that installed some refrigeration measures. The survey targets were loosely designed to achieve 90/10 confidence and precision, with significant oversampling due to the relatively inexpensive per-survey cost.

7.3 Program Review

The evaluation team designed the program review task to understand changes and updates to the program design, implementation and energy and demand savings assumptions. The key program characteristics include the following:

- **Program Design** – The SBES program is designed to offer high incentives (up to 80 percent of the total cost of the project) on efficient equipment to reduce energy use and peak demand. It specifically targets small business customers that are difficult to reach and often do not pursue

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energy efficiency on their own. In PY2015 the program rolled out new marketing materials centered around case studies for various types of small business customers.

- **Program Implementation** – A third-party contractor administers the SBES program on Duke Energy's behalf. The IC handles all aspects of the program, including customer recruitment, facility assessments, equipment installation (through independent installers contracted by the IC), and payment and incentive processing. The IC reports energy and peak demand reduction estimates to Duke Energy. The IC has continued to refine their processes to ensure that savings estimates are reasonable, customer complaints are handled in a timely manner.
- **Incentive Model** – The IC offers potential participants a recommended package of energy efficiency measures along with equipment pricing and installation costs. The incentive is proportional to estimated energy savings and can be as high as 80 percent of the total cost of the project.
- **Savings Estimates** – Energy and peak demand savings are estimated on a per-fixture basis, taking into account existing equipment, proposed equipment, and operational characteristics unique to each customer.

7.4 Key Process Findings

The following sections detail the process findings from all relevant sources of program information, including interviews with Duke Energy and IC staff, interactions with customers during verification site visits, and the results of the customer surveys, organized by topic. This discussion addresses 1) marketing and outreach; 2) customer experience; 3) implementation contractor; 4) installation contractor; 5) program incentives; 6) lighting equipment; and 7) participant suggested improvements.

The feedback received indicates that the SBES Program continues to be a successful program in PY2015, has expanded into the DEC jurisdiction effectively, and is a mature program in Duke Energy portfolio. The Duke Energy program management team and the IC staff and management have made several improvements to the program in PY2015, especially concerning installation contractor training, automated checks in the auditing tool, marketing, and new LED measures. Key findings are as follows:

- The primary channel through which customers hear about the program is Duke Energy (38 percent), followed by the implementation contractor (28 percent).
- Participants listed energy savings, reduced energy bills, and better quality equipment as the primary reasons for participating in the SBES Program.
- A majority of SBES participants were satisfied with the program. On a scale of 0 to 10, where 0 indicates "not satisfied at all" and 10 indicates "extremely satisfied":
    - 87 percent of participants indicated 8-10 for satisfaction with overall program experience.
    - 87 percent of participants indicated 8-10 for satisfaction with the contractor's quality of work.
    - 91 percent of participants indicated 8-10 for satisfaction with their new equipment.
- Eighty-nine percent of participants stated that equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time.
- Eighty-seven percent of participants said they plan to participate in other Duke Energy programs in the future.

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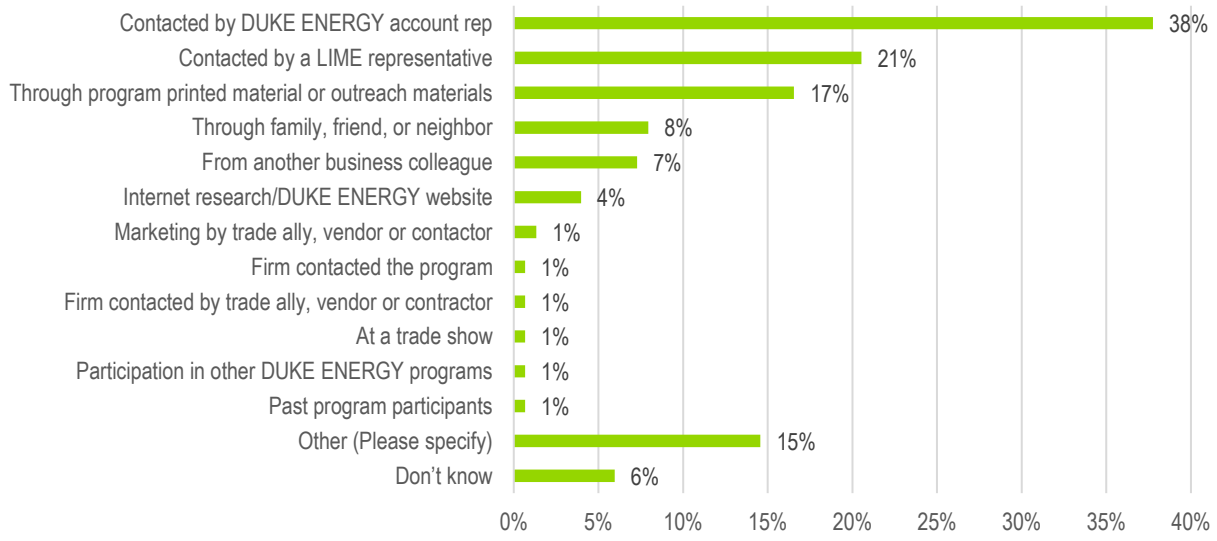
The following sections detail the process findings and addresses the following topics:

