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2017 Evaluation Report for the Duke Energy Carolinas PowerShare® Program

Prepared for:

Duke Energy

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Submitted by:
Navigant Consulting, Inc.
1375 Walnut St.
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

Prepared by:
Peter Steele-Mosey
Will Sierzchula
Jeff McMillan
Brian Eakin
Mark Bielecki
Stuart Schare

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CONTENTS

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EXECUTIVE SUMMARY

This document presents Navigant's evaluation of the Duke Energy Carolinas (DEC) PowerShare® Program for Program Year 2017. The PowerShare Program is a demand response (DR) program offered to commercial and industrial customers that is part of Duke Energy's portfolio of demand side management and energy efficiency (DSM/EE) programs. PowerShare offers participating commercial and industrial customers a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

The DEC program offers customers the following four options:

- **Mandatory Curtailment:** In exchange for a monthly availability payment and event performance payments, participants must reduce load during each Mandatory Curtailment Period to a contracted firm level.
- **Voluntary Curtailment:** In exchange for an event performance payment, participants may reduce load to a pre-nominated level during Voluntary Curtailment Periods.
- **Generator Curtailment:** In exchange for a monthly availability payment and event performance payments, participants must transfer load from a Duke Energy source to a private generation source during Generator Curtailment Periods.
- **CallOption Curtailment:** In exchange for a monthly availability payment and event performance payments, participants must reduce load during Emergency or Economic Curtailment periods to a contracted firm level. There are currently no DEC customers enrolled in CallOption Curtailment, so it is not addressed in this report.

Evaluation Objectives

The research objectives of this evaluation are as follows:

1. Review updates to the SAS code used by Duke Energy to estimate baseline as well as monthly and seasonal capability.
2. Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric Energy Profiler Online™ (EPO) methods used to calculate the energy (kWh) and demand (kW) impacts used to determine settlement payments.

To complete the first objective, Navigant reviewed updates to the SAS code used by Duke Energy to determine participant baselines and monthly and seasonal capability. To complete the second objective, Navigant replicated the EPO energy and demand calculations used by Duke Energy to determine settlement payments.

Key Findings

This section presents Navigant's key evaluation findings for the two principal evaluation objectives:

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Duke Energy Baseline SAS Code Review

Duke Energy Applied Updates Per Navigant's Recommendations. During the 2016 PowerShare evaluation, Navigant performed a detailed audit of the SAS code used by Duke Energy to calculate settlement baselines, as well as monthly and seasonal capabilities. As an outcome of this audit, Navigant provided Duke Energy with several recommendations to improve the functionality and organization of the SAS code. For 2017, Navigant again reviewed the SAS code and found that Duke Energy appropriately implemented the changes recommended by Navigant.

Verification and Validation of Settlement Energy and Demand Calculations

Settlement calculations verified as correct. Duke Energy uses EPO to determine the energy (kWh) and capacity (kW) values that are the basis for calculating monthly settlement amounts. Navigant replicated EPO's calculations for all participants from June through September of 2017**.** Because Duke Energy did not call any Voluntary curtailment events, and no customers were enrolled in the CallOption program, this report only includes Mandatory and Generator curtailment event results.

Initially, Navigant found a number of discrepancies between its energy and capacity settlement calculations and those provided by Duke Energy. After several discussions with Duke Energy, Navigant identified the following causes of discrepancies:

- Interval data issues related to power outages (caused most of the discrepancies)
- Missing usage data
- Alternate event test dates granted by Duke Energy under special circumstances, such as generator failure during primary testing period
- Meter clock drift that caused a mis-match of usage and times
- Customers leaving the program mid-month

Upon resolving those discrepancies, Navigant found that all of Duke Energy's estimates are accurate per the settlement algorithms defined by the program literature. A summary of the validation results, by option and credit type, may be found in Table E- 1 below. The program-level energy and demand impacts are shown in Table E-2 and Table E-3, respectively.

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Table E- 1: Verification of EPO Calculations

Program Option	Credit Type	Customers	Unique Accounts	# of EPO Results Replicated[a]	Average % Absolute Error[b]
Mandatory Curtailment	Capacity	159	159	619	0.00%
Generator Curtailment	Energy	9	10	38	0.00%
Generator Curtailment	Capacity	9	10	38	0.00%

a. *The number of calculations reproduced by Navigant for this analysis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and four curtailment events. In a small number of cases, data was not available for every account for every event, which is why the number of replicated EPO results is slightly lower than the number of accounts times the number of events.*

b. *The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.*

Source: EPO Settlement Data and Navigant analysis

Table E- 2: Summary of 2017 Event Energy Impacts at the Meter (Total Program MWh per Event)

Program Name	June 21st	July 19th	Aug.16th	Sep. 20th	Total (MWh)
Generator Curtailment	8.2	7.5	8.2	7.8	31.7

Source: EPO Settlement Data and Navigant analysis

Table E- 3: Total Monthly Capacity for 2017 at the Meter (MW)

Program Name	June	July	August	September	Average (MW)
Mandatory Curtailment	316	294	309	286	301
Generator Curtailment	8	7	8	8	8

Source: EPO Settlement Data and Navigant analysis

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1. INTRODUCTION

This document presents Navigant's evaluation for the Duke Energy Carolinas (DEC) PowerShare® Program for Program Year 2017. The PowerShare Program is a demand response program offered to commercial and industrial customers that is part of Duke Energy's portfolio of demand side management and energy efficiency (DSM/EE) programs. PowerShare offers participating customers a financial incentive to reduce their electricity consumption when called upon by Duke Energy.

1.1 Program Overview

The customer contracts for DEC's PowerShare Program commence on the first day of the month and the initial contract term is three years. Customers can sign up for PowerShare at any time during the year if their DSM rider status is either Opted-In or Not Opted-Out (Opt-In then required to join the program). If they are Opted-Out, they must wait until one of the two Opt-In/Opt-Out election windows during the year (November-December or first week in March) is open in order to change their designation to Opt-In.

The DEC program offers customers four options to choose between: Mandatory Curtailment, Voluntary Curtailment, Generator Curtailment, and CallOption. There are currently no DEC customers enrolled in the CallOption PowerShare option. In addition, Duke Energy did not call any Voluntary curtailment events in the period of analysis. Consequently, this report focuses on Mandatory and Generator curtailment options:

- **Mandatory Curtailment:** In exchange for a monthly availability payment and event performance payments, participants must commit to reduce load during each Mandatory Curtailment Period to a contracted firm level.
- **Generator Curtailment:** In exchange for a monthly availability payment and event performance payments, participants must transfer load from a Duke Energy source to a private generation source during Generator Curtailment Periods.

The PowerShare Program is designed to encourage participating customers to reduce their electricity consumption for up to 100 hours each year on system peak days. Duke Energy contracts with Schneider Electric to calculate monthly customer settlements for the PowerShare Program. Schneider Electric is a specialized firm providing services in energy management and automation. The PowerShare settlements are calculated with the use of Schneider Electric's EPO, a hosted software application designed to assist utilities with energy data analysis. EPO uses participant interval data, Duke Energy-generated participant baselines, and a set of program option-specific formulas to calculate the event energy (kWh) and monthly capacity (kW) values that determine participant settlement payments.

1.2 Evaluation Objectives

The research objectives of this evaluation are:

1. Review updates to the SAS code used by Duke Energy to estimate baseline as well as monthly and seasonal capability.
2. Audit the hourly kW DR event load shed for participating customers by replicating the Schneider Electric EPO methods used to calculate the energy (kWh) and demand (kW) impacts that are used to determine settlement payments.

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1.2.1 Review Updates to SAS Code Used for DR Baseline and Capability Calculations

During the 2016 PowerShare evaluation, Navigant performed a detailed audit of the SAS code used by Duke Energy to calculate settlement baselines, as well as monthly and seasonal capabilities. As an outcome of this audit, Navigant provided Duke Energy with several recommendations to improve the functionality and organization of the SAS code. For 2017, Navigant again reviewed the SAS code and found that Duke Energy appropriately implemented the changes recommended by Navigant. Navigant reviewed about 70 files as part of this process, which included code scripts and extracts. Navigant did not execute the code; however the Navigant analyst performed a detailed assessment of output extracts from each section of the code, and coordinated closely with the Duke Energy SAS code author throughout the review process.

1.2.2 Verify Energy and Demand Calculations Used for Settlement

To complete the second objective, Navigant replicated Duke Energy's energy and demand calculations to determine settlement payments, and compared these with the energy and demand values reported in the program's operational tracking database containing settlement reports exported from EPO.

Schneider Electric's EPO outputs a settlement report for each participant settlement (monthly capacity and event energy settlements). Each report contains the data (including the Duke Energy baseline and the participant actuals) used and the arithmetic applied to calculate the settlement payment.

To fulfill this task, Duke Energy directed Navigant to replicate the settlement arithmetic for all PowerShare participants from June through September of 2017. The purpose of this replication was to audit the process and ensure that all algorithms were applied as specified in the program literature. A detailed methodology and findings are presented later in this report.

1.3 Program Rules

This sub-section provides additional detail regarding the program rules, specifically, how much DR participants are required to provide, and a summary of participant credits. This information is a summary of the DEC PowerShare Program brochure to which interested readers should refer for additional detail.[1] This section does not address the CallOption program or Voluntary curtailment, because these program elements were not employed during the 2017 summer season. Mandatory and Generator Curtailment options are associated with one of two compliance plans:

- Fixed. A "Fixed" compliance plan is a "down by" requirement (i.e., when called participants must reduce demand **by** *X* amount).
- Firm. A "Firm" compliance plan is a "down to" requirement (i.e., when called participants must reduce demand **to** *X* amount).

Mandatory options operate under the "Firm" compliance plan, whereas the Generator options operate under the "Fixed" compliance plan.

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[1] Duke Energy Carolinas, *PowerShare Carolinas* (Program Brochure), Accessed November 2017 https://www.duke-energy.com/business/products/powershare

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All options require participants to commit to curtailing a minimum of 100 kW per event.

Table 1, below, presents some additional detail regarding the program rules for the two PowerShare options in DEC.

Table 1: Detailed PowerShare Option Rules

	Mandatory	Generator
Eligibility	Available to customers served on rate schedules LGS, I, OPT-V, and HP.	Available to customers served on rate schedules LGS, I, and OPT-V.
Notice	30 Minutes	15 Minutes
Curtailment Frequency and Timing	Curtailment may occur at any time, but may last no more than 10 hours per event. A maximum of 100 hours of curtailment may be called per year.	Curtailment may occur at any time, but may last no more than 10 hours per event. A maximum of 100 hours of curtailment may be called per year.
Energy Payment	***Event Energy Credits.*** Energy eligible for credit is calculated as the difference between Forecasted Demand and Firm Demand during the curtailment period times. Participants earn $0.1 of credit per kWh curtailed.	***Event Energy Credits.*** Energy eligible for credit is the amount of energy transferred to the generator up to the Maximum Curtailable Demand during Curtailment Period times and monthly tests. Participants earn $0.1 of credit per kWh transferred.
Capacity Payment	***Capacity Credits.*** Capacity eligible for credit (i.e., “Effective Curtailable Demand”) is calculated by averaging the actual hourly load less the Firm Demand (the amount participant must curtail to) over the Exposure Period (hours of overall peak demand during which curtailment is most likely). Customer credits are $3.5/kW of Effective Curtailable Demand per month.	***Capacity Credits.*** The capacity eligible for credit is determined based on the average capacity generated during all Curtailment Periods and monthly tests, and is capped at participant Maximum Curtailable Demand. Eligible capacity is calculated monthly, and participants are paid $3.5/kW.
Penalty	Failure to reduce to Firm Demand levels incurs a penalty of $2/kWh for every kWh consumed above the Firm Demand level.	Failure to reduce by more than 50% of Maximum Curtailable Demand results in an energy charge of $2/kWh for energy shortfall below 50% of Maximum Curtailable Demand.

Source: Duke Energy program literature

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2. EVALUATION METHODS

This section of the PowerShare evaluation outlines the methods employed by the evaluation team to complete the evaluation. This section is divided into two sub-sections:

- **Duke Energy Baseline SAS Code Audit.** This sub-section describes Navigant's approach to auditing the SAS code developed by Duke Energy to estimate participant baselines and calculate capabilities.
- **Replication of EPO Calculations.** This sub-section describes the approach and data used to replicate the EPO calculations that deliver the energy and demand used by Duke Energy to determine settlement payments.

2.1 Duke Energy Baseline SAS Code Audit

Navigant's approach to reviewing the SAS code was to focus on the changes implemented to the code based on the recommendations provided by Navigant during the 2016 evaluation. Navigant requested and reviewed a number of files containing SAS coding script and other extracts from the code. Navigant did not run the code.

2.2 Replication of EPO Calculations

This sub-section describes the approach and data used by Navigant to replicate the EPO calculations for energy and demand used by Duke Energy to determine settlement payments. It is divided in two parts:

- **Input Data.** This part lists the key data and documents used as inputs for this analysis.
- **Description of EPO Calculations.** This part provides the algebraic descriptions of the calculations replicated by Navigant.

2.2.1 Input Data

Navigant used the following key input data and documents to replicate the EPO settlement calculations:

1. EPO settlement results data
2. DEC PowerShare participant interval consumption data
3. DEC PowerShare program brochure[2]
4. DEC PowerShare 2017 event dates and times
5. Duke Energy pro forma data
6. The Schneider Electric summary of data required to complete settlement algorithms, provided to Navigant by Duke Energy
7. PowerShare program guidelines, provided to Navigant by Duke Energy

[2] The DEC PowerShare Program brochure can be found at https://www.duke-energy.com/business/products/powershare

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2.2.2 Description of EPO Calculations

This section summarizes Navigant's replication of the EPO calculations that estimate the energy and demand values used by Duke Energy to determine settlement. Key terms include:

- **Exposure Period**: Hours of overall peak demand in which curtailment is most likely. Actual curtailment events can occur outside of the seasonal exposure period.
- **Forecasted Demand**: Estimated hourly demand a customer would normally exhibit in absence of curtailment.
- **Firm Demand**: Portion of demand not subject to curtailment.
- **Maximum Curtailable Demand**: Maximum amount of load transferred from the utility source to the generator during Curtailment Periods and monthly tests that is eligible for incentives.

Navigant applied the equations in this section to the interval consumption data resulting in the relevant energy or capacity credits. Navigant then compared the calculated credits to the EPO settlement data and verified that the results were essentially identical for each calculation.[3]

Monthly Capacity Credits (Applies Only to Mandatory Participants)

$$ECD = A_i - M$$

Where:

A_i	=	Average demand for month i during the exposure period
M	=	Firm demand
ECD	=	Effective Curtailment Demand

Event Energy Credits (Applies Only to Generator Participants)

$$GE = \sum_{h} (G_h)$$

Where:

GE	=	Generated energy eligible for credit
G_h	=	Energy generated in half hour h

Generated energy above the maximum curtailable demand for any half hour is not eligible.

Monthly Capacity Credits (Applies Only to Generator Participants)

$$AMGC = \sum_{e \in m} (GE_e) / \sum_{e \in m} (H_e)$$

Where:

[3] Some small insignificant differences in individual calculations were found due to rounding effects.

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AMGC	=	Average monthly generated capacity
GE_e	=	Generated energy eligible for credit in event e
H_e	=	Number of half-hour intervals in event e
$e \in m$	=	Events occurring during month m

Events are defined as all generator curtailment events and tests in a given month.

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3. EVALUATION FINDINGS AND RESULTS

This section describes the findings and results of Navigant's evaluation. It is divided into two sections:

- **Duke Energy Baseline SAS Code Audit.** This section describes Navigant's findings and recommendations based on our audit of the Duke Energy SAS code.
- **PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations.** This section describes Navigant's findings based on our analysis of the program tracking database[4] and the replication of the EPO calculations that deliver the energy and demand impacts used by Duke Energy to determine settlement payments.

3.1 Duke Energy Baseline SAS Code Audit

Navigant found that Duke Energy addressed all recommendations from the 2016 PowerShare EM&V reports. This resulted in improvements to the code that should enhance the usability and mitigate the potential for errors.

3.2 PowerShare Impacts and Findings from Navigant's Replication of EPO Calculations

Navigant replicated the EPO calculations for all participants in the period from June - September of 2017**.** Initially, Navigant found a number of discrepancies between its energy and capacity settlement calculations and those provided by Duke Energy. After several discussions with Duke Energy, Navigant identified the following causes of discrepancies:

- Interval data issues related to power outages (caused most of the discrepancies)
- Missing data
- Alternate test dates granted by Duke Energy under special circumstances, such as generator failure during primary testing period
- Meter clock drift that caused a mismatch of usage and times
- Customers leaving the program mid-month

Upon resolving those discrepancies, Navigant found that all of Duke Energy's estimates are accurate per the settlement algorithms defined by the program literature. A summary of the validation results, by option and credit type, may be found in Table 2 below.

[4] The "program tracking database" refers to the documentation provided by Duke Energy outlining the reported capacity and energy values used by Duke Energy for settlement payment.

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Table 2: Verification of EPO Calculations

Program Option	Credit Type	Customers	Unique Accounts	# of EPO Results Replicated[a]	Average % Absolute Error[b]
Mandatory Curtailment	Capacity	159	159	619	0.00%
Generator Curtailment	Energy	9	10	38	0.00%
Generator Curtailment	Capacity	9	10	38	0.00%

a. The number of calculations reproduced by Navigant for this analysis. For energy there is one credit calculated per participating account per event. For capacity there is one credit calculated per participating account per month. The period of analysis for this evaluation included four months and four curtailment events. In a small number of cases, data was not available for every account for every event, which is why the number of replicated EPO results is slightly lower than the number of accounts times the number of events.

b. The absolute error represents the difference between Navigant's replicated settlement results and the EPO estimates used by Duke Energy. The near-zero error demonstrates that Navigant was able to replicate settlement calculations using the algorithms provided by Duke Energy.

Source: EPO Settlement Data and Navigant analysis

Navigant calculated energy and capacity curtailment according EPO algorithms described above using Duke Energy's participant baselines and interval data. Duke Energy only called one-hour test events in June – September 2017, so the energy impacts only include generator curtailment. The results from these impacts are summarized in Table 3, below.

Table 3: Summary of 2017 Event Energy Impacts at the Meter (Total Program MWh per Event)

Program Name	June 21st	July 19th	Aug.16th	Sep. 20th	Total (MWh)
Generator Curtailment	8.2	7.5	8.2	7.8	31.7

Source: EPO Settlement Data and Navigant analysis

Total program impacts are driven by curtailment for individual meters. Figure 1 shows each meter's average hourly event energy reduction across the summer. These are sorted in descending order, to highlight the contrast between the largest and smallest contributors in the program.

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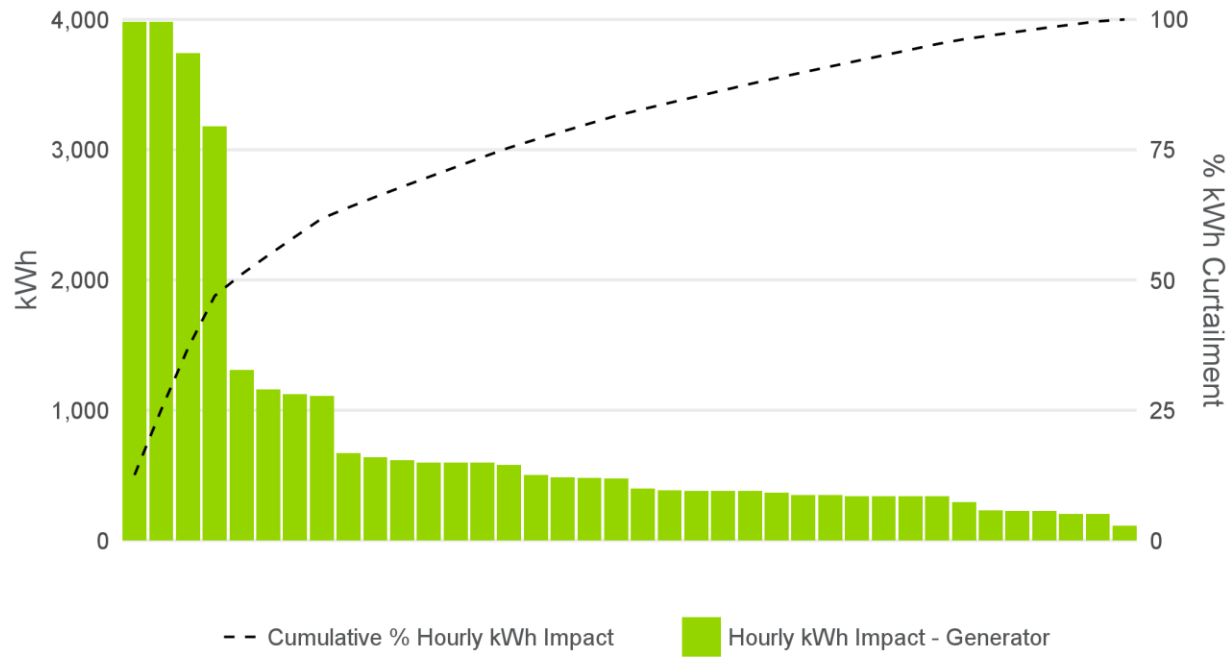
Figure 1: Average Event Curtailment by Participant



Source: EPO Settlement Data and Navigant analysis

The PowerShare Program paid out capacity credits to participants for an average monthly capacity of approximately 301 MW during the summer of 2017. This value is calculated according the EPO algorithms described above using Duke Energy's participant baselines and participant interval data. As is the case for delivered energy, the vast majority of this was delivered by customers enrolled in the Mandatory Curtailment option. The total DR capacity per month for the summer of 2017 by PowerShare option is summarized in Table 4, below.

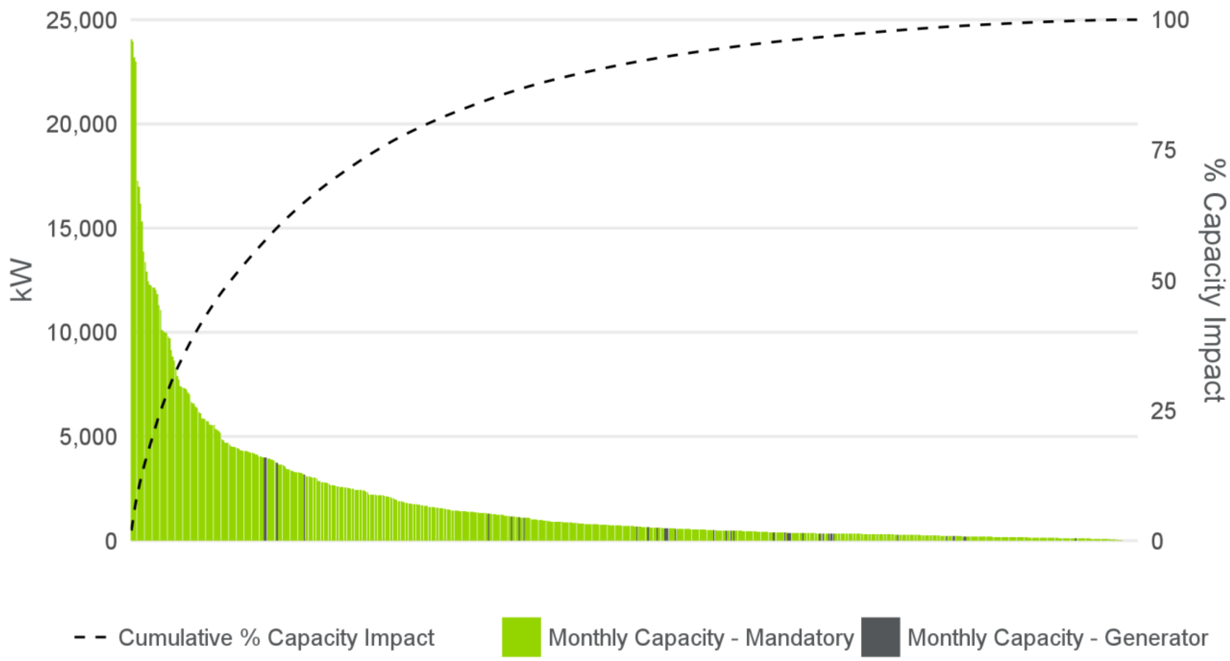
Table 4: Total Monthly Capacity for 2017 at the Meter (MW)

Program Name	June	July	August	September	Average (MW)
Mandatory Curtailment	316	294	309	286	301
Generator Curtailment	8	7	8	8	8

Source: EPO Settlement Data and Navigant analysis

Average monthly capacity was driven by a small percentage of meters. The top seven meters in terms of average monthly capacity accounted for 28% of total average monthly capacity.

Figure 2: Average Monthly Capacity by Participant



Source: EPO Settlement Data and Navigant analysis

Program participation[5] was consistent throughout the summer with an average of approximately 10 customers participating in the Generator Curtailment option. Table 5, below, provides a summary of the number of customers, that participated in each event.

Table 5: Summary of Participation by Event for 2017 (Number of Participants)

Program Name	June 21st	July 19th	Aug. 16th	Sep 20th	Average
Generator Curtailment	9	9	10	10	10

Source: EPO Settlement Data and Navigant analysis

[5] For the purposes of this evaluation report, a meter is defined as having "participated" in an event only when it delivers some (non-zero) energy reduction during the curtailment period.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Duke Energy SAS Code Audit

Navigant's detailed review of Duke Energy's SAS code determined that Duke Energy addressed all recommendations from the 2016 EM&V report for improving the organization and functionality of the code. The evaluation team believes the code is functioning correctly and does not need further review or updates at this time.

4.2 Verification and Validation of Settlement Energy and Demand Calculations

Although Navigant initially encountered some discrepancies when replicating Duke Energy's settlement calculations, these discrepancies were a result of the process for making sure that all relevant information was exchanged between Navigant and Duke Energy for evaluation purposes. These discrepancies were eventually resolved, and Navigant found that Duke Energy's settlement calculations were accurate per the algorithms defined in Section 2.2. This finding confirms that Duke Energy's procedure for calculating impacts is functioning in accordance with the program definitions, and therefore there will be limited value in continuing to audit settlement calculations using the methods described in this report.

However, if future evaluation efforts include similar efforts to replicate the settlement calculations, Navigant recommends that Duke Energy implement a detailed process for tracking all outages such that it can easily be determined when missing interval data was replaced with pro forma figures to minimize the initial discrepancies and expedite the evaluation.

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Carolina/ Duke Energy Progress

Non-Residential Prescriptive Program Evaluation Report – Final

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Opinion Dynamics

Contributors

Antje Flanders
Vice President

Matt Drury
Director, Engineering

John Tortorella
Consultant

Nick McKay
Consultant

Dan Chen
Senior Consultant

Mallorie Gattie-Garza
Managing Consultant, Engineering

Kai Zhou
Managing Consultant, Data Science

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Table of Contents

Opinion Dynamics

Table of Tables

Opinion Dynamics

Table of Figures

1. Evaluation Summary

1.1 Program Summary

The Duke Energy Carolina (DEC) Smart $aver Prescriptive Program and the Duke Energy Progress (DEP) Energy Efficiency for Business (EEB) Program (hereafter referred to as the DEC/DEP Non-Residential Prescriptive Program) provide incentives for electric commercial and industrial customers to purchase and install a variety of high-efficiency equipment, including lighting, HVAC systems, pumps and drives, and qualifying process, food service, and information technology equipment. The programs also use incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are available for new construction and retrofits and replacements. Prescriptive incentives under the programs are limited to 75% or less of the customer cost.

The main delivery channel for the DEC/DEP Non-Residential Prescriptive Program is application-based and driven by trade allies. The program has two additional delivery channels:

1. The Business Savings Store on the Duke Energy website (hereafter referred to as the "online store") offers customers a limited number of qualified products for which they can receive an instant discount. The discounts offered in the store are consistent with incentive levels in the main delivery channel.
2. The midstream channel allows distributors to provide instant discounts on eligible lighting equipment to prequalified customers. The discounts offered through this channel are also consistent with incentive levels in the main delivery channel. The midstream channel is offered through distributors only and is not available through trade allies.

The Non-Residential Prescriptive Program period under evaluation in this report is:

- DEC: August 1, 2015 to February 28, 2017
- DEP: March 1, 2016 to February 28, 2017

For the DEP service territory, the evaluation period begins later because the program completed its transition to the Smart $aver incentive structure in February 2016. This evaluation includes only projects that were incented under the new incentive structure, i.e., after February 2016.

Given the relatively small contribution of the online store and the midstream channel to total program savings, the focus of this evaluation is on the main program delivery channel, i.e., projects that receive incentives provided via traditional applications. However, we develop program-level gross impacts by applying gross impact results from the main channel to measures incented through the online store and the midstream channel, where applicable.

1.2 Evaluation Objectives

Our evaluation addresses the following key objectives.

Gross Impact Evaluation

- Verify deemed savings estimates through review of measure assumptions and calculations.

  - Document causes of differences between ex post (evaluated) and ex ante savings estimates.
  - Develop a realization rate for each reviewed measure.
- Estimate the amount of observed gross energy and peak demand savings (both summer and winter) by measure group via engineering analysis.

Net-to-Gross Analysis

- Develop a net-to-gross ratio (NTGR) and determine net impacts by estimating free-ridership (FR) and spillover (SO).

Process Evaluation

- Identify barriers to program participation and how these barriers can be addressed.
- Identify program strengths and opportunities for improvements.
- Assess customer and trade ally satisfaction with program processes.
- Assess the effects of the Non-Residential Prescriptive Program on trade ally practices.

1.3 High-Level Findings

During the evaluation period, non-residential customers completed 12,855 projects through the DEC Smart $aver Program and 3,186 projects through the DEP Energy Efficiency for Business Program. These projects generated approximately 287 GWh (DEC) and 73 GWh (DEP) of net energy savings, 49 MW (DEC) and 11 MW (DEP) of net summer peak demand savings, and 47 MW (DEC) and 10 MW (DEP) of net winter peak demand savings. Seventy-four percent of DEC net energy savings and 91% of DEP net energy savings were generated through the program's main delivery channel, with the remainder coming from purchases through the program's midstream channel and online store. Lighting accounted for the majority of program projects and savings.

Our gross impact analysis found realization rates for energy savings of over 100% for the DEC and DEP programs overall. Realization rates for summer demand savings were also over 100% for both DEC and DEP, generally due to deemed savings adjustments to lighting. Winter demand savings saw the largest change to realization rates, with DEC at 251% and DEP at 173%. These realization rates were driven by the program not claiming winter demand savings for several lighting measures. Our desk reviews and site visits found relatively few data tracking issues with respect to the quantities of installed measures. We adjusted the quantities for 6 of the 145 sampled projects. Of the six discrepancies, five were relatively minor, while one adjustment for a food service project had a significant impact on the food service realization rate.[1]

Based on our net impact analysis, the program-level NTGR for the Non-Residential Prescriptive Program is 78.7% for DEC and 85.8% for DEP. For both jurisdictions, the lighting NTGR is higher (81.0% DEC; 86.4% DEP) compared to the non-lighting NTGR (59.3% DEC; 67.9% DEP). We estimate overall program-level FR for DEC to be 28.5% and 21.4% for DEP. PSO and TA SO are 0.06% and 7.2% respectively.

Table 1-1 summarizes the net-to-gross results of our evaluation.

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[1] The adjustment for the food service project was due to a data entry error. The program has since implemented additional quality assurance processes to avoid similar errors in the future.

Table 1-1. Summary of DEC and DEP NTG Results

Technology	FR	PSO	TA SO	NTGR*
DEC				
Lighting	26.3%	0.06%	7.2%	81.0%
Non-Lighting	48.0%			59.3%
DEC Total	**28.5%**	**0.06%**	**7.2%**	**78.7%**
DEP				
Lighting	20.8%	0.06%	7.2%	86.4%
Non-Lighting	39.4%			67.9%
DEP Total	**21.4%**	**0.06%**	**7.2%**	**85.8%**

*NTGR = 1 – FR + PSO + TA SO

Table 1-2 and Table 1-3 summarize ex post gross and net savings for the evaluation period for DEC and DEP, respectively.

Table 1-2. Summary of DEC Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	268,914,950	44,373	42,064		211,751,454	35,026	33,382
Lighting	*240,987,942*	*40,161*	*38,891*	*0.81*	*195,187,673*	*32,528*	*31,500*
Pumps and Drives	*10,267,207*	*1,481*	*1,598*	*0.59*	*6,089,581*	*878*	*948*
HVAC	*7,869,879*	*1,840*	*656*	*0.59*	*4,667,702*	*1,091*	*389*
Food Service Products	*4,889,807*	*439*	*418*	*0.59*	*2,900,193*	*260*	*248*
Information Technology	*3,322,377*	*146*	*195*	*0.59*	*1,970,534*	*87*	*116*
Process Equipment	*1,577,738*	*306*	*306*	*0.59*	*935,772*	*181*	*181*
Midstream Channel	*65,238,691*	11,731	11,376	1.00	*65,238,691*	11,731	11,376
Online Store	*9,591,131*	1,893	1,864	1.00	*9,591,131*	1,893	1,864
DEC TOTAL	343,744,772	57,997	55,304		286,581,276	48,651	46,622

Table 1-3. Summary of DEP Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	77,664,493	11,581	10,936		66,708,433	9,933	9,399
Lighting	*65,966,238*	*10,398*	*10,053*	*0.86*	*57,025,896*	*8,989*	*8,691*
HVAC	*1,485,524*	*366*	*239*	*0.68*	*1,008,938*	*248*	*162*
Food Service Products	*807,334*	*54*	*53*	*0.68*	*548,325*	*36*	*36*
EEB - Lighting	*9,376,146*	*760*	*589*	*0.86*	*8,105,406*	*657*	*509*
EEB - HVAC	*29,252*	*4*	*1*	*0.68*	*19,867*	*3*	*1*
Midstream Channel	6,227,819	1,026	987	1.00	6,227,819	1,026	987
Online Store	43,549	6	7	1.00	43,549	6	7
DEP TOTAL	83,935,861	12,614	11,930		72,979,800	10,966	10,393

Our process evaluation found a program that is operating effectively, with satisfied participants that are generating significant numbers of projects and energy savings. The program has gone through a number of transitions shortly before and during the evaluation period. Key program design and implementation changes include:

- The EEB and Smart $aver programs, which operated separately in DEP and DEC territory, were brought into closer alignment. This included changing the DEP incentive structure from a watts-reduced approach to a per-unit incentive.

- Application and incentive processing—previously carried out by external contractors—was brought in-house. Applications are now processed through a Salesforce-integrated system.

- In the fall of 2014, the Non-Residential Prescriptive Program added Business Energy Advisors (BEAs) to its roster of program staff. The primary responsibility of BEAs is to work with small and medium-sized customers to generate interest and participation in the Non-Residential Prescriptive Program and to assist customers with the participation process.

- In March 2016, the program rolled out an online application portal for DEC customers and trade allies. The online portal was introduced to DEP customers in January 2017. This online portal was designed to streamline and ease the participation process.

- The program opened the online store to DEC customers in early 2016 and to DEP customers in December 2016.

Our process evaluation sought to explore customer and trade ally awareness and use of some of these new program features and to assess how effective they were in streamlining program processes and reducing barriers to participation. However, the timing of these changes, relative to our evaluation period, means that some participating customers and trade allies may not have been exposed to the new features or may have experienced them during the time of transition, when the new processes may not have been fully functional. As such, some of the findings presented in this report, while reflective of participants during the evaluation period, may not be fully representative of current participants. We note in the detailed discussion in this report where this might be the case.

Overall, our process evaluation found the following:

Sources of Information

- Contractors and trade allies continue to be an important source of information for customers.
  - 41% of DEC and 37% of DEP participants first learned about the program from a trade ally or contractor.
  - 87% of DEC participants and 85% of DEP participants worked with a contractor or vendor to select equipment.
  - Word of mouth (35% DEC; 38% DEP) was another common source of awareness, suggesting that participants are generally satisfied with their experience and are recommending the program to others.

Barriers to Energy Efficiency and Participation

- Higher cost of energy efficient equipment and access to financing/capital are key barriers to installing energy-efficient equipment.
- Trade allies and participants consider financial considerations; paperwork, application processes, and time required to participate; and incentive levels to be the barriers to program participation. However, a large number of trade allies and participants do not see any barriers to program participation.

Satisfaction

- Participants are highly satisfied with the program overall and all program components, rating no component less than an average score of 8.4 on a scale of 0 to 10. The program overall was rated an average of 8.8 by DEP participants and 9.2 by DEC participants, the highest and second highest rating for the respective territories.
  - 75% of DEC participants and 84% of DEP participants are very or somewhat likely to participate again.
  - 93% of DEC participants and 78% DEP participants are very likely to recommend the program to other businesses.
- Trade allies are somewhat less satisfied with program processes than participants, but still rated their satisfaction with all program factors an average of 6.5 or higher. Trade allies in both territories gave their highest average ratings to program staff interactions and the program overall.

Business Energy Advisor Interactions

- Twenty-five percent of DEC and 27% of DEP participants have had energy efficiency-related interactions with a BEA.
  - The most common reason for interaction with the BEA was for program scoping (54% DEC) and application support (37% DEP).

- 85% of DEC and 68% of DEP participants who worked with a BEA said the BEA was very or somewhat influential in their decision to participate in the program.

Online Portal

- Relatively few participants (37% DEC; 28% DEP) are aware of the customer online portal. Fewer still have used the portal (16% DEC; 12% DEP). The most common use was to submit applications (63% DEC; 70% DEP).
- Trade ally awareness of the portal is high (76% DEC; 72% DEP). More than half of DEC trade allies (54%) have used the portal, while slightly fewer DEP trade allies (44%) have.

Online Store

- Moderate numbers of main channel participants (46% DEC; 22% DEP) are aware of the online store. Fewer—13% of DEC participants and 1% of DEP participants—have made a purchase from the store. The later rollout of the online store to DEP customers may explain their lower awareness and use of this program channel.
  - 75% of DEC participants and 62% of DEP participants said that they were very or somewhat likely to make a purchase within the next year.
  - Barriers to making a purchase from the online store include existing vendor relationships, specific company purchasing requirements, or having no need for additional equipment.

Trade Ally Business Practices

- Nearly all trade allies reported an increase in one or more high-efficiency aspects of their business, and most of those trade allies said that the program was at least somewhat influential in those increases.
  - The aspect for which the highest share of trade allies reported significant increases was percent of sales recommending high-efficiency equipment (DEC 51%; DEP 41%).
- Trade allies generally credited the program with the highest influence on the increases in sales recommendations and energy-efficient installations (total volume and percentage of jobs).
- Less than half of trade allies have participated in program-sponsored training.
  - Of those who attended any training, the largest share (54% DEC; 79% DEP) attended program training, and about half attended online portal training.
  - The main reasons for not participating in any training were a lack of awareness that the program offered training, a lack of time to participate, and a lack of need for training.

1.4 Evaluation Recommendations

Through our research, we identified several opportunities for program improvement.

Increase Promotion of Lesser-Known Program Components

While the program is performing well and generating savings, there are program components that can be further promoted and improved to create even higher levels of participation. The BEAs represent a strong opportunity for the program to reach small- and medium-sized businesses and increase program knowledge and participation among this group. Increased operational support could be provided to the BEAs to facilitate more targeted communications and knowledge transfer to customers at the key moment when they are selecting equipment for their projects.

The program should also make attempts to increase promotion of the online store and the online portal, particularly among DEP customers for whom these components are still relatively new. The online store represents an opportunity for customers with relatively simple projects (primarily lighting) to purchase equipment in a streamlined fashion and could drive increased participation. BEAs in particular should promote this option to their customers, as it might be well suited for the needs of smaller businesses. At the same time, the program should emphasize the online portal in communications with customers and trade allies as a mechanism to streamline the application process and as a way for these key stakeholders to receive vital information about the program.

Finally, the program periodically provides training to trade allies in the form of in-person meetings and webinars. However, knowledge of and participation in these trainings was relatively low among surveyed trade allies. Since the trainings address some of the areas of lower trade ally satisfaction (e.g., application processing, the online portal), there is an opportunity for the program to better educate trade allies, remove some of the obstacles to participation, and increase satisfaction. The program might also consider making an introductory training mandatory, to ensure that all trade allies are aware of key program processes and requirements. Some similar programs that have lists of registered trade allies do require this.[2] In some cases, they also require attendance in annual meetings, to inform trade allies of important changes to the program.

Consider More Frequent Updates of Eligible Measure List, Especially for Lighting Measures

Many trade allies install non-incented high-efficiency equipment, and many of these installations are not completed through the program because the measures are not on the program's list of eligible equipment. Trade allies listed multiple types of energy-efficient equipment—mostly lighting measures—that they think should be eligible for a program incentive: tubular LED bulbs; high-output lighting, such as high-bay LEDs and "corn cob LEDs"; LED floodlights; low-wattage TLEDs; and generally, a wider range of LED bulbs and fixtures.

While relying on third-party lists of qualifying equipment, such as those from the DLC and ENERGY STAR®, allows the program to reduce its administrative burden, the program may be missing opportunities for increasing participation and realizing more savings. Lighting still represents an excellent source of program

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[2] Examples of similar business programs that have trade ally training requirements include NIPSCO's Business Energy Efficiency Program, which requires new TAs to complete an orientation session; ComEd's Smart Ideas® Energy Efficiency Program, which requires new TAs to attend a Trade Ally Basic Training class and one launch event per program year; SDG&E's C&I programs, which require new TAs to participate in the Trade Professional Program Essentials training; and PG&E's C&I programs, which require new TAs to attend the Trade Professional Alliance 101 Seminar before participating in the programs.

savings, and levels of FR are low compared to non-lighting measures. As such, staying current with newer and better lighting technologies represents an opportunity for the program to continue capturing lighting-related savings.

Continue to Improve and Streamline the Application Process

The program has taken steps to improve the application process, including bringing the application processing system in-house and offering an online application system for participants and trade allies. Nevertheless, the online portal is the lowest-rated program components for trade allies. While the evaluation team did not have direct access to the online portal, we recommend that the program collect specific feedback from portal users and explore implementing solutions to the most commonly cited challenges. Among suggestions provided by trade allies surveyed in support of this evaluation were a function to auto-populate data for customers with multiple sites, allowing a multi-location application, and including an archive or filter function.

Improve Data Collection and Tracking Processes

Our review and processing of program tracking data revealed a number of issues that, if addressed, would allow program staff to better track program activity and would also facilitate evaluation efforts. In particular, areas that can be improved include the following:

- **Create unique identifiers for participants and trade allies.** During interviews and conversations, program staff noted two difficulties related to data tracking: (1) an inability to identify and enumerate unique customers in the participation data and (2) difficulty identifying inactive trade allies for potential removal from the program's trade ally list. Creating a unique identifier for each participating customer and each participating trade ally would solve both of these problems and would allow program staff to easily tabulate program activity, identify top- and low-performing trade allies, identify repeat customers, and better target specific types of customer or trade ally. Assigning unique identifiers could also help with auto-populating certain information in the online portal, as suggested by one trade ally to streamline the application process.