1. Marketing and outreach;
2. Customer experience;
3. Implementation contractor;
4. Installation contractor;
5. Measure incentives;
6. Upgraded equipment; and
7. Suggested improvements.

7.4.1 Marketing and Outreach

Duke Energy markets the program to eligible customers primarily through direct contact that Duke Energy and the IC initiate. Participants were asked to indicate all the sources through which they learned about the program. Over half of the participants indicated that they learned about the program directly from the IC staff (either through direct contact or outreach materials), and an additional quarter indicated they had learned about the program through Duke Energy themselves. Figure 7-1 shows the range of ways in which customers found out about the program. Significantly more customers reported that they learned about the program through Duke Energy directly (38 percent in PY2015 compared to 26 percent in PY2014)

Figure 7-1. How Program Participants First Learned About the SBES Program (n = 151)



Source: Navigant analysis

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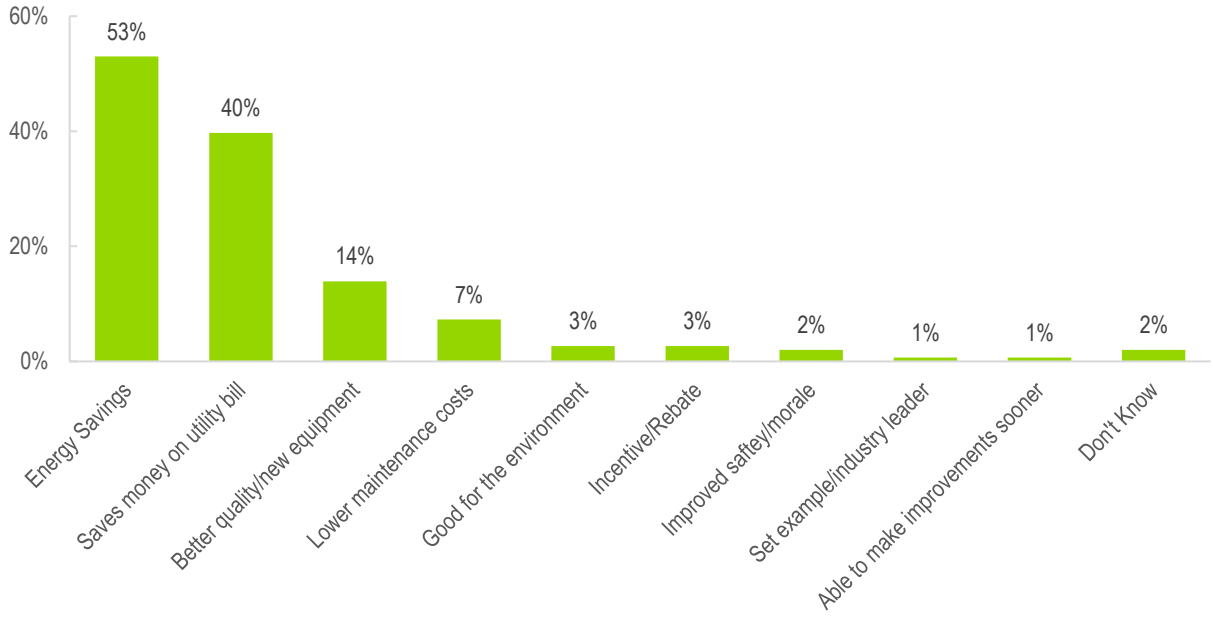
When asked about the main benefits of participating in the program, over 50 percent of survey respondents cited energy savings as a reason they decided to participate in the program (see Figure 7-2 below). Beyond energy savings and, in turn, utility bill savings, participants cited higher-quality equipment, and the lower maintenance costs associated with new equipment as reasons to participate in the program. Coordinated efforts to market all of the benefits of program participation are key to enhancing participation across the variety of small business customer that Duke Energy serves.

Figure 7-2. Primary Reasons for Deciding to Participate in the Program[6] (n = 151)



Source: Navigant analysis

[6]Totals exceed 100% because respondents could offer more than one answer.

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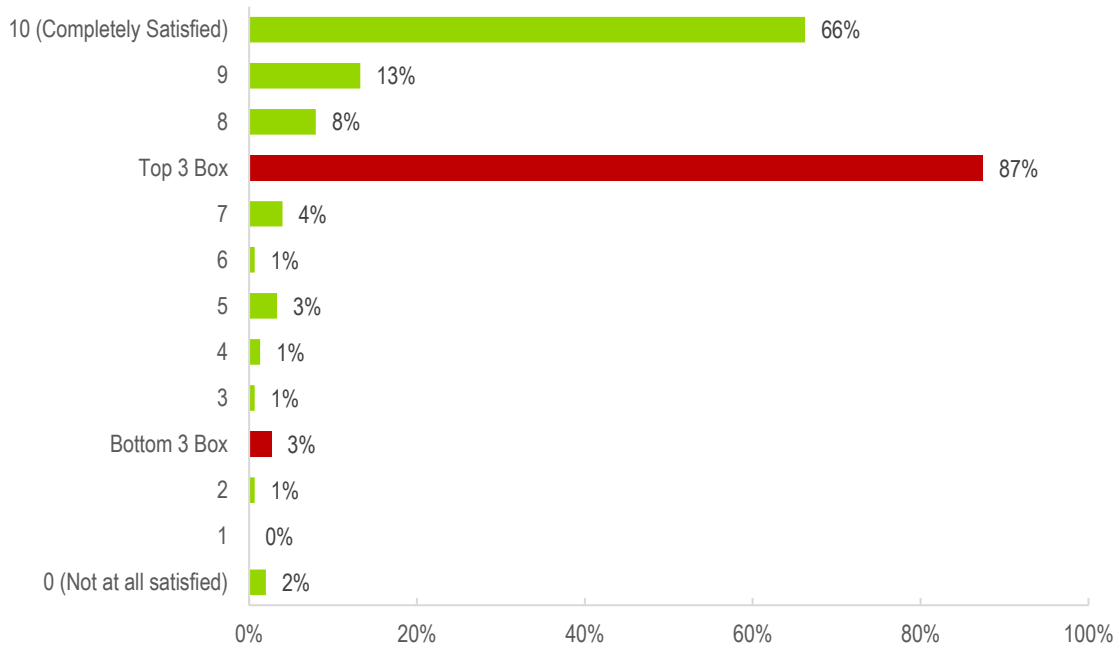
7.4.2 Customer Experience

Customers reported very high satisfaction with their overall program experience in PY2015 through both the participant survey and informal polling conducted on-site during verification visits. On a scale of 0 to 10, where 0 is “not satisfied at all” and 10 is “extremely satisfied”, 87 percent of participants scored their overall experience with the program as an 8, 9, or 10, with 66 percent responding that their experience was a 10 (see Figure 7-3). Participants who assigned low scores to their overall experience did so because typically they did not perceive monetary savings on their bill. One customer reported that they thought their new lights were already outdated, and another was not happy with the installation. Overall satisfaction remains similar to PY2014 levels.

Figure 7-3: Customer Satisfaction with Overall Program (n=151)



Source: Navigant analysis

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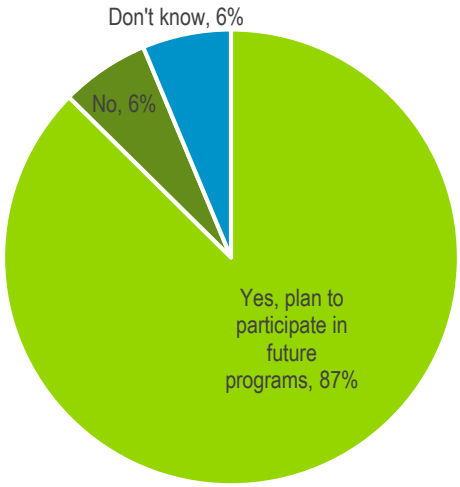
Eighty-seven percent of participants said they plan to participate in other Duke Energy programs in the future (see Figure 7-4), compared to 83 percent in PY2014. This indicates increased satisfaction as well, and a continued opportunity to market the program to previous participants as a wider range of measures become available and cost-effective.