- **Perform additional quality assurance steps on the data entered into the program tracking database.** While our impact analysis generally found few data tracking issues, one major error in quantity significantly affected the realization rate of food service equipment. Additional checks on entered data, e.g., for outlier values, could help prevent such issues in the future.

- **Ensure that information collected on the application is complete and consistently entered into the program tracking database.** Missing data encountered during our evaluation included operational information, such as hours of use, as well as customer contact information. Collecting and entering more complete technical and operational data will enable more accurate estimates of program impacts while more complete customer contact information will support program outreach efforts.

2. Program Description

2.1 Program Design

The Duke Energy Carolina (DEC) Smart $aver Prescriptive Program and the Duke Energy Progress (DEP) Energy Efficiency for Business (EEB) Program (hereafter referred to as the DEC/DEP Non-Residential Prescriptive Program) provide incentives for electric commercial and industrial customers to purchase and install a variety of high-efficiency equipment, including lighting, HVAC systems, pumps and drives, and qualifying process, food service, and information technology equipment. The programs also use incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are available for new construction and retrofits and replacements. Prescriptive incentives under the programs are limited to 75% or less of the customer cost.

The main delivery channel for the DEC/DEP Non-Residential Prescriptive Program is application-based and driven by trade allies. The program has two additional delivery channels:

1. The Business Savings Store on the Duke Energy website (hereafter referred to as the "online store") offers customers a limited number of qualified products for which they can receive an instant discount. The discounts offered in the store are consistent with incentive levels in the main delivery channel.

2. The midstream channel allows distributors to provide instant discounts on eligible lighting equipment to prequalified customers. The discounts offered through this channel are also consistent with incentive levels in the main delivery channel. The midstream channel is offered through distributors only and is not available through trade allies.

The Non-Residential Prescriptive Program was first implemented in the DEC/DEP territory in 2009. Prior to March 2016, the DEP Energy Efficiency for Business Program provided incentives on a performance basis, e.g., watts reduced, rather than on a per-unit basis. In an effort to more closely integrate the DEC and DEP programs, the Energy Efficiency for Business Program incentive structure was transitioned to the per-unit basis offered by the Smart $aver Prescriptive Programs in Duke Energy's other jurisdictions (including DEC). This evaluation covers projects incented through the DEP Energy Efficiency for Business Program after the transition to the per-unit incentive structure.

2.2 Program Implementation

Duke Energy staff implement the Non-Residential Prescriptive Program, along with contractor support for some program components. The program is also offered in other Duke Energy territories, and most program staff share responsibilities across the territories. In the DEC and DEP territories, the program is managed by two program staff, with support from Duke Energy marketing staff, a trade ally outreach team, a team of BEAs and operational support for processing applications and incentives.

The program is marketed to commercial and industrial customers through targeted outreach and communications by the program. Marketing approaches during the evaluation period included email and direct mail; online marketing; print marketing using tailored marketing collateral, such as a do-it-yourself (DIY) brochure; and monthly marketing materials that focused on a different topic each month to generate interest in specific technologies and areas of the program. Additional outreach is conducted by Large Business Account Managers, BEAs, and Local Government and Community Relations staff. BEAs are a new addition to the program as of the fall of 2014. The role of BEAs is to conduct targeted outreach to small and medium-sized businesses that fall below the threshold for large account management.

The program also has a trade ally outreach team that is specifically tasked with marketing the program to trade allies, who in turn are encouraged to promote the program to their customers. The trade ally outreach team manages existing trade ally relationships, recruits new trade allies, and educates trade allies about the program offerings and changes in the program as they occur. The program also offers a co-marketing campaign for trade allies that provides reimbursement for up to 50% of their marketing costs (up to $2,000).

During the evaluation period, the program changed several of its implementation strategies:

- Application and incentive processing—previously carried out by external contractors—was brought in-house. Applications are now processed through a Salesforce-integrated system.
- In March 2016, the program rolled out an online application portal for DEC customers and trade allies. The online portal was introduced to DEP customers in January 2017. This online portal aligns with the new application processing system.
- The program opened the online store to DEC customers in early 2016 and to DEP customers in December 2016.

2.3 Program Participation and Performance

During the evaluation period (August 1, 2015 to February 28, 2017 for DEC; March 1, 2016 to February 28, 2017 for DEP), the program completed 12,855 projects in DEC territory and 3,186 projects in DEP territory.[3] These projects were completed by close to 7,000 unique DEC customers and 1,700 unique DEP customers, and they accounted for 332 GWh of ex ante gross savings for DEC and almost 75 GWh of ex ante gross savings for DEP.

More than 7 of 10 (72.3%) DEC projects and 92.6% of DEP projects were completed through the main channel. In DEC territory, 16.7% of projects were completed through the midstream channel and 11.0% were completed through the online store. In DEP territory, only 7.0% of projects went through the midstream channel and fewer than 1% went through the online store.

Project counts and ex ante savings are summarized, by territory, in Table 2-1.

[3] The program tracking database tracks measures but not projects. For evaluation purposes, we defined unique projects as one or more measures of the same technology installed by the same customer (based on account number and name), at the same location, at the same time. Project counts in this report exclude 35 projects with zero savings.

Table 2-1. Non-Residential Prescriptive Projects and Ex Ante Gross Savings during the Evaluation Period

Delivery Channel	Projects		Number of Unique Customers[A]	Ex Ante Savings	
	Number	Percent		kWh	Percent
DEC					
Main Channel	9,288	72.3%	5,124	262,599,683	79.2%
Midstream Channel	2,152	16.7%	1,190	59,834,601	18.0%
Online Store	1,415	11.0%	1,027	9,280,200	2.8%
DEC Total	**12,855**		**6,916**	**331,714,484**	
DEP					
Main Channel	2,949	92.6%	1,570	69,375,093	92.9%
Midstream Channel	224	7.0%	160	5,301,118	7.1%
Online Store	13	0.4%	11	39,783	<0.1%
DEP Total	**3,186**		**1,696**	**74,715,994**	

[A] Note that some customers participated in more than one delivery channel. As a result, the sum of unique customers across delivery channels does not add to the DEC and DEP totals.

Table 2-2 shows the distribution of main channel projects by technology type. Lighting accounted for the majority of projects for both DEC and DEP. During the evaluation period, lighting represented 89% of projects and 86% of savings for DEC and 81% of projects and 82% of savings for DEP. HVAC projects (5% DEC; 6% DEP) and food service projects (5% DEC; 7% DEP) were the next most common project type in the program. Some DEP projects were categorized as "EEB lighting" and "EEB HVAC," without any additional measure detail. Based on our desk reviews, at least some of these projects included more than one technology. Therefore, we categorize these projects and their savings separately.

Table 2-2. Distribution of Main Channel Projects and Savings by Technology Type

Technology	% Projects		% Ex Ante Savings	
	DEC	DEP	DEC	DEP
Lighting	89%	81%	86%	82%
HVAC	5%	6%	3%	2%
Food Service Products	5%	7%	5%	2%
Pumps and Drives	1%	–	4%	–
Process Equipment	<1%	–	1%	–
Information Technology	<1%	–	1%	–
EEB Lighting	–	6%	–	14%
EEB HVAC	–	<1%	–	<1%

3. Overview of Evaluation Activities

To address the research objectives outlined in the previous section, the evaluation team performed a range of data collection and analytic activities, including:

- Program staff interviews (n=3)
- Program materials review
- BEA interviews (n=3)
- A participant survey (n=127 DEC; n=94 DEP)
- A trade ally survey (n=111 DEC; n=31 DEP)
- Database review
- Engineering desk reviews (n=145)
- Site visits (n=32 DEC; n=6 DEP)
- Deemed savings review

3.1 Program Staff Interviews

We conducted three in-depth interviews with program staff: one with the two Duke Energy Non-Residential Prescriptive Program managers, one with the leader of the trade ally outreach team, and one with the leader of the BEA team.

- The interview with the program managers took place in March 2016. The purpose of this interview was to understand the program's current design and implementation, including the online store and the midstream channel. We also explored recent program changes, strengths, and challenges, as well as program staff's priorities for the process evaluation.
- The trade ally outreach team leader interview took place in April 2016. The goals of this interview were to understand the role of trade allies in the Non-Residential Prescriptive Program, to identify key program outreach activities targeted at trade allies, and to discuss areas for further research.
- The BEA team leader interview took place in April 2016. The goals of the interview were to understand the role of BEAs in the Non-Residential Prescriptive Program and to identify key activities that BEAs undertake to reach small and medium-sized customers and to encourage them to participate in the program. We attempted, but did not complete, a follow-up interview with the BEA team leader in June/July 2017 to explore any changes in the BEAs' role in the program.

3.2 Program Materials Review

The evaluation team reviewed the following prior evaluation reports for the DEC and DEP Non-Residential Prescriptive Program:[4]

[4] Prior evaluations were conducted for the DEC and DEP programs separately.

- DEC Evaluations:
  - Duke Energy Carolinas Smart $aver® Prescriptive Incentive Program (July 2016, revised August 2017; The Cadmus Group)
  - Process Evaluation of the 2013-2014 Smart $aver® Nonresidential Prescriptive Incentive Program in the Carolinas System (December 2015; The Cadmus Group)
  - Process and Impact Evaluation of the Non-Residential Smart $aver Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors (April 2013; TecMarket Works)
- DEP Evaluations:
  - 2014 EM&V Report for the Energy Efficiency for Business Program (March 2016; Navigant Consulting)
  - 2013 EM&V Report for the Energy Efficiency for Business Program (December 2014; Navigant Consulting)
  - 2012 EM&V Report for the Energy Efficiency for Business Program (September 2013; Navigant Consulting)

We also reviewed summary documents describing the program design and implementation approach, marketing materials and collateral developed for the program, and documentation of the incentives and technologies available through the program. In support of the gross impact evaluation, we also reviewed a number of technical reference manuals (TRMs), including the Arkansas TRM, the Illinois TRM, the Indiana TRM, the Mid-Atlantic TRM, the Wisconsin TRM, the Tennessee Valley Authority TRM, and the Texas TRM, as well as a variety of secondary materials documenting Duke Energy's ex ante deemed savings assumptions. The full list of these materials is included in the Deemed Savings Review Memorandum in (see Appendix).

3.3 Business Energy Advisor Interviews

We interviewed three of the five BEAs assigned to the Non-Residential Prescriptive Program in the DEC and DEP territories. The BEAs are primarily responsible for working with small and medium-sized customers to generate interest and participation in the program and for assisting customers with the participation process. The goals of these interviews were to explore the BEAs' perspective on program processes, including program strengths and weaknesses and areas for improvement; to hear their perspective on customer awareness of and interest in the program; and to better understand customer barriers to energy efficiency and program participation.

3.4 Participant Survey

We conducted a computer-assisted telephone interview (CATI) survey with a stratified random sample of participants in the main channel. The survey was designed to collect information on FR and PSO in support of the net impact analysis, and on program processes, such as interactions with BEAs, awareness and prior use of the online store and the online application portal, barriers to participation, and satisfaction.

Sample Design

The survey sample was designed to allow for the development of statistically significant FR estimates for four analysis groups: DEC lighting projects, DEC non-lighting projects, DEP lighting projects, and DEP non-lighting projects. We further stratified the sample in each group based on project savings. While the sampling unit for this survey was the unique customer contact, the FR questions had to be asked about a specific project completed by that customer. Because many customers had completed more than one project during the evaluation period, our sampling approach prioritized projects in strata with fewer available sample points, i.e., projects with larger savings and non-lighting projects.

We completed 221 total interviews with customers who participated in the program's main delivery channel, 127 with DEC participants and 94 with DEP participants.[5] The average length of the interviews was 15 minutes and 33 seconds. The response rate was 20.3%.

Table 3-1 summarizes the population, sample frame, and number of survey completes, by jurisdiction and technology.

Table 3-1. Sampling Approach for Participant Survey

	DEC		DEP	
Technology	# of Projects in Population (Main Channel)	# of Completes	# of Projects in Population (Main Channel)	# of Completes
Total	9,288	127	2,949	94
Lighting	8,243	71	2,392	70
Non-Lighting	1,045	56	373	22
HVAC	*467*	*36*	*170*	*17*
Food Service Products	*470*	*11*	*203*	*5*
Pumps and Drives	*75*	*5*	--	--
Process Equipment	*28*	*4*	--	--
Information Technology	*5*	--	--	--
EEB Lighting	--	--	182	*2*
EEB HVAC	--	--	2	–

Process Weights

Our sample design was based on the needs of the FR analysis and oversampled projects with larger savings and projects with non-lighting technologies. To ensure that aggregated responses to process questions are representative of the population, we developed process weights. Process weights were calculated as the stratum's percentage of projects in the population divided by its percentage of projects in the sample, within each jurisdiction. Table 3-2 summarizes the process weights.

[5] The survey excluded participants in the online store and the midstream channel.

Table 3-2. Participant Survey Process Weights

Stratum	Population (Projects)		Survey Completes		Weight
	Count	%	Count	%	
DEC					
Lighting Small	6,415	69%	22	17%	3.99
Lighting Medium	1,667	18%	25	20%	0.91
Lighting Large	161	2%	24	19%	0.09
Non-Lighting Small	839	9%	37	29%	0.31
Non-Lighting	176	2%	14	11%	0.17
Non-Lighting Large	30	0.3%	5	4%	0.08
Total DEC	**9,288**	**100%**	**127**	**100%**	
DEP					
Lighting Small	1,720	58%	29	31%	1.89
Lighting Medium	738	25%	26	28%	0.90
Lighting Large	116	4%	17	18%	0.22
Non-Lighting Small	244	8%	13	14%	0.60
Non-Lighting	111	4%	3	3%	1.18
Non-Lighting Large	20	1%	6	6%	0.11
Total DEP	**2,949**	**100%**	**94**	**100%**	

3.5 Trade Ally Survey

We conducted an online survey with trade allies who had completed at least one project through the Non-Residential Prescriptive Program during the evaluation period. The goals of this survey were to support the estimation of trade ally TA SO attributable to the program and to examine process-related questions, such as program impacts on trade ally business practices, trade ally satisfaction with the program, awareness of the program among customers, barriers to participation in the program, and trade ally training.

We sent an email invitation to each company that completed at least one project through the Non-Residential Prescriptive Program during the evaluation period, i.e., we attempted a census of trade ally companies. As such, our data collection approach was not sample-based, and the concept of sampling precision does not apply. To promote participation in the survey, we offered an incentive of $50 to the first 30 trade allies who completed the survey, and an additional $50 incentive to a randomly selected group of 25 trade allies.

Overall, 111 DEC and 32 DEP trade allies completed the online survey. The response rate was 18.2%.

3.6 Database Review

We received various data extracts from the program tracking database, each containing a subset of the data needed in support of our evaluation. Our team of energy data scientists and engineers merged and cleaned these data and created a single dataset that reflects program activity during the evaluation period and that could be used for the gross impact analysis and survey sampling. Key data cleaning activities included development of project IDs, development of ex ante savings (by merging per-unit savings into the tracking data and multiplying those by measure quantities), verification of installation dates, removal of duplicate and otherwise ineligible records (e.g., those not achieving the minimum efficiency level), and cleaning of respondent and trade ally contact information for sampling purposes.

3.7 Engineering Desk Reviews and Site Visits

To verify measure quantities tracked by the program, our engineering team performed 145 desk reviews of main channel projects, sampled by technology. The desk reviews consisted of a thorough examination of all available program documentation for the projects, including applications, invoices, and specifications sheets. Additionally, we followed up with site contacts to confirm quantities, as necessary. Our team also performed 38 site visits (32 DEC; 6 DEP) to confirm measure quantities and other key project parameters of incented projects.

To select projects for desk reviews, we used a stratified random sampling approach, stratifying by technology and project savings (Table 3-3). The projects selected for site visits were a subset of the 145 desk review projects (nested sample), selected at random. We targeted a precision level of 10% at 90% confidence for each technology.

Table 3-3. Summary of Desk Reviews and Site Visits

Technology	Number of Projects		
	Population (Main Channel)	Desk Reviews	Site Visits
Lighting	10,635	53	12
Food Service Products	673	30	5
HVAC	637	30	10
Pumps and Drives	75	15	5
Information Technology	28	5	0
Process Equipment	5	10	5
EEB Lighting	182	2	1
EEB HVAC	2	0	0
Total	**12,237**	**145**	**38**

3.8 Deemed Savings Review

To verify per-unit savings values in the program tracking database, our engineering team performed a deemed savings review of key measures incented during the evaluation period.[6] The program provided incentives for 204 unique measures, and our deemed savings review included 66 of these measures, accounting for 93% of ex ante savings. For each of these 66 measures, we reviewed existing program documents, assumptions, TRMs, and other resources as applicable to determine the appropriateness of the per-unit savings values. We then recommended changes to per-unit savings for several measures, based on the review of materials.

[6] The deemed savings review covered the data available as of the time of the data pull for this task (i.e., through July 31, 2016), rather than the full evaluation period through February 28, 2017. It included measures in all three delivery channels.

4. Gross Impact Evaluation

Our gross impact evaluation included four main evaluation activities: a program database review, a desk review of a sample of projects, site visits of a sample of projects, and a review of Duke Energy's ex ante (deemed) savings assumptions. While the desk reviews and site visits focused on projects completed through the program's main channel, we did include midstream channel and online store measures in the deemed savings review and also applied gross impact realization rates to midstream channel and online store measures.

4.1 Methodology

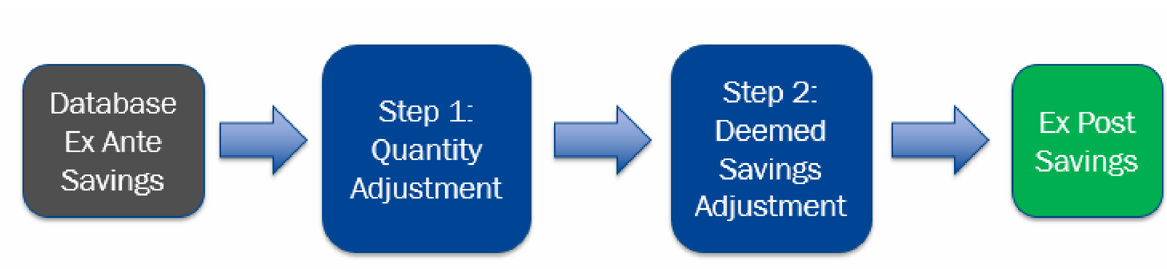
The first step in the gross impact evaluation was to perform a database review. This review consisted of several steps. First, we reviewed and merged various data extracts from the program tracking database and developed unique project identifiers. Second, we calculated ex ante savings, by technology, by multiplying per-unit database savings by measure quantities. Third, we verified dates of installation, identified duplicate records, and checked for any other qualifying parameters that may disqualify measures (e.g., not achieving the minimum efficiency level). The database review resulted in a clean dataset that reflects the eligible population of program projects with complete data required to estimate savings, including measure- and project-level ex ante savings. We used this dataset to select measures for the deemed savings review, to select projects for the engineering desk reviews and site visits, and to develop technology- and program-level ex ante gross impacts.

Following the database review, the evaluation team used a combination of desk reviews, site visits, and a deemed savings review to estimate ex post (verified) gross impacts. The methodology consisted of a two-step process to adjust the ex ante savings from the program tracking database:

- **Step 1: Quantity Adjustment:** Based on 145 desk reviews and 38 site visits, we developed technology-specific quantity adjustment factors, which we applied to the measure quantities in the program tracking database. The sample included both DEC and DEP projects, but did not target specific quota for each jurisdiction.
- **Step 2: Deemed Savings Adjustment:** Based on the deemed savings review, we developed measure-specific per-unit savings adjustment factors, which we applied to the per-unit measure savings in the program tracking database.

Figure 4-1 depicts this process.

Figure 4-1. Gross Impact Evaluation Approach



4.1.1 Quantity Adjustment

The purpose of the desk reviews and site visits was to verify measure quantities included in the program tracking database. We began by performing desk reviews for a sample of 145 main channel projects, sampled by technology (see Table 3-3 above). We reviewed all available project documentation for sampled projects, including the project application; any supplied calculations, invoices, specification sheets, and inspection forms; and any other project-specific data made available to our team. For all sampled projects, we compared measure types and quantities listed on project documents with measure types and quantities listed in the program tracking database to ensure consistency and to check for any errors. Additionally, we followed up with site contacts to confirm quantities if there were significant, unexplained differences between project documents and the database.

Following the desk reviews, we selected a random sample of 35 projects[7] from among the desk review projects (nested sample) to perform site visit inspections of measure quantities. We used the site visits to confirm installation of the energy-efficient measure(s) and other project-specific parameters as applicable (e.g., type, size). We developed an on-site data collection plan, which documented the general on-site data collection approach, including final sample sizes; the timeline for the visits; the data to be collected during the visits; the requirements for technicians, such as badging and apparel; and any safety or training requirements.

We included projects identified in the database as “EEB Lighting” and “EEB HVAC” in our original sample, but learned through the desk reviews and site visits that the project documentation for these projects was incomplete and not consistent with other projects, which made it difficult to verify measure installations.[8] We were therefore not able to verify measure quantities for EEB lighting and EEB HVAC projects and applied a default realization rate of 100% to those projects.

Based on information from both desk reviews and site visits, we developed technology-level quantity adjustment factors. While the desk reviews and site visits only included main channel projects, we applied the technology-level adjustment factors to all program-incented measures, including those incented through the online store and the midstream channel.