Figure 7-4. Participants Who Plan to Participate in Other Duke Energy Programs in the Future (n = 151)



Source: Navigant analysis

7.4.3 Implementation Contractor

Customer survey results indicate that the IC plays a critical role in all program processes in line with the program design, including program marketing, outreach, recruiting, auditing, billing and customer service, and providing detailed tracking data to Duke Energy.

Navigant found that the measure installation tracking data is thorough, accurate, and detailed. This enabled the field verification team to locate specific measure installations quickly. The IC conducted consistent and thorough audits for most completed projects and generally covered all of the lighting fixtures in a facility that were not already energy efficient. The auditor's intentions were clear in the tracking data and demonstrated an understanding of the lighting that would best serve the customer's needs while providing substantial energy savings. Navigant found some discrepancies between the final work as recorded by the implementation contractor in the database and what was found onsite (such as some fixtures that were not retrofitted), but overall the accuracy was found to be very high.

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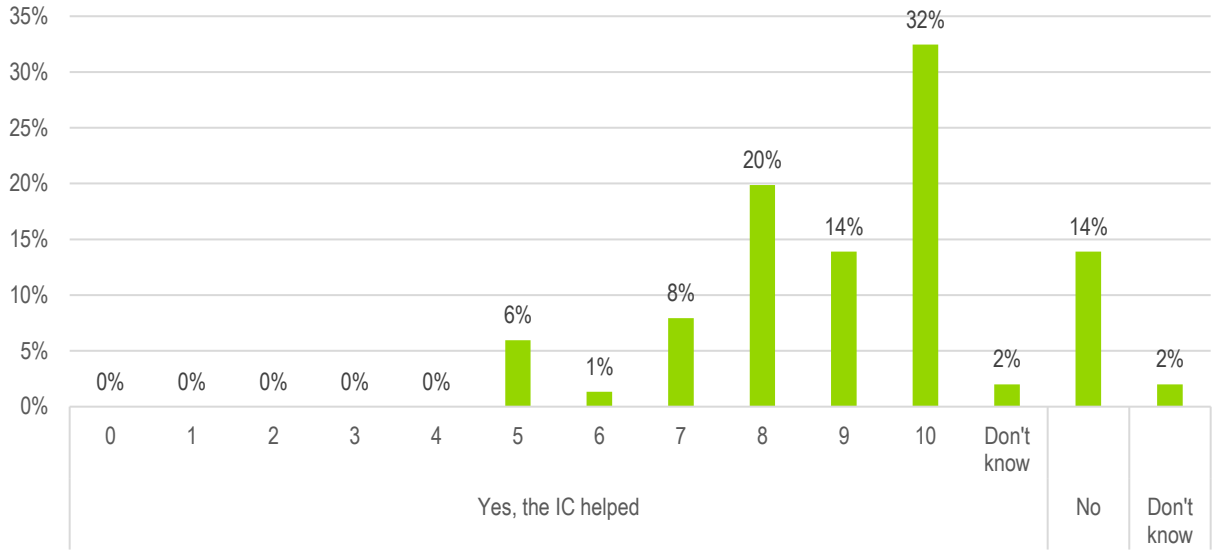
The IC helped 81 percent of SBES Program participants with their choice of lighting, and 66 percent stated that a recommendation from the IC was important (score of 8-10) in their decision to install the energy-efficient equipment (see Figure 7-5). Results are similar to PY2014.