4.1.2 Deemed Savings Adjustment

The purpose of the deemed savings review was to review per-unit savings assumptions for key measures incented through the Non-Residential Prescriptive Program. Because of the large number of unique measures incented during the evaluation period (a total of 204), we focused our efforts on the measures that accounted for the largest share of program savings.[9] We included measures incented through the Main channel as well as the online store and the midstream channel in this review.

Table 4-1 presents the number of measures incented through the program, as well as those selected for review, by technology. As seen in Table 4-1, the deemed savings review included 66 measures that accounted for 93% of total ex ante program savings. For the measures not covered by the deemed savings

[7] We targeted 35 sites, but completed 38, as we overscheduled to ensure that any last-minute cancellations would not affect the targeted sample of 35 sites.

[8] For example, one sampled EEB lighting project appeared to be a New Construction project and included only baseline and installed lighting power density calculations, making it difficult to verify the exact quantities of fixtures in each room. Additionally, the project included HVAC measures, and the amount of savings from lighting measures versus HVAC measures could not be discerned from the project documentation.

[9] The measure selection for the deemed savings review was based on the data available at the time of the data pull for this task, i.e., through July 31, 2016, rather than the full evaluation period through February 28, 2017.

review (accounting for the remaining 7% of total ex ante savings), we maintained existing per-unit ex ante assumptions.

Table 4-1. Summary of Measures Reviewed

Technology	All Measures[A]		Reviewed Measures		
	Number	Ex Ante Savings (kWh)	Number	Ex Ante Savings (kWh)	% of Total Ex Ante Savings
Lighting	83	120,429,112	54	117,423,913	98%
Food Service Products	43	9,892,610	2	7,924,384	80%
Pumps and Drives	8	5,868,817	3	5,827,024	99%
HVAC	63	5,775,575	5	1,701,603	29%
Information Technology	4	3,318,558	2	2,927,158	88%
Process Equipment	3	1,122,447	0	0	0%
Total	204	146,407,119	66	135,804,082	93%

[A] This table includes measures incented through July 31, 2016, rather than for the full evaluation period. As a result, total ex ante savings in this table do not match program totals in other parts of the report.

For the selected measures, we reviewed all program-supplied ex ante documentation and exchanged several rounds of questions with Duke Energy to clarify specific assumptions. We leveraged a variety of TRMs, including the Arkansas TRM, the Illinois TRM, the Indiana TRM, the Mid-Atlantic TRM, the Tennessee Valley Authority TRM, and the Wisconsin TRM, as well as ASHRAE, ENERGY STAR®, and other references, as needed.

The full, measure-level deemed savings review, including the supporting spreadsheet, can be found in Appendix).

4.2 Gross Impact Results

Table 4-2 summarizes the overall gross energy impacts for DEC and DEP (including savings from all three delivery channels) resulting from the two-step adjustment approach described above. The overall realization rates are greater than 100%, driven mainly by deemed savings review adjustments. The quantity adjustment resulted in a slight decrease to savings for lighting measures, but this decrease was offset by the savings increases from the deemed savings review. We describe these adjustments in more detail below.

Table 4-2. Overall Gross Energy (kWh) Impacts

Technology	DEC			DEP		
	Ex Ante kWh	Realization Rate	Ex Post kWh	Ex Ante kWh	Realization Rate	Ex Post kWh
Lighting	294,891,311	107%	315,354,420	62,195,290	116%	72,231,570
Pumps and Drives	10,267,207	100%	10,267,207	0	N/A	0
HVAC	7,956,142	104%	8,302,759	1,491,559	100%	1,491,559
Food Service Products	13,673,591	36%	4,911,371	1,623,748	50%	807,334
Information Technology	3,321,658	100%	3,331,277	0	N/A	0
Process Equipment	1,604,575	98%	1,577,738	0	N/A	0
EEB – Lighting	0	N/A	0	9,376,146	100%	9,376,146
EEB – HVAC	0	N/A	0	29,252	100%	29,252

Technology	DEC			DEP		
	Ex Ante kWh	Realization Rate	Ex Post kWh	Ex Ante kWh	Realization Rate	Ex Post kWh
Totals	331,714,484	104%	343,744,772	74,715,994	112%	83,935,861

Table 4-3 summarizes the overall gross demand impacts for DEC and DEP (including savings from all three delivery channels) resulting from the two-step adjustment approach described above.

- The overall summer demand realization rates are greater than 100%, driven mainly by deemed savings adjustments to lighting.
- The overall winter demand realization rates are significantly higher than 100%, driven mainly by deemed savings adjustments to lighting measures. The program did not claim winter demand savings for several lighting measures, but we added them for ex post.

We describe these adjustments in more detail below.

Table 4-3. Overall Gross Demand Impacts

Technology	DEC			DEP		
	Ex Ante kW	Realization Rate	Ex Post kW	Ex Ante kW	Realization Rate	Ex Post kW
Summer Demand Impacts						
Lighting	50,556	106%	53,762	11,000	104%	11,431
Pumps and Drives	1,481	100%	1,481	0	N/A	0
HVAC	2,255	83%	1,862	365	100%	365
Food Service Products	1,976	22%	440	156	34%	54
Information Technology	145	101%	146	0	N/A	0
Process Equipment	310	99%	306	0	N/A	0
EEB - Lighting	0	N/A	0	760	100%	760
EEB - HVAC	0	N/A	0	4	100%	4
Totals	**56,723**	**102%**	**57,997**	12,286	**103%**	**12,614**
Winter Demand Impacts						
Lighting	17,127	304%	52,102	5,888	188%	11,047
Pumps and Drives	1,598	100%	1,598	0	N/A	0
HVAC	844	81%	684	239	100%	239
Food Service Products	1,946	22%	419	160	33%	53
Information Technology	212	92%	195	0	N/A	0
Process Equipment	310	99%	306	0	N/A	0
EEB - Lighting	0	N/A	0	589	100%	589
EEB - HVAC	0	N/A	0	1	100%	1
Totals	22,035	**251%**	**55,304**	6,877	**173%**	**11,930**

The following subsections provide more detailed results from the quantity and deemed savings adjustment analyses.

4.2.1 Quantity Adjustment

Based on our desk reviews and site visits, we adjusted the quantities for 6 of the 145 sampled projects. Of the six adjustments, five were relatively minor, while the sixth adjustment, for a food service project, had a significant impact on the food service products realization rates. This food service project (enrollment number PSN15-0000072017) had a tracked quantity of 1,500 Full Size Holding Cabinets, but project documents showed a quantity of 1. We confirmed through a follow-up call with the customer that the quantity of 1 was correct.

Table 4-4 summarizes the quantity adjustments that we made to the six projects.

Table 4-4. Summary of Adjusted Projects

Sample Project #	Measure	Unit of Measure	Quantity		
			Database	Desk Review	Site Visit
#1	Holding Cabinet Full Size Insulated	Cabinet	1,500	1	N/A[A]
#2	Variable Speed Drive Air Compressors	Horsepower	216	200	N/A
#3	Variable Speed Drive Air Compressors	Horsepower	232	200	N/A
#4	LED Lamps	Lamps	1,344	1,344	1,171
#5	T12HO 8ft 2 lamp retrofit	Fixtures	55	55	38
#6	LED Lamps	Lamps	396	396	257
#7–#145	Various	Various	All quantities verified		

[A] Project was not selected for a site visit, but we confirmed via a call with the customer that the desk review quantity (1) was correct.

The quantity adjustments for the six projects resulted in adjustments to lighting, food service products, and process equipment technologies, as shown in Table 4-5. We did not make any adjustments to the other technologies because we did not find any discrepancies in our sample for those technologies. We achieved relative precision of ±2% for lighting projects, ±14% for food service products, and ±1% for process equipment, and ±0% for all other technologies at the 90% confidence level.

Table 4-5. Quantity Adjustments

Technology	DEC Quantity Adjustments			DEP Quantity Adjustments		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	99%	99%	97%	99%	99%	97%
Pumps and Drives	100%	100%	100%	N/A	N/A	N/A
HVAC	100%	100%	100%	100%	100%	100%
Food Service Products	50%	34%	33%	50%	34%	33%
Information Technology	100%	100%	100%	N/A	N/A	N/A
Process Equipment	98%	99%	99%	N/A	N/A	N/A
EEB - Lighting	N/A	N/A	N/A	100%	100%	100%
EEB - HVAC	N/A	N/A	N/A	100%	100%	100%
Totals	**97%**	**96%**	**92%**	**98%**	**98%**	**96%**

4.2.2 Deemed Savings Adjustment

The deemed savings review resulted in modifications to per-unit savings assumptions for lighting, HVAC, food service, and information technology equipment. No adjustments were made for pumps and drives or process equipment. The deemed savings review resulted in the following adjustments:

- Lighting
  - Incorporated measure-specific annual operating hours, which generally increased lighting energy savings.[10]
  - Updated pre- and post-wattages, coincidence factors, and waste heat factors, as applicable, based on more recent and more relevant studies, which resulted in slight increases and decreases to savings that mostly cancelled each another out.
  - Estimated winter demand savings for four measure types (LED High Bay, High Bay Fluorescent, LED Panel, and LED Tube), which were not included in ex ante per-unit savings assumptions. This significantly increased winter demand savings.
- HVAC
  - Developed a new savings methodology for chillers to be consistent with several TRMs, which resulted in slight increases to energy savings and decreases to summer demand savings.
  - Removed winter demand savings for chillers as chillers would not typically operate during winter months, resulting in a decrease to winter demand savings.
- Food Service Products
  - Revised the savings methodology for Holding Cabinets to reflect the latest ENERGY STAR® Calculator assumptions. This resulted in a reduction of nearly 50% in energy savings, as well as summer and winter demand savings.
- Information Technology
  - Used three separate methods for ex post savings to develop an average savings for server virtualization, which resulted in minor adjustments to ex ante savings.

Table 4-6 summarizes the results of the deemed savings review, by technology. The full, measure-level deemed savings review, including the supporting spreadsheet, can be found in the Appendix.

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[10] Ex post lighting hours of use reflect average annual operating hours, based on the program tracking database (a lighting metering study was outside the scope of this evaluation; however, a lighting metering study is planned for the next evaluation cycle.). Ex ante values were based on a combination of previous studies, night-time hours (for exterior lighting), and other unsourced assumptions.

Table 4-6. Deemed Savings Adjustments

Technology	DEC Deemed Savings Adjustments			DEP Deemed Savings Adjustments		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Lighting	108%	108%	315%	117%	105%	194%
Pumps and Drives	100%	100%	100%	N/A	N/A	N/A
HVAC	104%	83%	81%	100%	100%	100%
Food Service Products	72%	65%	64%	100%	100%	100%
Information Technology	100%	101%	92%	N/A	N/A	N/A
Process Equipment	100%	100%	100%	N/A	N/A	N/A
EEB - Lighting	N/A	N/A	N/A	100%	100%	100%
EEB - HVAC	N/A	N/A	N/A	100%	100%	100%
Totals	**106%**	**105%**	**263%**	**114%**	**105%**	**181%**

5. Net-to-Gross Analysis

5.1 Methodology

Our net-to-gross (NTG) analysis includes consideration of free-ridership (FR), participant spillover (PSO), and trade ally spillover (TA SO). FR and PSO are based on the participant telephone survey, while TA SO is based on the online trade ally survey. The net-to-gross ratio (NTGR) is calculated as follows:

$$NTGR = 1 - FR + PSO + TA\ SO$$

5.1.1 Free-Ridership

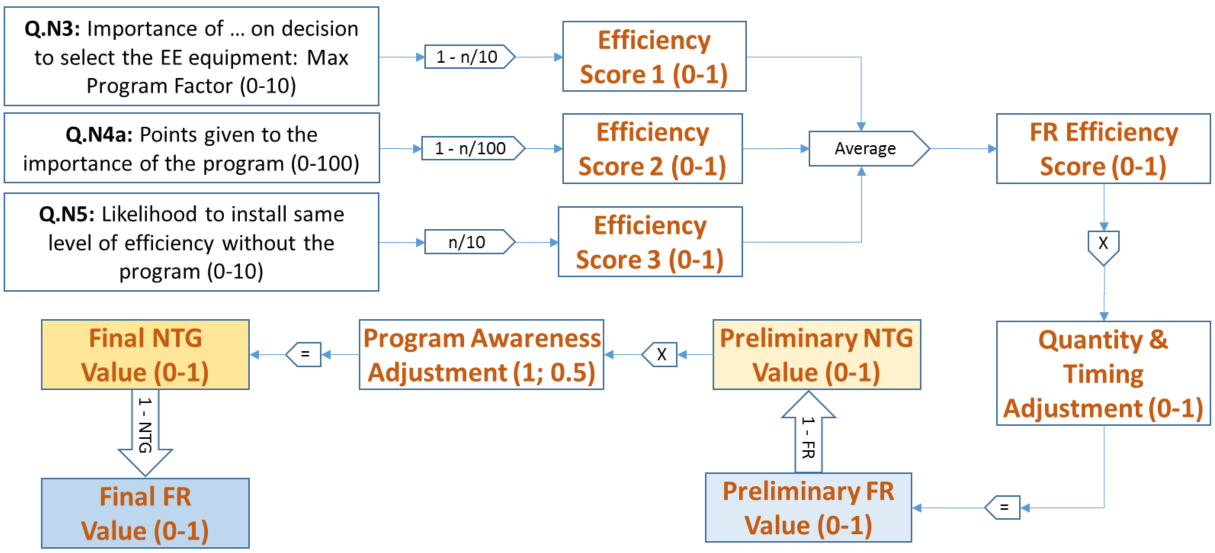
Free-riders are program participants who would have completed the same energy efficiency upgrade without the program. FR scores represent the percentage of savings that would have been achieved in the absence of the program. FR scores can range from 0% (not a free-rider, i.e., the participant *would not* have completed the project without the program) to 100% (a full free-rider, i.e., the participant *would* have completed the project without the program). FR scores between 0% and 100% represent partial free-riders, i.e., participants who were to some degree influenced by the program to complete the energy efficiency upgrade.

FR survey questions focus on the importance of various program factors[11] on the decision to install energy-efficient equipment, as well as on the likelihood of making the same upgrades in the absence of the program (the counterfactual). These questions are used to determine program influence on levels of efficiency and on measure quantity (where applicable) and project timing. We developed three measurements of program influence on levels of efficiency and used consistency checks in cases where inconsistent responses were given. Responses about measure quantity and project timing are used to adjust the efficiency-based FR rate, allowing the program to receive credit in cases where the program influenced project size and timing rather than, or in addition to, the level of efficiency. A second adjustment, the Program Awareness Adjustment, is applied in cases where participants reported having learned about the program *after* they selected the equipment for which they received an incentive. This adjustment, if applied, reduces a respondent's program attribution (1 – FR) by 50%.

Figure 5-1 presents a diagram of the FR algorithm used for this evaluation, including references to question numbers. A more detailed description of the algorithm can be found in the Appendix.

[11] Program factors asked about in the survey include program incentive, previous experience with the program, recommendation from a Duke Energy representative, information from the Non-Residential Prescriptive Program/program marketing materials, previous experience with the equipment (if through prior participation in a Duke Energy program), expected savings (if they found out about them from a Duke Energy representative), and financial criteria (if the incentive moved the project within the acceptable range).

Figure 5-1. Overview of Free-Ridership Algorithm



We developed separate FR estimates for the four analysis groups: DEC lighting, DEC non-lighting, DEP lighting, and DEP non-lighting. We explored the possibility of developing separate FR estimates for the various non-lighting technologies (i.e., HVAC; process equipment; pumps and drives; food service products; and information technology). However, due to the small number of unique customers who completed non-lighting projects, we did not obtain enough responses to develop statistically valid FR estimates at the technology level.

We developed FR estimates for each of the four analysis groups and for the two jurisdictions as follows:

- We first aggregated FR estimates to the stratum level, weighting the sampled projects within each stratum by their ex post gross savings. For the DEC and DEP non-lighting groups, we combined the strata for large and medium projects, due to a relatively low number of responses.
- For each analysis group, we developed a FR value by applying ex post savings weights to reflect the relative contribution of each stratum to the group's overall savings.
- For both jurisdictions, we developed a FR value by applying ex post savings weights to reflect the relative contribution of the two technologies (lighting and non-lighting) to the jurisdiction's overall savings.

5.1.2 Participant Spillover

PSO refers to additional energy efficiency upgrades participants made after their participation in the Non-Residential Prescriptive Program that were influenced by the program but for which they did not receive a program incentive. PSO was estimated across both jurisdictions and is expressed as a percentage of program savings.

To determine if a survey respondent is eligible for SO savings, we asked a series of questions about additional energy efficiency installations that they made without receiving an incentive and the degree to which the program influenced their decision to install the efficient equipment. The survey included two program influence questions:

SP2a. On a scale of 0-10, where 0 means “no influence” and 10 means “greatly influenced,” how much did your experience with the <PROGRAM> influence your decision to install high-efficiency equipment on your own?

SP2b. If you had NOT participated in the <PROGRAM>, how likely is it that <COMPANY> would still have installed this additional energy-efficient equipment? Please use a 0–10 scale, where 0 means you “definitely WOULD NOT have implemented this equipment” and 10 means you “definitely WOULD have implemented this equipment.”

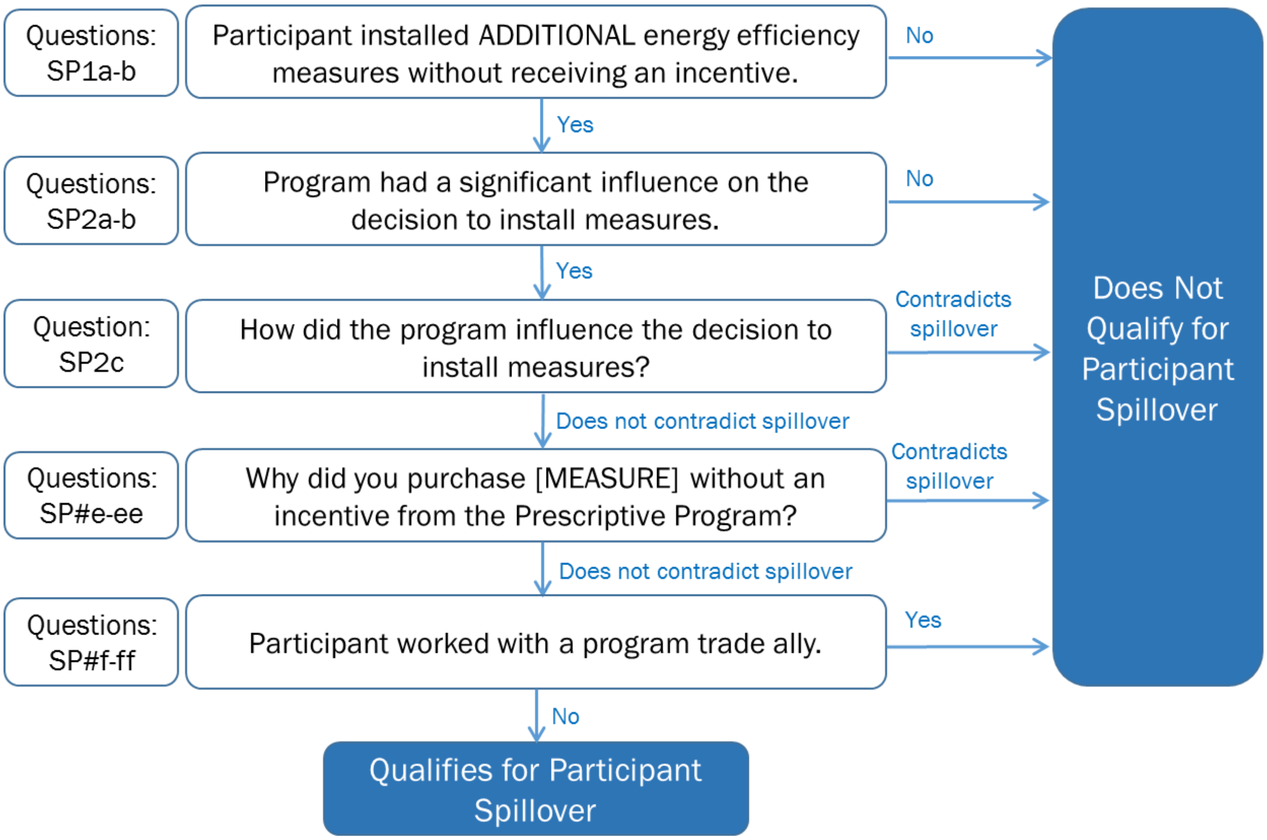
To supplement these numeric responses, we asked open-ended questions about how the program influenced the decision to make the energy efficiency installations and why the participant made the installations without a program incentive. A respondent’s additional energy efficiency installations were deemed eligible for SO if two conditions were met: the Program Influence Factor (see below) was greater than 7.0 and the open-ended responses did not contradict that the installations were eligible for SO. The Program Influence Factor is defined as follows:

$$Program\ Influence\ Factor = (SP2a\ Response + (10 - SP2b\ Response)) \div 2$$

In addition, we applied a third SO eligibility condition: that the participant did *not* work with a participating trade ally. This condition was necessary because this evaluation also estimated TA SO. When estimating SO from multiple sources, it is important to avoid double-counting. In the case of this evaluation, double-counting could occur if participants and trade allies report SO installations from the same projects. We avoided such double-counting by determining if the participant’s SO project was completed by a trade ally who was in the sample frame for the TA SO survey (i.e., they completed at least one project through the Non-Residential Prescriptive Program during the evaluation period). If so, the SO reported by the participant was excluded from the PSO estimate as it will be captured through the TA SO analysis (see next section).

Figure 5-2 presents a diagram of the PSO eligibility determination used for this evaluation, including references to question numbers.