Figure 7-5. Participants Whom the IC Helped in Their Equipment Decision (n = 151)



Source: Navigant analysis

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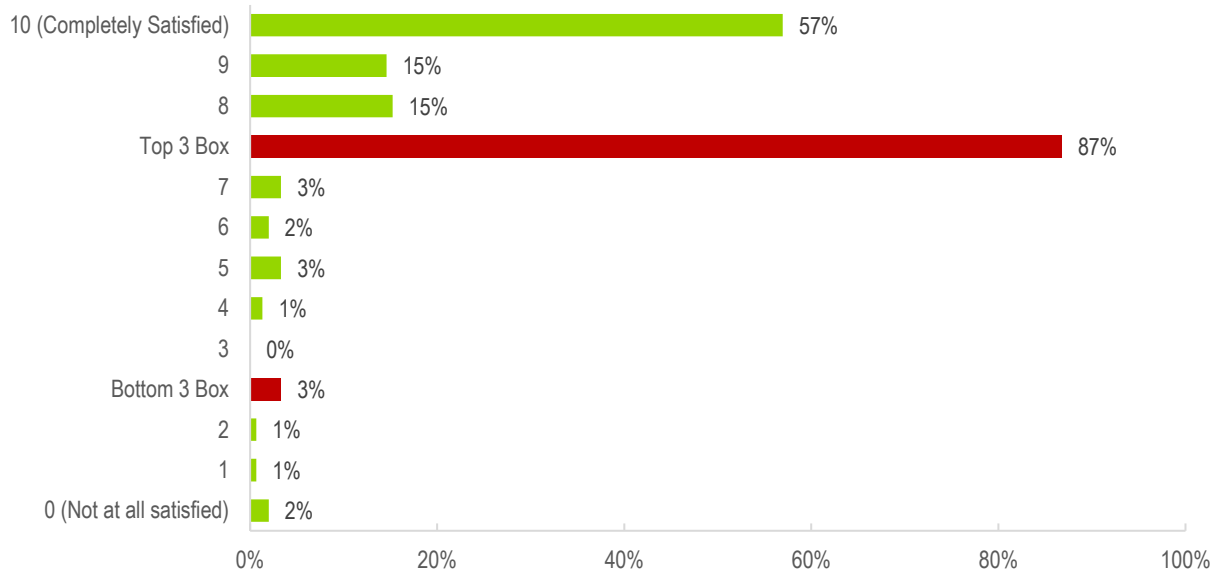
7.4.4 Installation Contractors

Customer satisfaction with contractor quality of work is high, and has improved slightly from PY2014 as well. Figure 7-6 shows that 87 percent of survey respondents ranked their satisfaction with contractor work as an 8, 9, or 10, compared to 84 percent in PY2014.

Figure 7-6: Customer Satisfaction with Contractor Quality of Work (n=151)



Source: Navigant analysis

A few customers indicated that they experienced installation issues that required follow-up visits, or that work took longer than expected. Other participants were impressed by the speed the installation contractors were able to get the work done. This indicates that the customer experience varies between installation contractors, but overwhelmingly participants are satisfied with this portion of the program.

7.4.5 Measure Incentives

The incentives offered through the SBES program appear to sufficiently motivate customers to upgrade to energy-efficient lighting and refrigeration. From discussions with decision makers on site, the incentive levels were appropriate. Several customers also expressed interest in efficient HVAC equipment, but this was not available to them at the time.

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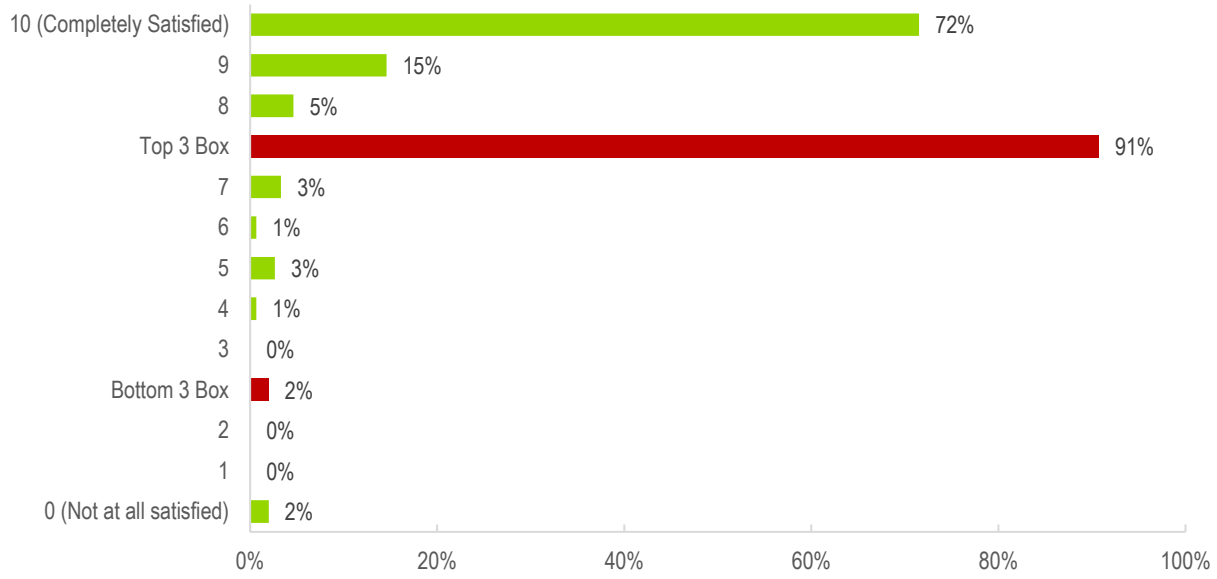
7.4.6 Upgraded Equipment