Figure 5-2. Participant Eligibility for Spillover – Methodology



Participants with SO from lighting measures were asked a few additional survey questions about their installations, including the type and number of light bulbs installed and replaced, and whether they were installed in a conditioned space. We limited these follow-up survey questions to lighting measures since lighting is the most common PSO technology. We also conducted follow-up calls to collect more information for all SO measures, such as baseline and efficient wattages, ages of equipment, and hours of use. We then used methods consistent with the deemed savings review and appropriate TRMs to develop SO savings for each measure.

The PSO Rate is calculated using the following formula:

$$PSO\ Rate = \frac{SO\ for\ each\ Measure\ in\ Sample}{Ex\ Post\ Gross\ Impacts\ in\ Sample}$$

5.1.3 Trade Ally Spillover

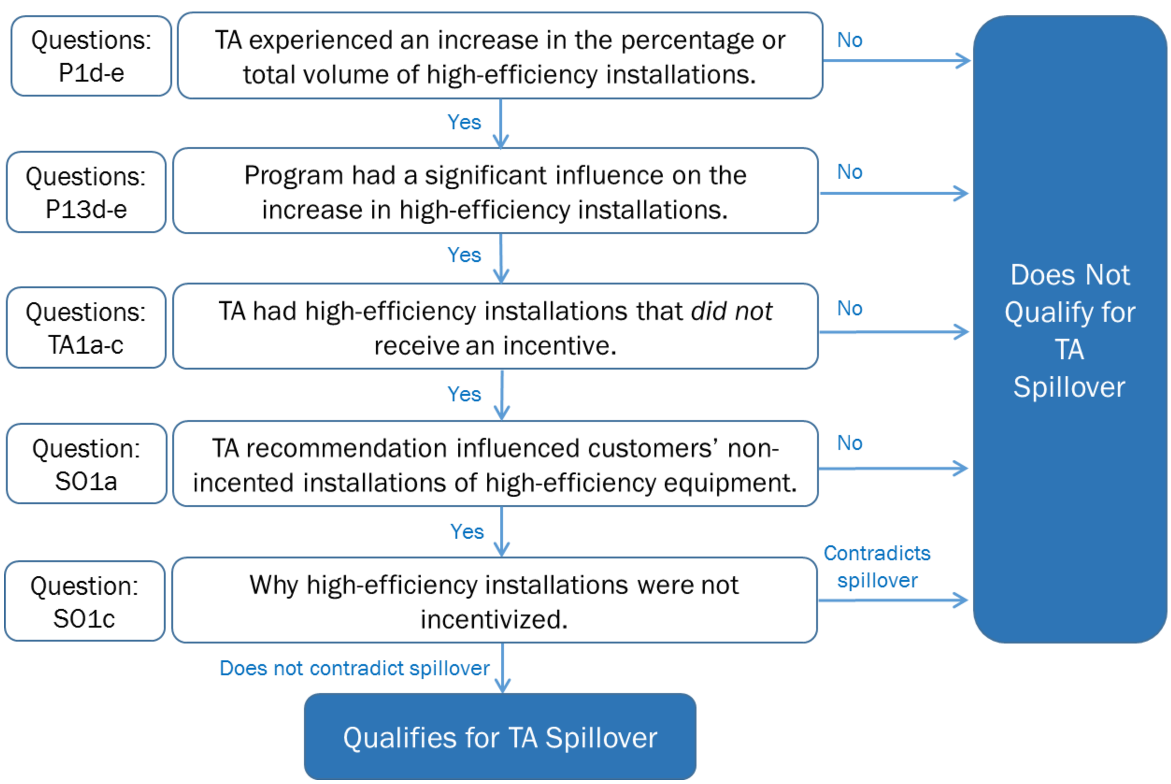
TA SO refers to non-incented energy efficiency upgrades made by customers who were influenced by a participating trade ally who was in turn influenced by the Non-Residential Prescriptive Program. TA SO was estimated across both jurisdictions and is expressed as a percentage of program savings. This section presents a high-level overview of the TA SO methodology. A more detailed description of the methodology can be found in the Appendix.

To determine if a trade ally is eligible for SO savings, the online survey asked a series of SO-related questions. We considered a trade ally eligible for SO if the following conditions were met:

- Since working with the Non-Residential Prescriptive Program, either the trade ally's percentage of high-efficiency installations increased or the trade ally's total volume of high-efficiency installations increased.
- The trade ally rated the importance of the Non-Residential Prescriptive Program on at least one of these increases an 8, 9, or 10 (on a scale of 0 to 10).
- The trade ally reported having installed high-efficiency equipment without an incentive from the Non-Residential Prescriptive Program during the evaluation period.
- The trade ally gave a rating of 8, 9, or 10 (on a scale of 0 to 10) for the importance of their recommendation on installations of high-efficiency equipment that *did not* receive an incentive from the Non-Residential Prescriptive Program.
- The trade ally's open-ended response about why customers with high-efficiency installations did not receive an incentive from the program did not contradict that non-incented, high-efficiency installations qualified as SO.

Figure 5-3 presents a diagram of the TA SO eligibility determination used for this evaluation, including references to question numbers.

Figure 5-3. Trade Ally Eligibility for Spillover – Methodology



For each respondent that met these qualifying conditions, we determined SO savings from the non-incented, high-efficiency installations through:

- Survey questions about:
  - The respective shares of the TA's total high-efficiency installations that did and did not receive a program incentive
  - The size of non-incented, high-efficiency installations relative to those that did receive an incentive (resulting in a "Size Adjustment" factor)
- Program tracking data on the savings associated with the Non-Residential Prescriptive Program projects for that respondent

For the trade allies who met the five qualifying conditions listed above, SO savings were considered to be equal to the savings of their non-incented, high-efficiency installations. SO for each qualifying trade ally is calculated using the following steps:

1. We first determined overall (unadjusted) savings from all energy efficient installations (incented and non-incented) made by the trade ally during the evaluation period. This is estimated by dividing the savings in the program tracking database (reflecting incented savings) by the percentage of the trade ally's efficient installations that received an incentive. It is calculated as:

   kWh Savings from All TA installations =

   Savings from Program Database / % Efficient Installations That Received Incentive

2. We then subtracted from that overall savings estimate the savings already tracked in the database. The resulting value represents savings from energy efficient installations that did not receive an incentive, assuming that non-incented projects have the same size as incented ones.
3. In the final step, we apply a size adjustment to reflect that non-incented projects might be of a different size (often smaller) compared to incented projects.

The overall equation for estimating respondent-level TA SO is:

$$\text{TA SO Savings (kWh)} = \left(\frac{\textit{Savings from Program Database}}{\begin{matrix}\textit{\% Efficient Installations} \\ \textit{That Received Incentive}\end{matrix}} - \begin{matrix}\textit{Savings from} \\ \textit{Program Database}\end{matrix} \right) * \textit{Size Adjustment}$$

To extrapolate savings to the program, we developed a Respondent SO Ratio by dividing the sum of the estimated SO savings by total program savings associated with all survey respondents. We then applied this Respondent SO Ratio to program savings associated with all trade allies (whether a survey respondent or not) to derive the overall SO estimate (in MWh).[12] Finally, we estimated the Program-level SO Ratio by dividing the overall SO estimate (in MWh) by total program ex post savings (in MWh). This final step is necessary to normalize the SO rate to the entire Non-Residential Prescriptive Program, taking into account that some customers complete projects without a trade ally.

[12] We excluded one respondent trade ally from this SO extrapolation method due to a SO ratio that we do not consider representative of non-responding trade allies. The TA SO results section (Section 5.2.3) and the Appendix provide more detail on this analysis.

5.2 NTG Results

We estimate the program-level NTGR to be 78.7% for DEC and 85.8% for DEP. For both jurisdictions, the lighting NTGR is higher (81.0% DEC; 86.4% DEP) compared to the non-lighting NTGR (59.3% DEC; 67.9% DEP).

Table 5-1 presents the individual NTG components (i.e., FR, PSO, and TA SO) and the resulting NTGRs by technology group (i.e., lighting and non-lighting) and jurisdiction. The NTGR is calculated as 1 – FR + PSO + TA SO.

Table 5-1. Summary of DEC and DEP NTG Results

Technology	FR	PSO	TA SO	NTGR*
DEC				
Lighting	26.3%	0.06%	7.2%	81.0%
Non-Lighting	48.0%			59.3%
DEC Total	**28.5%**	**0.06%**	**7.2%**	**78.7%**
DEP				
Lighting	20.8%	0.06%	7.2%	86.4%
Non-Lighting	39.4%			67.9%
DEP Total	**21.4%**	**0.06%**	**7.2%**	**85.8%**

[A]NTGR = 1 – FR + PSO + TA SO

5.2.1 Free-Ridership

A total of 217 total participants provided valid responses to the FR questions in the participant survey and were included in the FR analysis.[13] Of these respondents, 71 represented DEC lighting projects, 55 DEC non-lighting, 69 DEP lighting, and 22 DEP non-lighting. Using the algorithm summarized in Section 5.1.1 above, we estimate program-level FR to be 29% for DEC and 21% for DEP. In both DEC and DEP territories, FR levels are higher for non-lighting projects (48% DEC; 39% DEP) than for lighting projects (26% DEC; 21% DEP).[14]

Participants' free-ridership related survey responses show the following:

- **Efficiency:** Participants generally reported a high degree of program influence on the efficiency level of their projects, resulting in savings-weighted Efficiency FR Scores of 0.31 for DEC and 0.25 for DEP. Key findings for the three efficiency sub-scores include:
  - Most participants provided an importance rating of 10 (on a scale of 0 to 10, where 10 means "very important") for at least one program component, most often the incentive.
  - When asked to divide 100 points to reflect the importance of the program versus other factors, DEC and DEP participants allocated a savings-weighted average of 63 and 72 points, respectively, to the program.

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[13] Two survey respondents were excluded from the FR analysis due to incomplete responses to key FR questions and another two were excluded because they were "EEB lighting" projects with unconfirmed technologies.

[14] The relative precision, at 90% confidence, for these estimates (based on 1 – FR) is: DEC Total: 6.1%, DEP Total: 5.9%, DEC Lighting: 6.5%, DEP Lighting: 6.1%, DEC Non-Lighting: 15.9%, DEP Non-Lighting: 12.4%.

  - The average likelihood of participants to have selected the same level of efficiency without the program was 5.2 for DEC and 4.2 for DEP.

- **Quantity:** The program had a significant influence on the scope of many incented projects, with participants reporting that 52% of the efficient measures in DEC and 64% of the efficient measures in DEP would not have been installed at the same time without the program. Notably, the share of non-lighting measures that would not have been installed at the same time without the program (8% DEC; 25% DEP) is much smaller than the share of lighting measures (57% DEC; 65% DEP), suggesting that customers have more flexibility in the scope of lighting projects and that the program was successful in encouraging them to make additional upgrades.

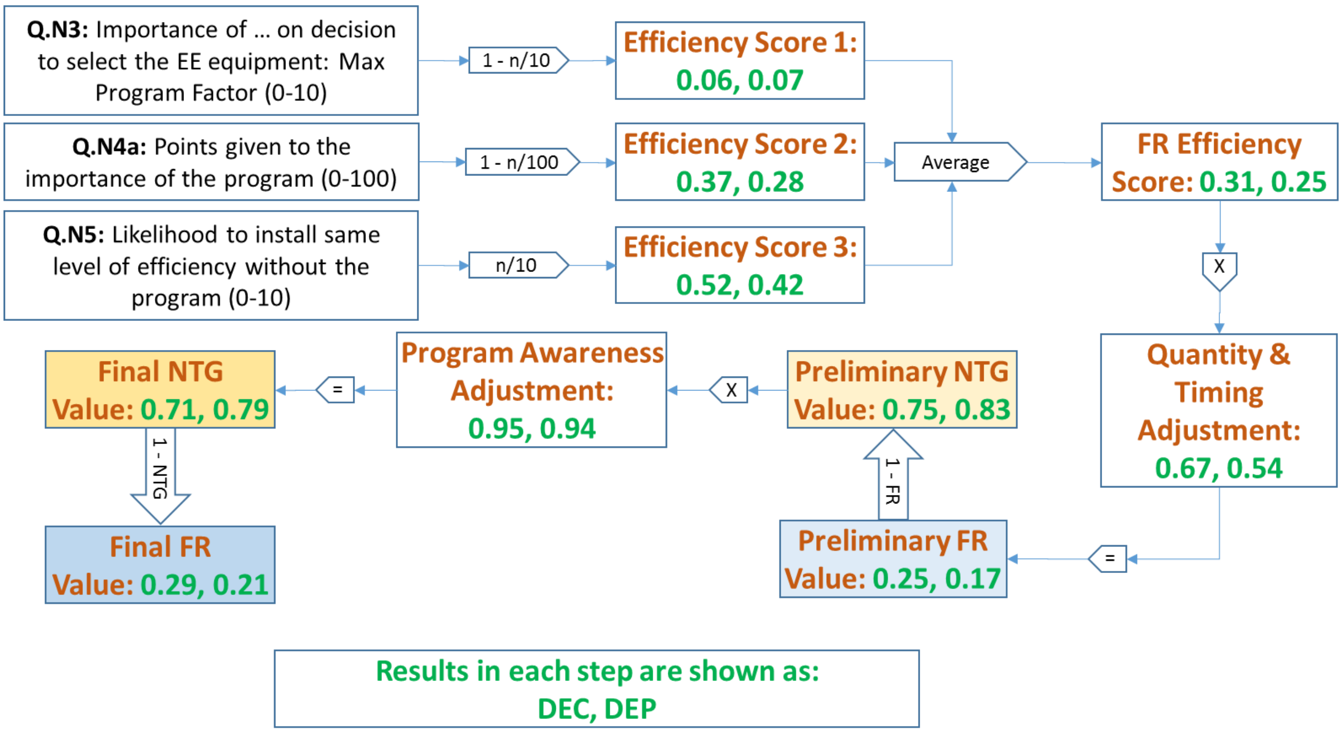
- **Timing:** Responses to the timing questions show trends similar to the quantity questions: Participants reported that the program was responsible for a greater acceleration of DEP projects and of lighting projects. The resulting timing adjustment factors, applied to the quantity that participants would not have installed at the same time without the program, are 0.41 and 0.55 for DEP and DEC lighting projects, respectively, and 0.79 and 0.96 for DEP and DEC non-lighting projects, respectively.

- **Quantity and Timing Adjustment:** Combining the responses to the quantity and timing questions resulted in an overall Quantity and Timing Adjustment of 0.67 for DEC and 0.54 for DEP, meaning that the program can claim credit for one-third (1 − 0.67 = 0.33) to almost one half (1 – 0.54 = 0.46) of savings that would be considered free-rider savings based on efficiency alone.

- **Program Awareness:** Few participants reported having learned about the program *after* they selected the equipment for which they received an incentive. For these participants, we reduced the Preliminary NTGR by 50%, resulting in a program-level adjustment of 0.95 for DEC and 0.94 for DEP.

Figure 5-4 summarizes the program-level results of the FR analysis, by jurisdiction, using the same diagram as in Figure 5-1.

Figure 5-4. Program-Level Free-Ridership Results

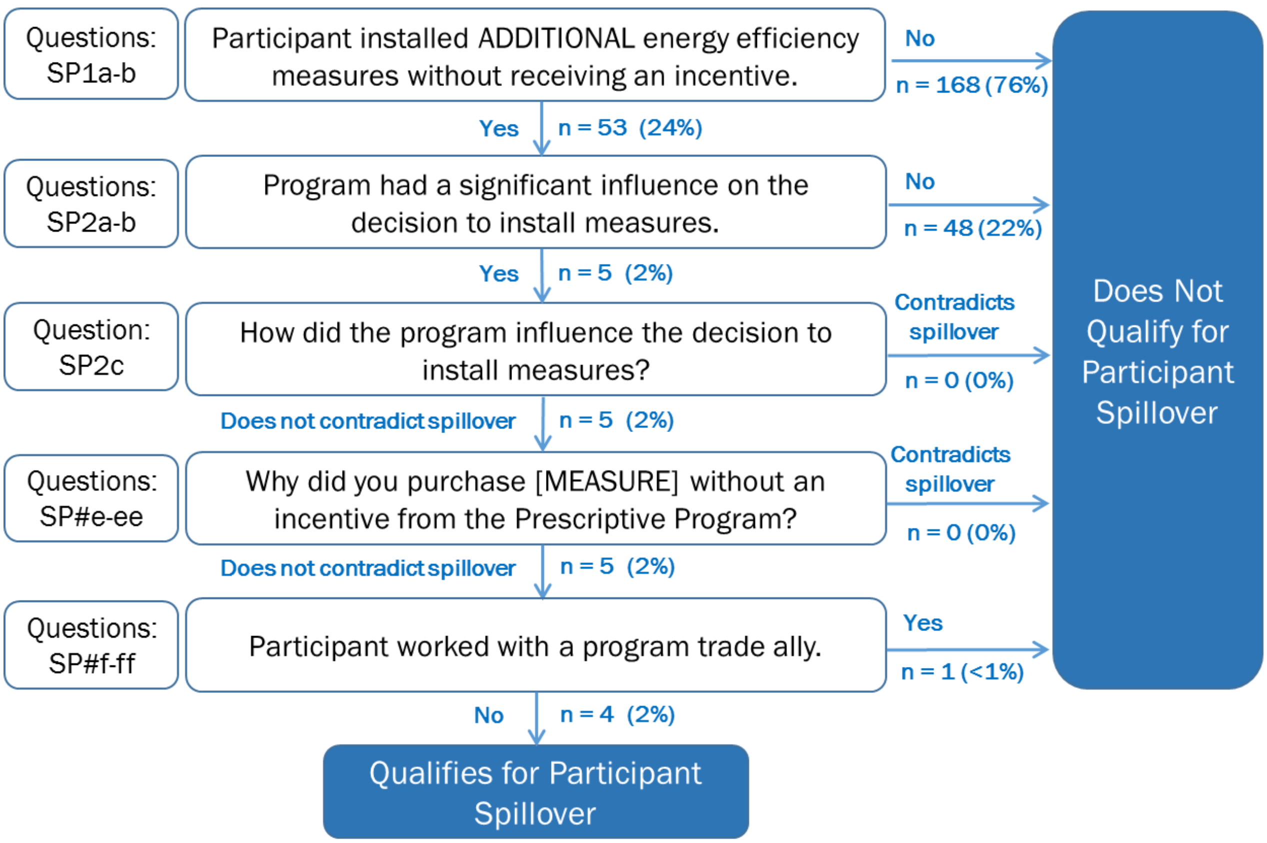


5.2.2 Participant Spillover

A total of 221 participants completed the SO questions in the participant survey and were included in the PSO analysis. The majority of these participants did not install any additional energy efficiency measures without receiving an incentive (76%) or did install additional measures but were not influenced by the program (22%). Of the five responding participants (2%) who installed additional measures and were influenced by the program, one worked with a program trade ally and four (2% of all responding participants) qualified for SO.

Figure 5-5 summarizes the analysis of PSO eligibility, using the same diagram as in Figure 5-2.

Figure 5-5. Participant Eligibility for Spillover – Results



We called the four respondents who qualified for PSO to get more-detailed information on their SO installations. The installed spillover measures included 55 lighting controls and 4 T8 lighting fixtures. One participant also installed a "Big Ass Fans" brand ceiling fan, for which we were could not estimate SO savings because we were unable to contact this participant for additional information.[15] Table 5-2 summarizes the results of the measure-level SO analysis.

Table 5-2. Summary of Measure-Level Participant Spillover

	Measure	Quantity	Analysis Approach	kWh Savings	
				Per unit	Total
#1	Lighting Controls	40	Illinois TRM v6.0 methodology, supplemented with customer-specific inputs.	135.3	5,410
#2	Lighting Controls	15		281.4	4,221
#3	T8 Lighting Fixtures	4		415.8	1,663
#4	Big Ass Fan	Unknown	n/a	Unable to estimate	
				Total	11.294

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[15] In order to calculate SO savings for this fan installation we would need to know the number of fans installed, the size of the building, and if the building is air conditioned.

To determine the program-level SO rate, we divided the SO savings estimated for the survey respondents by the total ex post gross savings of the sampled projects completed by the 221 survey respondents, yielding a rate of 0.06%.

$$\text{PSO Rate} = \frac{\text{SO for each Measure in Sample}}{\text{Ex Post Gross Impacts in Sample}} = \frac{11{,}294 \text{ kWh}}{19{,}310{,}953 \text{ kWh}} = 0.06\%$$

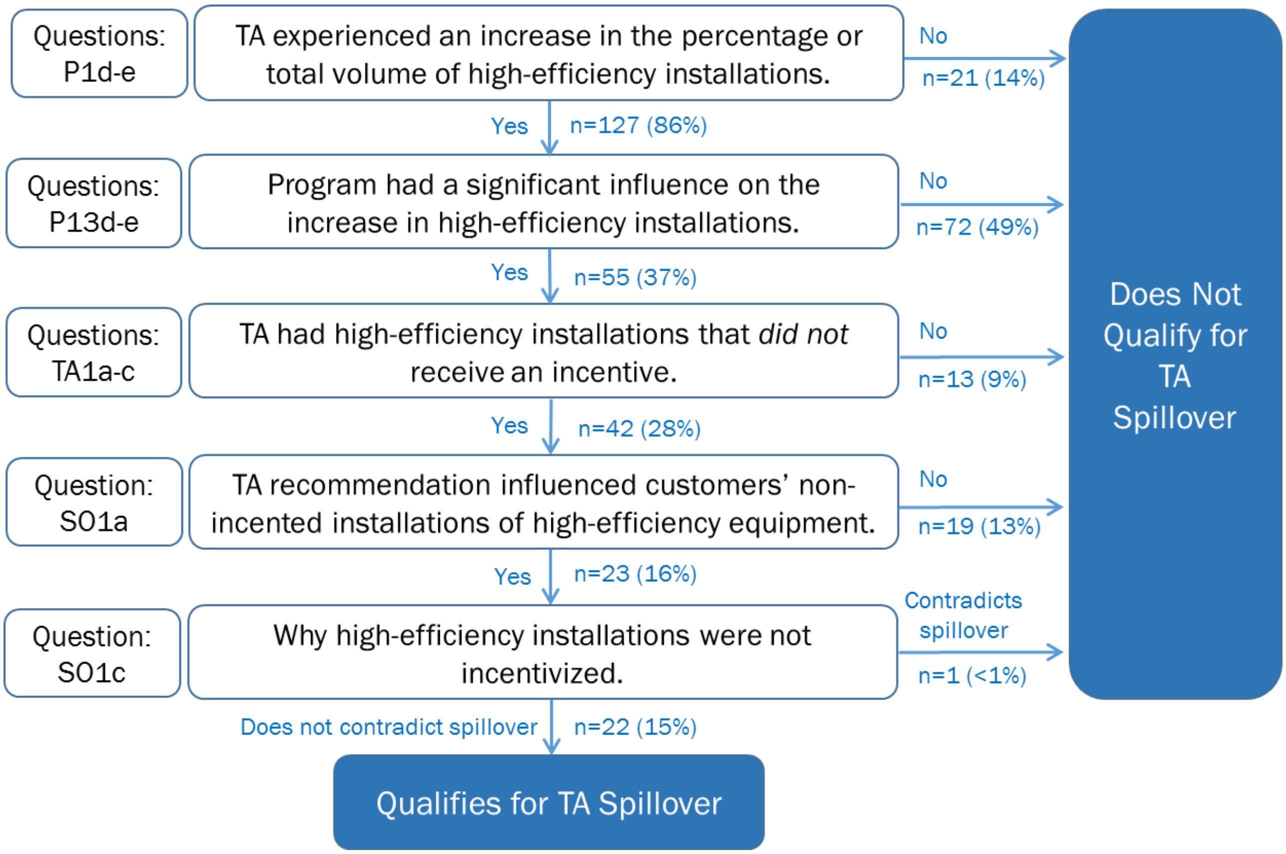
5.2.3 Trade Ally Spillover

A total of 148 trade allies completed the spillover section of the online survey. The majority of responding trade allies reported increases in either the percentage or the total volume of their high efficiency installations (86%), and close to half of these (43%) attribute these increases to the program. Trade allies commonly credit the available program incentive—and the resulting shorter payback or increased return-on-investment (ROI) for their customers—with the increases in energy-efficient installations. Trade allies also noted a range of other, non-program, factors that have contributed to the increase in their high-efficiency sales over time, including decreasing material costs, increased customer knowledge and awareness of high-efficiency measures (especially around LED measures), and state-based energy code requirements.

Most trade allies (78%) report having had at least one high-efficiency project that did not receive a program incentive during the evaluation period. On average, trade allies reported that 16% of their installations during the evaluation period were standard efficiency, while 65% were high efficiency and received an incentive, and 20% were high efficiency and did not receive an incentive. On average, non-incented, high-efficiency installations are smaller in size, about 62%, compared to projects that receive an incentive from the Non-Residential Prescriptive Program.

Overall, 15% of responding TAs qualified for SO. Those that did not qualify experienced no increase in their energy-efficient installations (14%), were not influenced by the program (49%), did not have any non-incented, high-efficiency installations (9%), or did not think that their recommendations influenced their customers' choice of non-incented, high-efficiency equipment (13%). Figure 5-6 summarizes these SO eligibility results.

Figure 5-6. Trade Ally Eligibility for Spillover



Trade allies who qualify for SO most often indicate that the high-efficiency installations were completed without an incentive because of the project's timing (i.e., customer could or would not complete paperwork), because the customer was opted-out of the program, because the customer was interested in high-efficiency measures not covered by the program, and/or due to the incentive level.

We estimated SO savings for each of the trade allies who qualify for SO (22 respondents, or 15%) using (1) the trade ally's program savings from the program tracking database and (2) their survey responses on the share of high-efficiency installations that received a program incentive and on the relative size of incented and non-incented projects (see the formula in Section 5.1.3). These respondent-level SO savings ranged from 431 kWh to 11,076,762 kWh.

Table 5-3 summarizes the results of the respondent-level TA SO savings.

Table 5-3. Summary of Respondent-Level Trade Ally Spillover

Trade Ally	Number of Non-Residential Projects	Percent of Energy Efficient Installations that Did Not Receive an Incentive	Estimated Spillover Savings (kWh)
#1	125	20%	624,511
#2	2	88%	442,989
#3	32	95%	427,447
#4	35	28%	408,591
#5	6	67%	316,297
#6	46	26%	234,654
#7	7	33%	178,163
#8	36	10%	44,879
#9	10	25%	37,482
#10	6	25%	19,631
#11	9	20%	16,800
#12	28	15%	15,446
#13	22	10%	12,248
#14	7	6%	8,723
#15	3	10%	5,308
#16	1	37%	3,707
#17	74	5%	3,455
#18	6	30%	3,178
#19	65	1%	2,970
#20	1	37%	878
#21	1	10%	431
Subtotal			**2,807,787**
#22	149	83%	11,076,762

Of the 22 trade allies who qualified for spillover, the spillover savings from 21 (accounting for 2,808 MWh) were used to extrapolate spillover savings to the population.[16] Following the analytical steps outlined in the Appendix, we estimated a Respondent SO Rate (excluding Trade Ally #22) of 4.6% and a Program TA SO Rate (again excluding Trade Ally #22) of 4.1%. Adding the SO savings of Trade Ally #22 increases the overall Program TA SO Rate to 7.2%, our final estimate of the program's TA SO.

5.3 Net Impact Results

Table 5-4 and Table 5-5 present the ex post net impacts for the DEC and DEP Non-Residential Prescriptive Program, respectively, that result from applying the evaluation NTGRs to ex post gross savings. Note that for the midstream channel and the online store, we apply a default NTGR of 1.0 since we did not conduct NTGR research for these two program delivery channels.

[16] We excluded Trade Ally #22 from this SO extrapolation method due to a SO ratio that we do not consider representative of non-responding trade allies. The Appendix provides more detail on this analysis.

The DEC program realized net savings of approximately 287 GWh during the evaluation period. The main channel contributed 212 GWh to this total while the midstream channel contributed 65 GWh and the online store contributed 10 GWh. The largest share of net savings came from lighting projects, with 92% of the main channel net savings and 68% of total DEC net savings.

Table 5-4. Summary of DEC Net Program Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	268,914,950	44,373	42,064		211,751,454	35,026	33,382
Lighting	*240,987,942*	*40,161*	*38,891*	*0.81*	*195,187,673*	*32,528*	*31,500*
Pumps and Drives	*10,267,207*	*1,481*	*1,598*	*0.59*	*6,089,581*	*878*	*948*
HVAC	*7,869,879*	*1,840*	*656*	*0.59*	*4,667,702*	*1,091*	*389*
Food Service Products	*4,889,807*	*439*	*418*	*0.59*	*2,900,193*	*260*	*248*
Information Technology	*3,322,377*	*146*	*195*	*0.59*	*1,970,534*	*87*	*116*
Process Equipment	*1,577,738*	*306*	*306*	*0.59*	*935,772*	*181*	*181*
Midstream Channel	*65,238,691*	11,731	11,376	1.00	*65,238,691*	11,731	11,376
Online Store	*9,591,131*	1,893	1,864	1.00	*9,591,131*	1,893	1,864
DEC TOTAL	343,744,772	57,997	55,304		286,581,276	48,651	46,622

The DEP program realized net savings of approximately 73 GWh during the evaluation period. The main channel contributed 67 GWh to this total while the midstream channel contributed 6 GWh and the online store contributed less than 0.1 GWh. Similar to DEC, the largest share of net savings came from lighting projects, with 85% of the main channel net savings and 78% of total DEP net savings.

Table 5-5. Summary of DEP Net Program Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	77,664,493	11,581	10,936		66,708,433	9,933	9,399
Lighting	*65,966,238*	*10,398*	*10,053*	*0.86*	*57,025,896*	*8,989*	*8,691*
HVAC	*1,485,524*	*366*	*239*	*0.68*	*1,008,938*	*248*	*162*
Food Service Products	*807,334*	*54*	*53*	*0.68*	*548,325*	*36*	*36*
EEB - Lighting	*9,376,146*	*760*	*589*	*0.86*	*8,105,406*	*657*	*509*
EEB - HVAC	*29,252*	*4*	*1*	*0.68*	*19,867*	*3*	*1*
Midstream Channel	*6,227,819*	1,026	987	1.00	*6,227,819*	1,026	987
Online Store	*43,549*	6	7	1.00	*43,549*	6	7
DEP TOTAL	83,935,861	12,614	11,930		72,979,800	10,966	10,393

6. Process Evaluation

6.1 Researchable Questions

The process evaluation focused on program processes, customer and trade ally satisfaction with the program, program strengths and weaknesses, barriers to participation from the customer and trade ally perspective, and opportunities for program improvement. Our research focused on areas of change, e.g., the introduction of BEAs to the Non-Residential Prescriptive Program, as well as areas of interest identified by program staff. We explored the following main topic areas:

- Barriers to program participation and how these barriers can be addressed
- Program strengths and opportunities for improvements
- Customer and trade ally satisfaction with program processes
- Effects of the Non-Residential Prescriptive Program on trade ally practices

Process-related research questions included:

- What are the sources of program information for participating customers?
- How effective are the program implementation and data-tracking practices?
- Are participants and trade allies satisfied with their program experiences?
- How effective has the addition of BEAs been in increasing program participation?
- What is the level of awareness and interest in the online store among program participants?
- What is the level of awareness and interest in the midstream channel among program participants and trade allies?
- What are the program's strengths and weaknesses and opportunities for program improvement?
- What are the key barriers to the installation of energy-efficient equipment and program participation?
- How likely are participants to participate again?
- How has the DEP transition from the Energy Efficiency for Business Program to the Non-Residential Prescriptive Program incentive structure gone?

6.2 Methodology

The process evaluation relied primarily on the program staff interviews, program materials review, BEA interviews, and our analysis of responses to the participant and trade ally surveys. Each of these activities is described in more detail in Section 3.

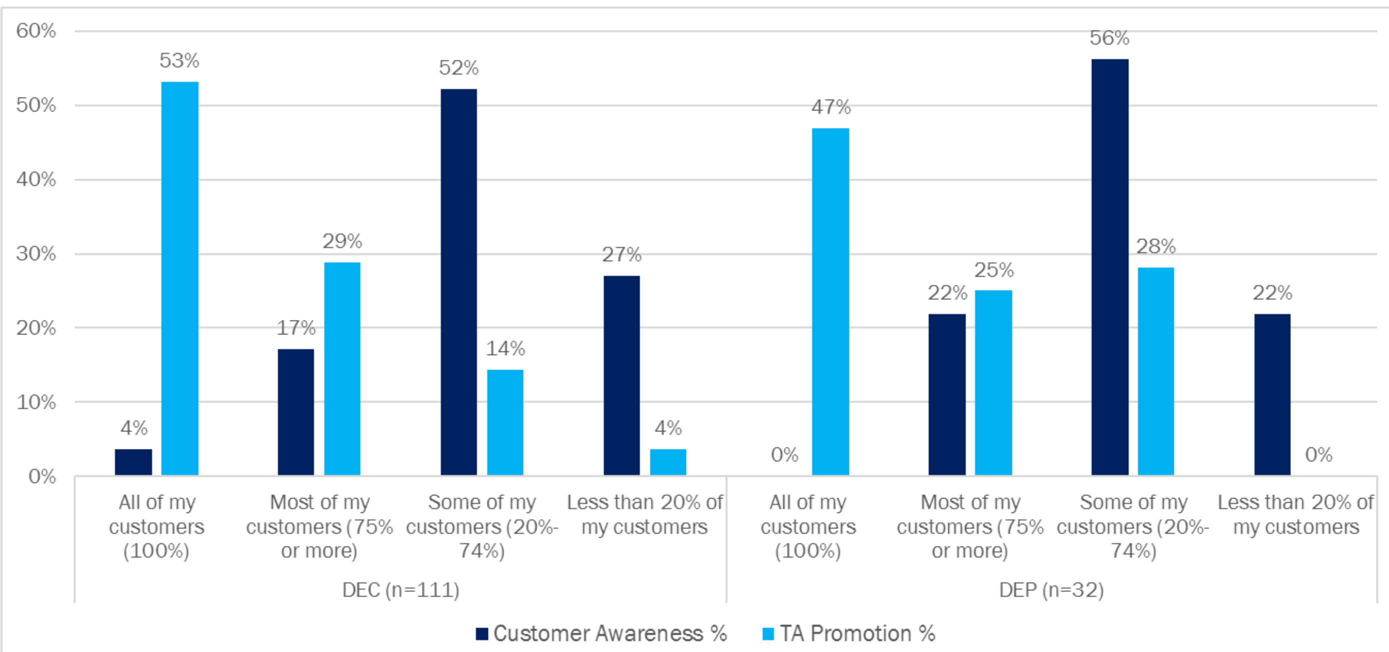
6.3 Key Findings

6.3.1 Customer Awareness and Sources of Program Information

The Non-Residential Prescriptive Program relies on Duke Energy staff—including program staff, BEAs, and Large Business Account Managers—and trade allies working together to drive customer awareness of and participation in the program. We explored customer awareness and sources of program information through the participant survey, the trade ally survey, and the BEA interviews.

We asked trade allies about the percentage of their customers who are already aware of the Non-Residential Prescriptive Program before they discuss it with them and about the percentage of their customers to whom they promote the program. Not surprisingly, we received diametrically opposed responses to these two questions. While few trade allies (4% DEC; 0% DEP) believe that all of their customers are already aware of the program, approximately half of the surveyed trade allies (53% DEC; 47% DEP) promote the program to all of their customers. The majority of trade allies (52% DEC; 56% DEP) reported that somewhere between 20% and 74% of their customers are aware of the Non-Residential Prescriptive Program before they discuss it with them.

Figure 6-1. Customer Awareness and Promotion of the Non-Residential Prescriptive Program, Trade Ally Perspective



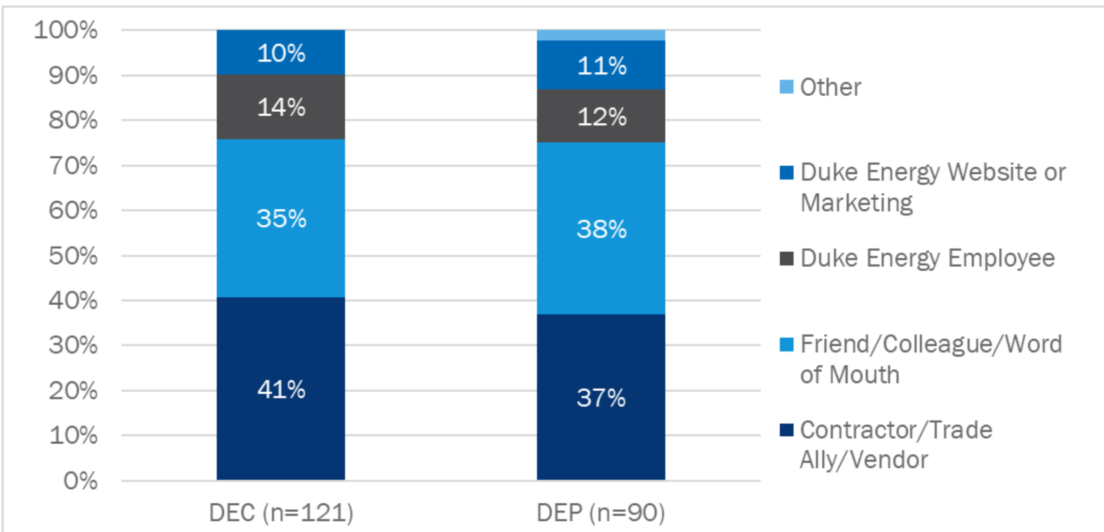
These results confirm that there is an awareness gap among Duke Energy business customers, and that trade allies play an important role in closing that gap. When asked about reasons for not promoting the program to all of their customers, trade allies mentioned several, including that the project needs to be completed quickly, that the customer is opted-out of the program, that the customer is not interested in high-efficiency equipment, that the desired high-efficiency equipment does not qualify for the program, and that the financial incentive is not high enough to justify participation.

Results from the participant survey confirm the important role that contractors and trade allies play in driving customer awareness of and participation in the program: Many participants (41% DEC; 37% DEP) first heard about the Non-Residential Prescriptive Program from a contractor or trade ally. Moreover, 87% of DEC participants and 85% of DEP participants worked with a contractor to select their energy-efficient equipment, and 73% in both jurisdictions worked with a contractor to install the incented equipment.

In addition to contractors and trade allies, word of mouth (35% DEC; 38% DEP) was a common source of awareness, suggesting that participants are generally satisfied with their experience and are recommending the program to others (see also discussion in Section 6.3.2 below). In contrast, direct outreach by Duke Energy—including Duke Energy staff, the program website, and program marketing materials—was the source of awareness for less than one-quarter of participants (24% DEC; 23% DEP).

Figure 6-2 summarizes these results.

Figure 6-2. Participant Sources of Program Information



6.3.2 Barriers to Energy Efficiency and Participation in Non-Residential Prescriptive Program

Understanding the barriers that customers face in installing energy-efficient equipment and participating in the Non-Residential Prescriptive Program is an important first step in increasing program participation. Therefore, our research explored these barriers with trade allies, participants, and BEAs.

Barriers to Installing Energy-Efficient Equipment

Not surprisingly, financial issues rank high in responses from both trade allies and participants when asked about general barriers to installing energy efficient equipment. Among participants, the higher cost of energy-efficient equipment is the number one barrier by both DEC (51%) and DEP (30%) participants. Relatedly, 5% of DEC participants and 10% of DEP participants mentioned access to financing or capital for energy improvements as a barrier. Few DEC and DEP participants consider uncertainty about the energy savings from improvements or lack of knowledge about energy-efficient options a barrier to undertaking energy efficiency projects. Notably, 23% of DEC participants and 33% of DEP participants see no barriers to energy efficiency.

Trade allies reported similar barriers faced by their customers, with the higher upfront cost mentioned by more than half of trade allies (56% DEC; 53% DEP). Fewer trade allies (14% DEC; 9% DEP) than participants believe there are no barriers to installing energy efficient equipment.

Table 6-1. Barriers to Installing Energy-Efficient Equipment

	DEC		DEP	
Barriers to Installing Energy-Efficient Equipment (Multiple Response)	**Trade Allies (n=111)**	**Participants (n=127)**	**Trade Allies (n=32)**	**Participants (n=94)**
No Barriers	14%	23%	9%	33%
Higher Cost of Energy-Efficient Equipment	56%	51%	53%	30%
Access to Financing or Capital for Energy Improvements	20%	5%	25%	10%
Uncertainty about the savings from Energy Efficient Improvements	2%	5%	3%	5%
Lack of Knowledge of Energy-Efficient Options	2%	1%	3%	5%

Barriers to Program Participation

Many participants (37% DEC; 45% DEP) and trade allies (53% DEC; 34% DEP) reported that they see no barriers to participating in the program. Among DEC respondents, 18% of trade allies and 10% of participants cited financial considerations—including the cost of the equipment, available budgets, and access to capital—as barriers to participation; among DEP respondents, 28% of trade allies and 8% of participants cited this barrier.

The paperwork and application process associated with participating in the Non-Residential Prescriptive Program were also commonly cited barriers to participation, mentioned by 12% (DEC) and 13% (DEP) of trade allies and 20% (DEC) and 9% (DEP) of participants. A less frequent, but still commonly cited barrier by both trade allies and participants is the incentive levels offered by the program.

Table 6-2 summarizes the most commonly mentioned barriers to program participation.

Table 6-2. Barriers to Participating in the Non-Residential Prescriptive Program

	DEC		DEP	
Barriers to Program Participation (Multiple Response)	**Trade Allies (n=111)**	**Participants (n=127)**	**Trade Allies (n=32)**	**Participants (n=94)**
No barriers	54%	37%	34%	45%
Financial reasons	18%	10%	28%	8%
Paperwork, application process, and time required to participate	12%	20%	13%	9%
Incentive levels	3%	8%	9%	8%

BEAs largely echoed the perspective of trade allies and participants with respect to barriers to participation in the Non-Residential Prescriptive Program. Interviewed DEC/DEP BEAs consider the application process and paperwork a barrier to participation, noting that small and medium-sized businesses in particular may not have sufficient staff resources to identify and complete a project through the program and that the time commitment for paperwork may be too high. Despite identifying this as a barrier, BEAs also think that the application process has been improved over time and that the program was making strides in this area.

BEAs also mentioned upfront costs and access to capital and financing as barriers to energy efficiency in general and to program participation, especially for small and medium-sized businesses. One BEA also noted that sometimes there is a barrier generated by competing messages in the market about technologies and programs offered by Duke and others. Duke Energy is promoting many programs and opportunities, while trade allies are also conducting their own marketing and promotion efforts for specific technologies. This can create confusion for customers.

The program's use of DesignLights Consortium (DLC)-listed lighting projects was also noted by the interviewed BEAs as a barrier to participation. Customers may see that a piece of lighting equipment is DLC-listed and think that it will be eligible for an incentive, without understanding that the program sets limits on how the equipment can be used. BEAs noted that this can be a frustration for customers.