The majority of customers agreed that the new lighting measures were a significant improvement in light quality, and that the auditors were willing to work with customers to make sure that the new lighting fit their needs. Almost all participants (91 percent) indicated they were satisfied with their new equipment (see Figure 7-7), similar to previous findings. A higher percentage of customer reported a top satisfaction score of 10 in PY2015 at 72 percent, compared to 67 percent in PY2014.

Figure 7-7: Participant Satisfaction with New Equipment (n=151)



Source: Navigant analysis

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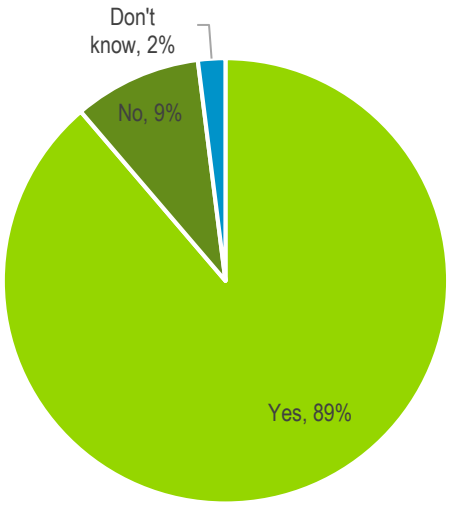
Another important survey finding was that 89 percent of participants stated that equipment offered through the program allowed them to upgrade all of the lighting equipment they wanted at the time of the project, rather than piecing together the upgrades in multiple phases (see Figure 7-8). This is an increase from 82 percent in PY2014, which indicates that auditors are getting better at capturing all possible measures at a site, or also that as LED prices have come down and savings have increased more lighting measures have become cost-effective.

Figure 7-8. Participants Who Stated that Equipment Offered Through the Program Allowed Them to Upgrade All of the Equipment They Wanted at the Time (n = 151)



Source: Navigant analysis

7.4.7 Suggested Improvements

Some customers reported difficulties they faced and provided suggested improvements in the survey's open-ended questions. The list below summarizes a few key points; responses that are more detailed will appear in the final SBES evaluation report.

Summary of Improvements Mentioned by Customers

- Higher incentives on eligible equipment;
- More equipment offerings, such as AC and motors;
- Greater publicity for the program and other Duke Energy offerings;
- More up-to-date equipment;
- Opportunity for savings for new construction

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8. CONCLUSIONS AND RECOMMENDATIONS

The evaluation team performed extensive on-site work, telephone surveys, and analysis to determine gross and net verified savings. Overall conclusions and recommendations appear in the following sections.

8.1 Conclusions

Overall, the SBES Program is a well performing, mature program in the DEP jurisdiction that has successfully expanded into the DEC jurisdiction. The key to continued success is working through quality and training issues as they arise.

- **Participants continue to be overwhelmingly satisfied with the SBES Program and Duke Energy**, including overall service, pricing, installation, and efficient equipment quality.
- **Duke Energy has successfully expanded into the DEC jurisdiction** in PY2015. The program had no apparent issues scaling up operations in the DEC service territory, and there are no meaningful differences in the EM&V team's findings between the two jurisdictions.
- **The program has increased average project savings substantially** compared to PY2014. This is driven by new LED measures that have higher per-unit savings, and targeting of larger customers that are able to generate more savings per site.
- The Duke Energy program management team and the IC have **demonstrated a commitment to quality** by quickly implementing program changes based on evaluation feedback provided in the PY2014 evaluation. Additionally, the IC team has created new branded marketing materials with case studies for a variety of small business facilities.
- The **installation of high–efficiency equipment continues to be the key selling point**. The SBES Program successfully added linear LED retrofit measures to the suite of program offerings for PY2015, replacing T8 fluorescent fixtures. LED measures have grown considerably as a share of total program savings, while refrigeration has remained stable from PY2014 at under 10 percent.
- The **energy savings realization rate is 1.11 for DEP and 1.12 for DEC,** and is driven by several EM&V adjustments that roughly balanced out. The key adjustments the EM&V team made were the in-service rates and HVAC interactive effects. The **peak demand realization rate is lower at 0.96 for DEP and DEC** and is driven by HVAC interactive effects and coincidence factors.
- The evaluation effort estimated **free ridership for the SBES Program at 6 percent and spillover at 9 percent**, which drives an **NTG ratio of 1.03**. This indicates that the SBES Program is successfully reaching customers that would have not completed energy efficiency upgrades in the absence of the program. Spillover has increased from PY2014 and indicates that the program is showcasing the benefits of energy efficiency.

8.2 Recommendations

The evaluation team recommends five actions for improving the SBES Program, based on insights gained through the comprehensive evaluation effort for PY2015. These recommendations provide Duke

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Energy with a roadmap to fine-tune the SBES Program for continued success and include the following broad objectives:

Increasing Program Participation

1. **Continue to emphasize non-energy benefits** of program participation, such as increased lighting quality, comfort for both business employees and customers, environmental benefits, and reduced maintenance. Now that the program has transitioned primarily to LED measures, increased education on the benefits that LED measures offer should enhance participation.

Increasing Customer Satisfaction

2. **Continue to prioritize customer satisfaction through installation contractor training and customer follow-up services.** The IC has improved in this area from PY2014, but a minority of customers are still reporting issues with installation and communication. Additionally, some customers are not perceiving savings on their electric bill, so managing this expectation would enhance customer satisfaction.
3. **Phase out fluorescent T8 lighting systems.** Linear LED lighting offers substantial savings above high-performance/reduced wattage T8 lamps and ballasts, which may be perceived as outdated.

Improving Accuracy of Reported Savings

4. **Add HVAC interactive effects and update coincidence factors for lighting measures**. This is the key impact finding to improve the accuracy of savings estimates. The IC should apply relevant HVAC interactive effects and coincidence factors to lighting measures as is appropriate, and ensure that outdoor lighting measures on daylight sensors do not accrue peak demand reductions during summer daylight hours.
5. **Ensure that efficient lighting power ratings for linear LED systems are accurate.** Navigant did not perform live metering of connected linear LED systems, but upon review of manufacturer specifications for lighting power there are different wattages that the system may draw depending on the specific configuration. As the share of savings attributed to linear LED systems grow, this should be quantified to reduce EM&V risk in future years.

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9. MEASURE-LEVEL INPUTS FOR DUKE ENERGY ANALYTICS

The SBES program estimates deemed savings on a per-fixture basis that takes into account specific operational characteristics. This approach differs from a more traditional prescriptive approach that applies deemed parameters by measure type and building type only.

For the lighting measures, the EM&V team applied HVAC interactive effects and coincident factors in the analysis that differed from those used by the IC; the values used are shown in Table 9-1 and Table 9-2. Note that for the PY2015 SBES evaluation the EM&V team applied the summer coincidence factors for both summer and winter peak demand reductions, with additional adjustments based on logger data for each of the corresponding peak periods, as in previous years.

Table 9-1. HVAC Interactive Effects[7]