Suggestions for Reducing Barriers to Program Participation

Trade allies, participants, and BEAs offered suggestions for overcoming barriers to program participation. We summarize these below.

- **Increase program support and guidance during the participation process.** 20 percent of DEC participants and 8% of DEP participants noted increased program support and guidance as ways to reduce the barriers that they face.
- **Increase program marketing and outreach.** While few participants and trade allies reported lack of program awareness as a barrier to participation, several nevertheless suggested that the program should increase and improve program marketing and communications. This was, in fact, the most common suggestion provided by DEP trade allies (22%). Suggested increased outreach could be in the form of mailed information as well as personal interaction between Duke Energy representatives and customers. One trade ally suggested that Duke Energy provide trade allies with funds (based on performance metrics) that can be used to actively advertise the program to their current and potential customers to increase awareness of the program and energy-efficient options.
- **Increase incentives for eligible measures.** Higher incentives—either for specific measures or across the board—was the most common recommendation for reducing barriers to program participation provided by DEC trade allies (11%). The same suggestion was provided by 6% of DEC participants and DEP trade allies and by 8% of DEC participants. While few trade allies and participants mentioned incentive levels as a primary barrier to program participation, more financial support from the program would address cost barriers, which trade allies consider the most important barrier. One interviewed BEA felt that the lighting incentives offered by the program were possibly too high, while other categories of equipment, such as HVAC, were lower than they should be to make the offerings attractive to customers.
- **Simplify the application process.** Both trade allies and participants feel that the program could simplify the application process in order to reduce the time commitment required to participate. Trade ally suggestions included further automating the application submittal process using digital options, providing easy-to-find information about how to participate in the program, requiring less information during the application process, and reducing the application timeline.
- **Improve the selection of eligible measures.** Many TAs suggested that the program could make more frequent updates to its list of eligible products. They listed multiple types of energy-efficient

equipment that they believe should be eligible for an incentive through the program. Most are lighting measures, such as tubular LED bulbs; high-output lighting, such as high-bay LEDs and "corn cob LEDs"; LED floodlights; low-wattage TLEDs; or generally a wider range of LED bulbs and fixtures. BEAs suggested removing the use requirements for DLC-listed lighting measures in order to reduce the need for additional research participants have to do to ensure their selected equipment will qualify.

6.3.3 Program Satisfaction

The participant and trade ally surveys explored satisfaction with the Non-Residential Prescriptive Program overall, as well as with individual program components. All satisfaction questions asked respondents to rate their satisfaction on a scale of 0 to 10, where 0 means "extremely dissatisfied" and 10 means "extremely satisfied." Consistent with Duke Energy's practices, we categorized numeric responses as follows:

- 0 to 4 = "Dissatisfied"
- 5 to 7 = "Neutral"
- 8 to 10 = "Satisfied"

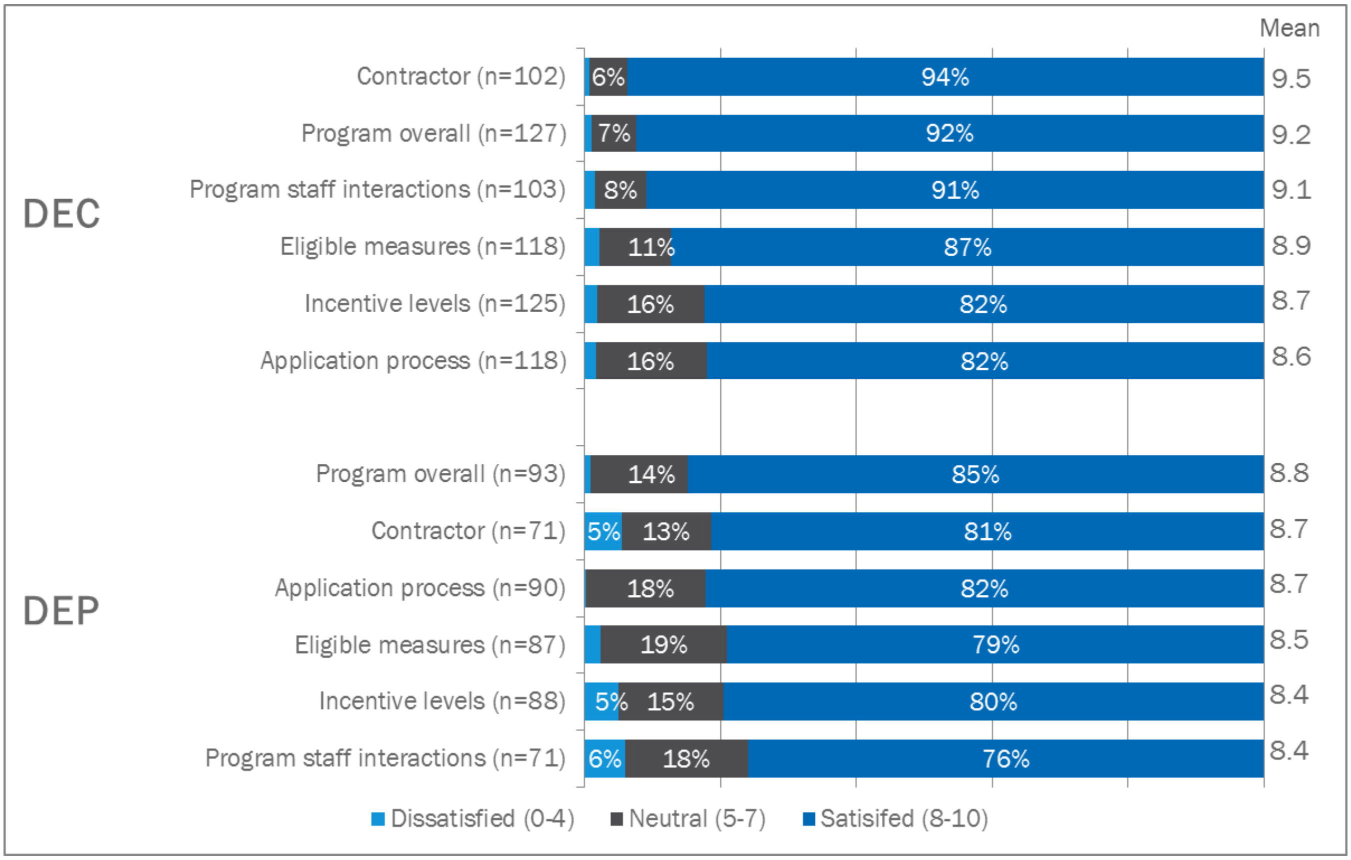
Participant Satisfaction

Both DEC and DEP participants were generally highly satisfied with their program experience overall and with most program components. All program components included in the survey received a mean rating of 8.4 or higher. Of particular note, the program overall was rated an average of 8.8 by DEP participants and 9.2 by DEC participants, the highest and second highest rating for the respective territories.

Most of the ratings did not show statistically significant differences between DEC and DEP participants, with the exception of satisfaction with the contractor and satisfaction with program staff interactions. The mean contractor satisfaction rating was 9.5 for DEC participants, the highest of all satisfaction ratings, compared to 8.8 for DEP participants. Overall, 94% of DEC participants were "satisfied" with their contractor compared to 81% of DEP participants. Similarly, 91% of DEC participants were satisfied with their program staff interactions compared to only 76% of DEP participants, the lowest share of "satisfied" participants of any program component and in both jurisdictions.

Figure 6-3 summarizes the responses to the participant satisfaction questions.

Figure 6-3. Participant Satisfaction with Program Components



Participants were also asked about the likelihood that they would again participate in the Non-Residential Prescriptive Program in the next year and whether they would recommend the program to other businesses.

- Consistent with the high satisfaction ratings, 75% of DEC participants and 84% of DEP participants considered themselves “somewhat likely” or “very likely” to participate again within the next year. Of those who said that they are “not very likely” or “not at all likely” to participate again, the vast majority said that they do not need any new equipment in the near future. Notably, 25% of DEC participants and 27% of DEP participants are repeat participants—i.e., they had already participated prior to the project about which we contacted them—indicating a potential to maintain robust and repeat participation.
- When asked how likely they are to recommend the program to other businesses like their own, 93% of DEC participants and 78% of DEP participants said that they are very likely to recommend the program. Only 1% in each jurisdiction are “not at all likely” to recommend the program to others.

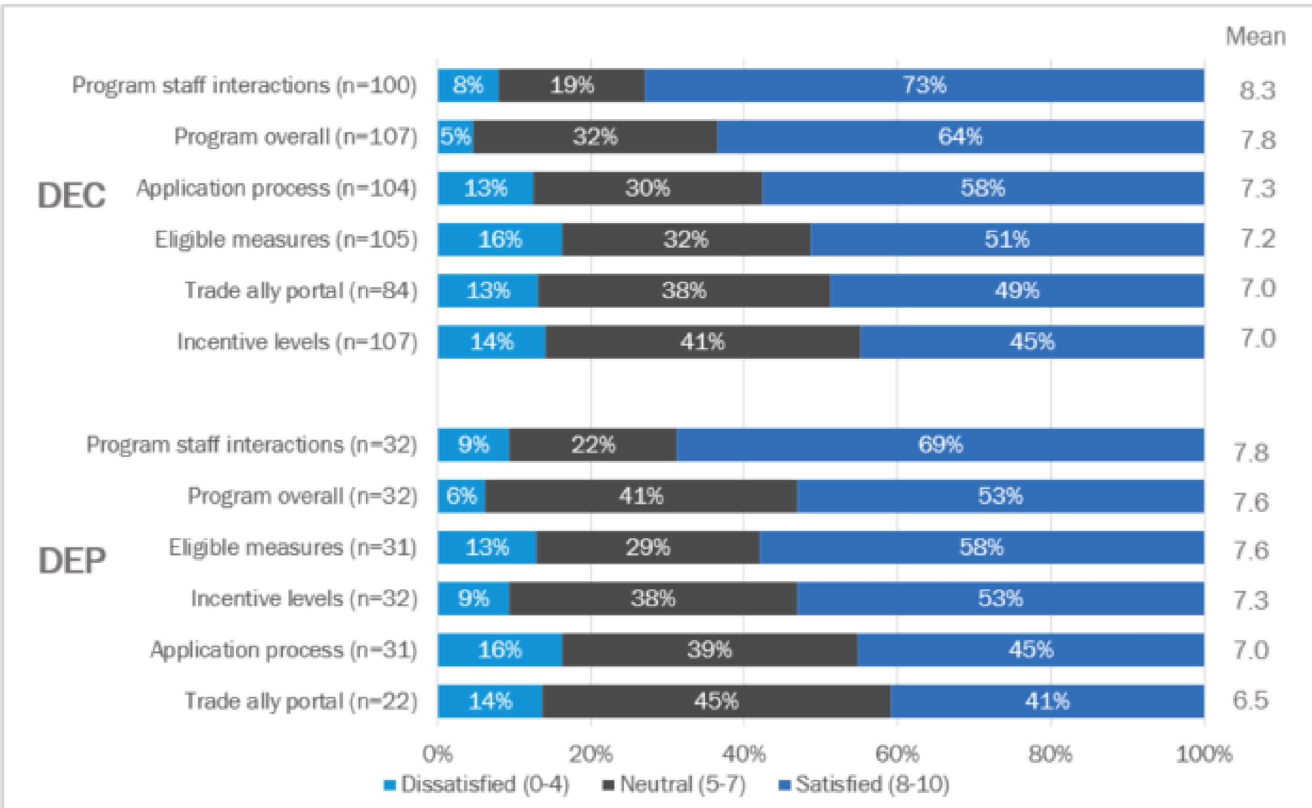
Trade Ally Satisfaction

In general, trade allies were satisfied with the program, but gave satisfaction ratings slightly lower than those given by participants. Mean satisfaction ratings from trade allies ranged from 6.5 to 8.3. In both jurisdictions, trade allies gave the highest ratings to their interaction with program staff (mean rating of 8.3 for DEC and 7.8 for DEP trade allies) and the second highest ratings to the program overall (7.8 DEC; 7.6

DEP). Areas of lower satisfaction included the application process (particularly among DEP trade allies), the trade ally online portal, and the incentive levels.

Figure 6-4 summarizes the trade ally satisfaction ratings. Following the figure, we provide additional information shared by trade allies who provided "dissatisfied" or "neutral" satisfaction ratings.

Figure 6-4. Trade Ally Satisfaction with Program Components



- DEP trade allies gave the second lowest ratings to the **application process**, with only 45% considering themselves "satisfied" with the process. Among DEC trade allies, the "satisfied" ratings for the application process were somewhat higher, at 58%, although this difference is not statistically significant. Trade allies who are less than satisfied with the application process most often noted that it takes too long and is too complicated. Trade allies also noted that the program and its forms change too often. For DEP trade allies, this observation is likely at least partially related to the recent transition of the program's incentive structure and the accompanying changes in the application forms.

  Below are a few representative quotations from trade allies with a "dissatisfied" or "neutral" satisfaction rating:

  > *"It's too cumbersome. Can't find the forms online when we want them. Program changes too much it confuses customers; it slows down projects."*

  > *"It seemed complicated to me, and ever changing."*

"Too many different versions are out there and every time I got a form from my suppliers it was different than what I would find online. Never really sure which one was the correct form."

"It is frustrating trying to figure out what forms to use. The forms seem to change and are not the same throughout [North Carolina]."

- Trade allies also provided lower satisfaction ratings (mean rating of 7.0 for DEC and 6.5 for DEP) for the **trade ally online portal**. The most common challenges with the online portal among TAs were the perception that it is not user friendly and the inability to make edits, resulting in the need to reenter data. Many trade allies reported that they had not yet used the online portal.
- Trade allies also provided lower satisfaction ratings (mean rating of 7.0 for DEC and 7.3 for DEP) for the **incentive levels** available through the program. Many of the comments made by those who provided satisfaction scores less than 8 for the program incentive levels and the equipment eligible for incentives are specific to certain technology types. The examples below present a snapshot of some typical comments that trade allies made to explain why they are less than satisfied with the incentive levels:

"High-quality, high-efficiency exterior area lighting is very expensive. The costs of commodity grade building mount has dropped and the current incentive levels are appropriate for wall packs but not in line with pole mount or many LED fixtures over 15' mounting height."

"Incentive levels leave much to be desired. Companies taking advantage will push the cheapest product to make the most money on installation, which will underbid another company who uses higher-quality fixtures."

"They may be right where they need to be, but even with the incentive program I've had customers choose not to use the high efficiency products just due to upfront costs. If the incentives are kept high more customers would choose the high efficiency option. I've sold mostly LED hi-bay equivalents, 2'x4' LED panels, and LED tubes. In the 2017 changes, the LED panel rebates were cut in half and I believe the LED tubes were eliminated altogether. We were reaching a point in the market where the lowering product costs combined with the incentive rebates were making it possible for many more customers to move in that direction, but with the reduced incentives it reset that back to where many small business customers can't swing the upfront costs."

"LEDs are still pretty expensive. The difference between upgrading to T-5s versus LED is narrow. Seems LEDs should be higher to encourage skipping fluorescence [sic] of any level."

6.3.4 Business Energy Advisors

Duke Energy introduced BEAs in the fall of 2014. The primary responsibility of BEAs has been to work with small and medium-sized customers who do not have designated account managers, to generate interest in the Non-Residential Prescriptive Program, and to assist customers with the participation process. In addition, BEAs spend some of their time promoting other Duke Energy programs, such as back-up generation, small business energy efficiency, and outdoor lighting.

Five BEAs have their primary assignment in the DEC and DEP service territories. Customers are assigned to BEAs based on geographic regions in the DEC and DEP service territories. In addition, BEAs have responsibility for chain accounts across the state. BEAs reported that they are each assigned between 800 and 4,000 customers representing between 300 and 700 parent accounts.

Our interviews with the BEA manager and three of the five DEC/DEP BEAs covered various topics, including outreach and perceived customer awareness of the program, barriers to customer participation, and strengths and challenges of the BEA role.[17] We also asked participating customers if they had worked with a BEA on energy efficiency, and, if so, about their interactions with the BEA.

Customer Outreach and Awareness

BEAs use a mix of approaches to communicate with customers about the Non-Residential Prescriptive Program. The three interviewed BEAs reported that they adjust their customer outreach approach based on their location and to address specific customer segments. BEAs located in the Carolinas reported that they try to focus their outreach on face-to-face meetings when possible, while also using phone calls and email to interact with potential participants. BEAs not local to the Carolinas leverage phone calls and email more heavily to interact with customers; however, they also spend time traveling to the service territory to visit with customers on a quarterly basis and utilize other local Duke Energy staff to make face-to-face contact when necessary.

BEAs noted that since they have been involved with the program in late 2014, they have worked to build and update email contact lists for their assigned customers and to develop the ability to target specific customer segments with email messages that promote certain program opportunities applicable to those segments. BEAs also noted that they consider the preferences of specific customers once they know them and will tailor their outreach approach to what works best for the customer.

Interviewed BEAs reported that they contact and work with between 50 and 160 customer contacts per month. When conducting outreach to customers, BEAs focus their efforts on the prescriptive program offerings; however, BEAs reported that they also spend between 10% and 35% of their time informing customers about other Duke Energy offerings.

When talking to a customer, the BEAs generally try to determine what opportunities the customer is interested in. They attempt to gather more information about the customer's equipment, what they would like to install, and whether they have already selected a vendor. BEAs typically try to share information about the incentives, and provide information about how to find trade allies on Duke Energy's website. BEAs reported that they also help customers with the application process, in particular if it is the customer's first time submitting an application to the program or if they have purchased equipment without the assistance of a trade ally.

Strengths and Challenges of the BEA Role

BEAs and their manager noted a number of strengths of the BEA role. A primary advantage is their unique role of focusing solely on promoting energy efficiency while staying out of account management issues that could otherwise divert their customers' attention. BEAs believe that their promotion and outreach to small and medium-sized customers has been effective in driving participation in the program. In addition to raising awareness, BEAs are able to provide one-on-one support to their customers, who would otherwise not receive any direct support from the program or Duke Energy because they fall below the threshold for large account management.

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[17] We interviewed the BEA manager and BEAs in April and July 2016, respectively. Therefore, conclusions from those interviews presented here do not reflect program changes or changes to the BEA role that have occurred since 2016. However, program staff indicated that no significant BEA changes occurred since the interviews were conducted.

In terms of challenges, BEAs and their manager noted that the number of customers assigned to BEAs was large and that the administrative requirements of serving such a large volume of customers was challenging. BEAs noted that they can each have more than 700 customers representing 3,000 to 4,000 accounts, which makes it difficult to provide one-on-one services and to reach all customers with targeted outreach. BEA management was aware of these challenges, noting that, at the time of our interview in the spring of 2016, processes and systems for BEA outreach were still under development with a goal of reducing the BEAs' administrative burden.

BEAs also noted in 2016 that they do not have the ability to access applications directly in the application processing system. As a result, if a customer has an issue with the application, such as missing information, the BEA cannot directly review the application and discuss it with the customer. BEAS felt that having a way to view an application in the processing system would help them better serve their customers and troubleshoot issues more directly. Related to this issue, BEAs noted that the processing times for applications were an issue for their customers. In particular, if an application needs to be resubmitted due to missing information or other issues, the processing timeline restarts which can further delay a customer's incentive payment.

Customer Interaction with BEAs

To gauge the effectiveness of BEAs in informing customers about the Non-Residential Prescriptive Program and in promoting participation, we asked participants several questions about their interactions with BEAs. Participants reported the following:

- Only 2% of DEC and DEP participants first heard about the program from a BEA.
- Only 6% of DEC participants and 7% of DEP participants reported that they had directly worked with a BEA on energy efficiency. However, an additional 19% of DEC participants and 20% of DEP participants reported that they had communicated with a BEA about energy efficiency or Duke's energy-efficiency programs. Participants who either directly worked or communicated with a BEA reported the following:
  - The most common way for DEC participants to first come into contact with a BEA was receiving a call or email from a BEA (36%), followed by a referral from other Duke staff (16%). Notably, a majority of DEP participants who had interacted with a BEA (59%) reported that they initiated the first contact with the BEA.
  - About half of participants (46% DEC; 52% DEP) who worked or communicated with a BEA interacted with the BEA only 1 or 2 times, while 23% of DEC participants and 12% of DEP participants interacted with a BEA 10 or more times.
  - DEC participants (54%) are more likely to work with BEAs on project scoping compared to DEP participants (23%). The most common BEA interaction of DEP participants was to provide support with the application process (37%). Table 6-3 summarizes common interactions between BEAs and participants.

Table 6-3. Participant Interactions with BEAs

Aspects of the Project where the BEA Assisted (multiple response)	DEC (n=55)	DEP (n=29)
Project Scoping	54%	23%
Application Process	30%	37%
Answering Questions About Available Program Incentives	22%	6%
Assisting at all Stages of Participation	4%	4%
Don't Know/Refused	8%	20%

  - Among those who interacted with a BEA, 85% (DEC) and 68% (DEP) thought that the BEA was very or somewhat influential in their decision to participate in the program.
  - Most participants were satisfied with their BEA interaction, giving a mean rating of 7.8 (DEC) and 8.4 (DEP) on a 0 to 10 scale. Those who were dissatisfied (a rating of 0 to 4) reported that the BEAs were not knowledgeable about the specific equipment they planned to install and requirements for eligibility.
- Overall, a quarter of participants (25% DEC; 27% DEP) reported interacting with a BEA, a remarkable share given that the BEAs are still a relatively new addition to the program's outreach team. It should also be noted that this share is based on all program survey respondents, including those who are not targeted by BEAs because of their size. These results are therefore likely to understate the share of small and medium-sized businesses that have worked or communicated with a BEA.