Building Type	Cooling Type	Heating Type	Energy HVAC Interactive Effect	Demand HVAC Interactive Effect
Grocery	Electric	Electric Resistance	1	1.43
Grocery	Electric	Electric HP	1.08	1.43
Grocery	Electric	Not Electric	1.22	1.42
Grocery	No Cooling	Electric Resistance	0.77	1
Grocery	No Cooling	Electric HP	0.86	1
Grocery	No Cooling	Not Electric	1	1
Grocery	DK	DK	1.14	1.36
Lodging	Electric	Electric Resistance	1.11	1.18
Lodging	Electric	Electric HP	1.11	1.18
Lodging	Electric	Not Electric	1.11	1.18
Lodging	No Cooling	Electric Resistance	1.11	1.18
Lodging	No Cooling	Electric HP	1.11	1.18
Lodging	No Cooling	Not Electric	1.11	1.18
Lodging	DK	DK	1.14	1.36
Manufacturing	Electric	Electric Resistance	1.1	1.29
Manufacturing	Electric	Electric HP	1.1	1.29
Manufacturing	Electric	Not Electric	1.1	1.29
Manufacturing	No Cooling	Electric Resistance	1.1	1.29
Manufacturing	No Cooling	Electric HP	1.1	1.29
Manufacturing	No Cooling	Not Electric	1.1	1.29

[7] PY2013 DEP EEB EM&V Report

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Manufacturing	DK	DK	1.14	1.36
Medical	Electric	Electric Resistance	1.05	1.44
Medical	Electric	Electric HP	1.12	1.44
Medical	Electric	Not Electric	1.22	1.43
Medical	No Cooling	Electric Resistance	0.83	1
Medical	No Cooling	Electric HP	0.89	1
Medical	No Cooling	Not Electric	1	1
Medical	DK	DK	1.14	1.36
Office	Electric	Electric Resistance	1.05	1.44
Office	Electric	Electric HP	1.12	1.44
Office	Electric	Not Electric	1.22	1.43
Office	No Cooling	Electric Resistance	0.83	1
Office	No Cooling	Electric HP	0.89	1
Office	No Cooling	Not Electric	1	1
Office	DK	DK	1.14	1.36
Other	Electric	Electric Resistance	1.05	1.44
Other	Electric	Electric HP	1.12	1.44
Other	Electric	Not Electric	1.22	1.43
Other	No Cooling	Electric Resistance	0.83	1
Other	No Cooling	Electric HP	0.89	1
Other	No Cooling	Not Electric	1	1
Other	DK	DK	1.14	1.36
Restaurant	Electric	Electric Resistance	1	1.43
Restaurant	Electric	Electric HP	1.08	1.43
Restaurant	Electric	Not Electric	1.22	1.42
Restaurant	No Cooling	Electric Resistance	0.77	1
Restaurant	No Cooling	Electric HP	0.86	1
Restaurant	No Cooling	Not Electric	1	1
Restaurant	DK	DK	1.14	1.36
Retail	Electric	Electric Resistance	1	1.43
Retail	Electric	Electric HP	1.08	1.43
Retail	Electric	Not Electric	1.22	1.42
Retail	No Cooling	Electric Resistance	0.77	1
Retail	No Cooling	Electric HP	0.86	1
Retail	No Cooling	Not Electric	1	1
Retail	DK	DK	1.14	1.36

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School	Electric	Electric Resistance	1.05	1.44
School	Electric	Electric HP	1.12	1.44
School	Electric	Not Electric	1.22	1.43
School	No Cooling	Electric Resistance	0.83	1
School	No Cooling	Electric HP	0.89	1
School	No Cooling	Not Electric	1	1
School	DK	DK	1.14	1.36
Warehouse	Electric	Electric Resistance	1.1	1.29
Warehouse	Electric	Electric HP	1.1	1.29
Warehouse	Electric	Not Electric	1.1	1.29
Warehouse	No Cooling	Electric Resistance	1.1	1.29
Warehouse	No Cooling	Electric HP	1.1	1.29
Warehouse	No Cooling	Not Electric	1	1
Warehouse	DK	DK	1.14	1.36

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Table 9-2. Coincidence Factors[8]

Building Type	Summer Coincidence Factor
OFFICE	0.81
SCHOOL	0.42
COLLEGE/UNIVERSITY	0.68
RETAIL/SERVICE	0.88
RESTAURANT	0.68
HOTEL/MOTEL	0.67
MEDICAL	0.74
GROCERY	0.81
WAREHOUSE	0.84
LIGHT INDUSTRY	0.99
HEAVY INDUSTRY	0.99
AVERAGE/MISC	0.77
AGRICULTURAL	0.50

[8] PY2013 Savings Basis and Changes, December 10, 2013. EEB Program Documentation.

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10. APPENDICES

One additional spreadsheet document details project level findings, and is embedded below:

- PY2015 DEP SBES Impact Summary.xlsx

PY2015 DEP_DEC
SBES Impact Summa

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