6.3.5 Program Influence on Trade Ally Business Practices

Since trade allies are a primary driver of program promotion, having direct contact with customers at the time of equipment selection and installation, our research explored the influence the program has on them. We explored two aspects of program influence on trade allies: program training provided to trade allies and changes to trade ally business practices as a result of their participation in the program.

Trade Ally Training

The Non-Residential Prescriptive Program offers several training opportunities to its trade allies, including general program training, sales training, and online portal training. While the EEB program used to require new trade allies to attend program training, this requirement was removed in an effort to synchronize EEB and Smart $aver requirements. As a result, the program does not currently require trade allies to attend a formal training when they submit paperwork to become a program trade ally.

Under the current design, the Duke Energy trade ally outreach team reaches out to trade allies when they join the program and provides introductory information on the program and its processes. The team also conducts many of the program trainings and webinars. According to program staff, when the online portal launched, the trade ally outreach team conducted webinars for 400 trade allies.

To gauge trade ally awareness and satisfaction with the training opportunities provided by the program, our online survey included several questions on this topic. Following is a summary of our findings:

- Overall, 43% of interviewed DEC trade allies and 44% of DEP trade allies have participated in one or more trainings provided by the program. Of those who attended any training, the largest share (54% DEC; 79% DEP) attended program training and about half attended online portal training. The larger share of DEP trade allies who have attended program training is likely due to the fact that this was, until recently, a participation requirement.

Table 6-4 summarizes the trainings that trade allies reported completing.

Table 6-4. Trade Ally Program Training Participation

Trade Ally Program Training Participation (multiple response)	DEC (n=48)	DEP (n=14)
Program Training	54%	79%
Online Application Portal Training	48%	50%
Sales Training	27%	14%
Other Training Offered Through Program	19%	0%

- Trade allies who have participated in program trainings generally found them to be useful, with 62% of DEC trade allies and 38% of DEP trade allies rating the usefulness of the program training greater than an 8 (on a scale of 0 to 10). Only 7% of DEC trade allies and 5% of DEP trade allies found the training to be not useful. All three types of training received similar mean usefulness ratings, ranging from 6.7 to 7.5.
- Trade allies who have not participated in any training said that they were not aware of it (52% DEC; 61% DEP), did not have the time for it (17% DEC; 6% DEP), or did not feel they needed any training (13% DEC; 11% DEP).

Program Influence on Trade Ally Business Practices

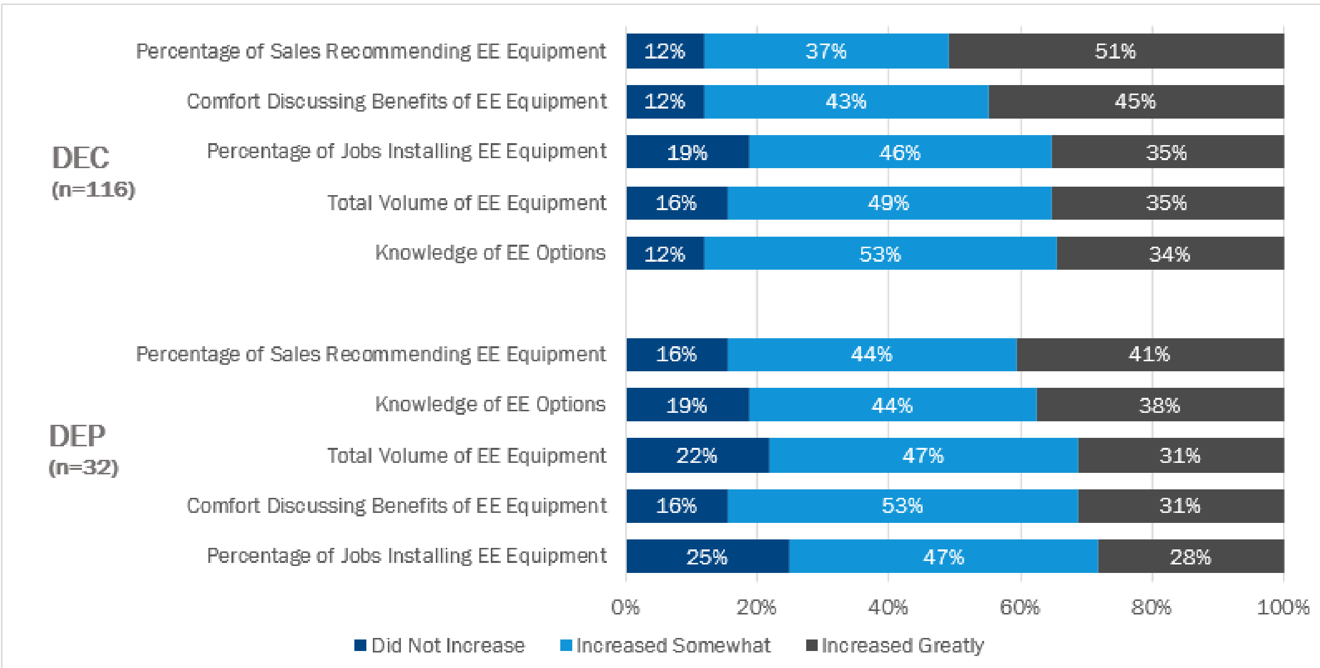
In support of the TA SO analysis, we asked trade allies a series of questions about how their participation in the Non-Residential Prescriptive Program has affected the energy efficiency components of their business. Responses to these questions were used as qualifying conditions for the TA SO analysis (see Section 5.2.3), but they also provide insights into energy efficiency-related aspects of trade allies who participate in the program.

We asked trade allies two sets of questions about five aspects of energy efficiency. The first set of questions asked if each aspect had changed since the trade ally started participating in the Non-Residential Prescriptive Program; the second set asked to what degree the program influenced that change. The five aspects are:

- Their knowledge of high-efficiency equipment options
- Their comfort discussing the benefits of high-efficiency equipment with customers
- The percentage of sales situations in which they recommend high-efficiency equipment
- The percent of jobs installing high-efficiency equipment
- The total volume of high-efficiency equipment sold

In response to questions about changes, trade allies reported increases in all of these energy efficiency-related aspects of their business, with the least change reported by DEP trade allies regarding the percentage of their jobs that were high-efficiency installations (25% reported no change). The aspect for which the highest share of trade allies reported significant increases was the percent of sales recommending high-efficiency equipment (DEC 51%; DEP 41%). Only 4% of DEC trade allies and 3% of DEP trade allies reported that none of the five aspects had increased since they became a TA. Figure 6-5 summarizes these responses.

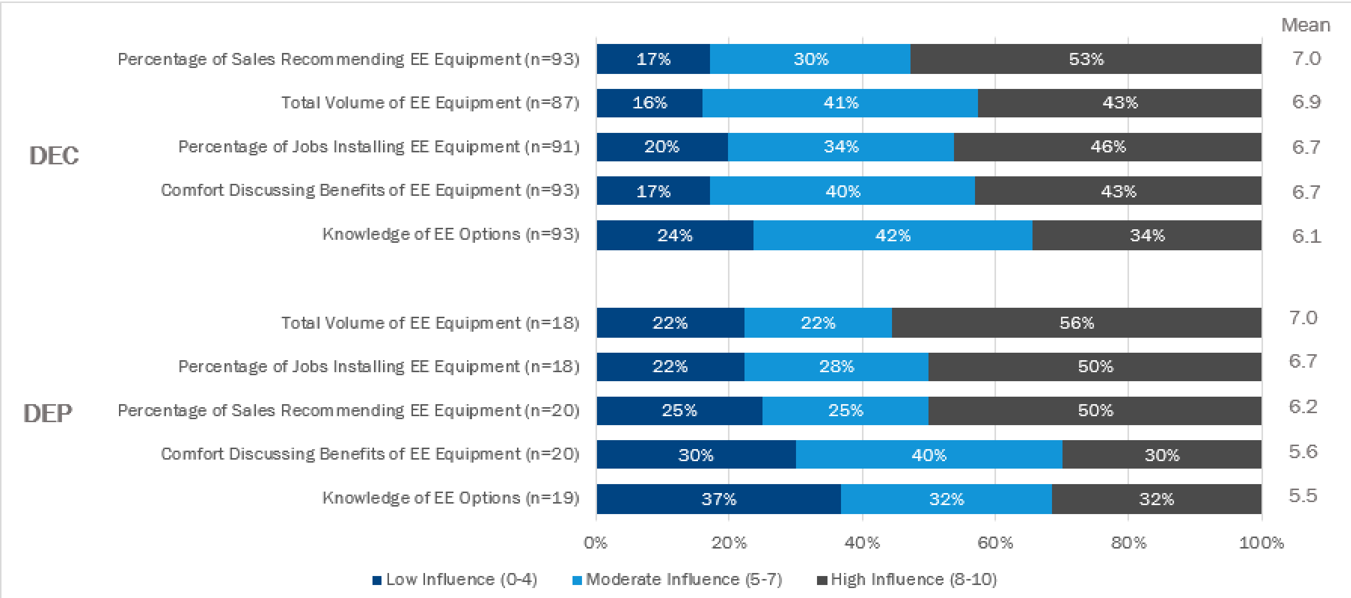
Figure 6-5. Increases in Energy Efficiency-Related Business Aspects since Becoming a Non-Residential Prescriptive Program Trade Ally



Trade allies generally credited the program with the highest influence on the increases in sales recommendations and energy-efficient installations (total volume and percentage of jobs). This is not surprising, given that the incentive provides trade allies with a strong sales proposition. The program's influence on the comfort of discussing benefits of high-efficiency equipment and on knowledge of high-efficiency options was rated lower—particularly in DEP territory, where less than one-third of those with increases attributed a high influence (a rating of 8 or higher) to the program—indicating that factors other than the Non-Residential Prescriptive Program have helped educate the market about energy efficiency. Trade allies named several other factors that contributed to the uptick in their energy efficiency-related business practices, including increases in customer knowledge and product quality and decreases in prices, particularly related to LEDs, as well as state-based energy code requirements.

Figure 6-6 summarizes trade ally responses on the influence of the Non-Residential Prescriptive Program on the changes to their business practices.

Figure 6-6. Trade Ally Attribution of Business Practice Changes to the Non-Residential Prescriptive Program



6.3.6 Online Store

The Non-Residential Prescriptive Program also offers an online store where participants can buy discounted equipment. Products available from the online store include basic lighting products (e.g., LEDs, CFLs, exit signs) as well as select non-lighting measures (e.g., programmable thermostats, low flow showerheads). The price for products available through the online store reflect incentives equivalent to those available through the main channel. As a result, customers do not need to file an application for incentives when they make a purchase, thereby simplifying the process of purchasing energy-efficient equipment.

While the focus of this evaluation was on the main channel, we asked participants about their awareness and use of the online store. Both awareness and use of the online store are significantly higher among DEC participants than DEP participants: Of DEC participants, 46% are aware of it, 36% have visited it, and 13% have made a purchase. In comparison, only 22% of DEP participants are aware of the online store, 8% have visited it, and just 1% have made a purchase. Table 6-5 summarizes awareness and use of the online store.

Table 6-5. Awareness and Use of the Online Store

	DEC	DEP
Aware	46%	22%
Visited	36%	8%
Made Purchase	13%	1%

The differences in participant awareness and use of the online store are likely due to the timing of the store's introduction in the two jurisdictions: It was available to DEC customers in early 2016 but did not roll-out in DEP service territory until December of 2016. Interviewed DEP program participants would therefore have had less time to learn about and use the online store compared to DEC participants.

Overall, 75% of DEC participants and 62% of DEP participants said that they were very or somewhat likely to make a purchase within the next year. Notably, significantly more DEP participants (21%) said that they were not at all likely to make a purchase within the next year than DEC participants (4%). The main reasons for being unlikely to make a purchase from the online store included existing vendor relationships or specific purchasing requirements, and not needing any new equipment.

6.3.7 Online Portal

Participant Perspective

In March 2016, the Non-Residential Prescriptive Program rolled out an online application portal for customers and trade allies among DEC customers.[18] The online portal was introduced to DEP customers in January 2017. The online portal is intended to streamline the application process for customers and trade allies by allowing them to start applications online, to select measures, to copy common information between applications, and to track submitted applications. According to program staff, both customers and trade allies had requested an online portal in the past. Participants and trade allies are not required to use the online system to submit applications, and paper applications are still accepted by the program.

We explored participant awareness and use of the online portal in the participant survey, finding the following:

- 37% of DEC participants and 28% of DEP participants are aware of the customer online portal.
- 16% of DEC and 12% of DEP participants have previously used it.
  - Of online portal users, the majority (63% DEC; 70% DEP) are using it to submit applications. Application tracking is less common, with 35% of DEC users and only 5% of DEP users having used the portal this way.

BEAs noted that participants have reacted favorably to the online portal. From their perspective, it has been an improvement to the program by allowing participants to track the status of their applications. However, they echoed survey findings by noting that awareness of the online portal was still low among participants.

While relatively few participants during our evaluation period were aware of or had used the online portal, this number is expected to increase over time. Since the online portal was introduced to DEP customers in January 2017, only one month prior to the close of the evaluation period, it is not surprising that uptake of this feature was low among the interviewed participants.

Trade Ally Perspective

The trade ally survey also included questions about the online portal, asking trade allies about their awareness of the online portal, whether they have used it, how they have used it, what percentage of applications they submit through the online portal, and their satisfaction with it.

Trade ally awareness of the online portal is high (76% DEC; 72% DEP). More than half (54%) of DEC trade allies have used the online portal, while slightly fewer (44%) of DEP trade allies have. Among online portal users, the most common use was submitting applications (92% DEC; 79% DEP). Trade allies who have used this function report submitting an average of 73% (DEC) and 50% (DEP) of applications online.

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[18] The program tested the online portal with a small subset of trade allies and customers prior to the full launch.

Table 6-6 summarizes trade ally uses of the online portal.

Table 6-6. Uses of the Online Portal Among Trade Allies

Use	DEC	DEP
Submit Applications	92%	79%
Track Status of Applications	70%	57%
Access Program Materials	43%	36%

When asked about their satisfaction with the portal, 49% of DEC trade allies and 41% of DEP trade allies said that they were satisfied with the online portal (a rating of 8 or higher on a scale of 0 to 10). The most common challenges with the portal were the perception that it is not user friendly (25% DEC; 17% DEP) and the inability to make edits, resulting in the need to reenter data. Below are a few representative quotations from trade allies with a “dissatisfied” or “neutral” satisfaction rating:

> *“Sometimes the interface can be cumbersome, but overall it is functional.”*

> *“It was closed down at one point, then reopened at another web address. Communication on this transition was poor. All of these portals and information on the programs are hard to find on the Duke Energy Website. I don't recall any ‘training’ or good explanations for specific applications that would have made it easier for me to use the online portal.”*

> *“I have not had information on how to access this portal. I would like to know more and to be able to access the portal plus attend some training by Duke Energy personnel.”*

> *“It would be useful to be able to auto populate data for customers that have multiple sites (i.e., chain and retail customers). This would save a lot of time. Alternatively, having a multi-location application would help too.”*

> *“There is no way to archive old applications. I have to go through pages to find the applications that I am looking for. I do not want to delete them but would like to make the [sic] inactive or have a filter by year.”*

According to staff from the trade ally outreach team, the trade ally response to the launch of the online portal had been favorable. The outreach team was trained on the functionalities of the portal so that they can respond to inquiries from trade allies.

7. Conclusions and Recommendations

7.1 Conclusions

During the evaluation period, non-residential customers completed 12,855 projects through the DEC Smart $aver Program and 3,186 projects through the DEP Energy Efficiency for Business Program. These projects generated approximately 287 GWh (DEC) and 73 GWh (DEP) of net energy savings, 49 MW (DEC) and 11 MW (DEP) of net summer peak demand savings, and 47 MW (DEC) and 10 MW (DEP) of net winter peak demand savings. Seventy-four percent of DEC net energy savings and 91% of DEP net energy savings were generated through the program's main delivery channel, with the remainder coming from purchases through the program's midstream channel and online store. Lighting accounted for the majority of program projects and savings.

Our gross impact analysis found realization rates for energy savings of over 100% for the DEC and DEP programs overall. Realization rates for summer demand savings were also over 100% for both DEC and DEP, generally due to deemed savings adjustments to lighting. Winter demand savings saw the largest change to realization rates, with DEC at 251% and DEP at 173%. These realization rates were driven by the program not claiming winter demand savings for several lighting measures. Our desk reviews and site visits found relatively few data tracking issues with respect to the quantities of installed measures. We adjusted the quantities for 6 of the 145 sampled projects. Of the six discrepancies, five were relatively minor, while one adjustment for a food service project had a significant impact on the food service realization rate.

Based on our net impact analysis, the program-level NTGR for the Non-Residential Prescriptive Program is 78.7% for DEC and 85.8% for DEP. For both jurisdictions, the lighting NTGR is higher (81.0% DEC; 86.4% DEP) compared to the non-lighting NTGR (59.3% DEC; 67.9% DEP). We estimate overall program-level FR for DEC to be 28.5% and 21.4% for DEP. PSO and TA SO are 0.06% and 7.2% respectively.

Table 7-1 summarizes the net-to-gross results of our evaluation.

Table 7-1. Summary of DEC and DEP NTG Results

Technology	FR	PSO	TA SO	NTGR*
DEC				
Lighting	26.3%	0.06%	7.2%	81.0%
Non-Lighting	48.0%			59.3%
DEC Total	**28.5%**	**0.06%**	**7.2%**	**78.7%**
DEP				
Lighting	20.8%	0.06%	7.2%	86.4%
Non-Lighting	39.4%			67.9%
DEP Total	**21.4%**	**0.06%**	**7.2%**	**85.8%**

*NTGR = 1 – FR + PSO + TA SO

Table 7-2 and Table 7-3 summarize ex post gross and net savings for the evaluation period for DEC and DEP, respectively.

Table 7-2. Summary of DEC Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	268,914,950	44,373	42,064		211,751,454	35,026	33,382
Lighting	*240,987,942*	*40,161*	*38,891*	*0.81*	*195,187,673*	*32,528*	*31,500*
Pumps and Drives	*10,267,207*	*1,481*	*1,598*	*0.59*	*6,089,581*	*878*	*948*
HVAC	*7,869,879*	*1,840*	*656*	*0.59*	*4,667,702*	*1,091*	*389*
Food Service Products	*4,889,807*	*439*	*418*	*0.59*	*2,900,193*	*260*	*248*
Information Technology	*3,322,377*	*146*	*195*	*0.59*	*1,970,534*	*87*	*116*
Process Equipment	*1,577,738*	*306*	*306*	*0.59*	*935,772*	*181*	*181*
Midstream Channel	*65,238,691*	11,731	11,376	1.00	*65,238,691*	11,731	11,376
Online Store	*9,591,131*	1,893	1,864	1.00	*9,591,131*	1,893	1,864
DEC TOTAL	343,744,772	57,997	55,304		286,581,276	48,651	46,622

Table 7-3. Summary of DEP Ex Post Gross and Net Savings

Technology	Ex Post Gross			NTGR	Ex Post Net		
	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Main Channel	77,664,493	11,581	10,936		66,708,433	9,933	9,399
Lighting	*65,966,238*	*10,398*	*10,053*	*0.86*	*57,025,896*	*8,989*	*8,691*
HVAC	*1,485,524*	*366*	*239*	*0.68*	*1,008,938*	*248*	*162*
Food Service Products	*807,334*	*54*	*53*	*0.68*	*548,325*	*36*	*36*
EEB - Lighting	*9,376,146*	*760*	*589*	*0.86*	*8,105,406*	*657*	*509*
EEB - HVAC	*29,252*	*4*	*1*	*0.68*	*19,867*	*3*	*1*
Midstream Channel	*6,227,819*	1,026	987	1.00	*6,227,819*	1,026	987
Online Store	*43,549*	6	7	1.00	*43,549*	6	7
DEP TOTAL	83,935,861	12,614	11,930		72,979,800	10,966	10,393

Our process evaluation found a program that is operating effectively, with satisfied participants that are generating significant numbers of projects and energy savings. The program has gone through a number of transitions shortly before and during the evaluation period. Key program design and implementation changes include:

- The EEB and Smart $aver programs, which operated separately in DEP and DEC territory, were brought into closer alignment. This included changing the DEP incentive structure from a watts-reduced approach to a per-unit incentive.

- Application and incentive processing—previously carried out by external contractors—was brought in-house. Applications are now processed through a Salesforce-integrated system.
- In the fall of 2014, the Non-Residential Prescriptive Program added BEAs to its roster of program staff. The primary responsibility of BEAs is to work with small and medium-sized customers to generate interest and participation in the Non-Residential Prescriptive Program and to assist customers with the participation process.
- In March 2016, the program rolled out an online application portal for DEC customers and trade allies. The online portal was introduced to DEP customers in January 2017. This online portal was designed to streamline and ease the participation process.
- The program opened the online store to DEC customers in early 2016 and to DEP customers in December 2016.

Our process evaluation sought to explore customer and trade ally awareness and use of some of these new program features and to assess how effective they were in streamlining program processes and reducing barriers to participation. However, the timing of these changes, relative to our evaluation period, means that some participating customers and trade allies may not have been exposed to the new features or may have experienced them during the time of transition, when the new processes may not have been fully functional. As such, some of the findings presented in this report, while reflective of participants during the evaluation period, may not be fully representative of current participants. We note in the detailed discussion in this report where this might be the case.

Overall, our process evaluation found the following:

Sources of Information

- Contractors and trade allies continue to be an important source of information for customers.
  - 41% of DEC and 37% of DEP participants first learned about the program from a trade ally or contractor.
  - 87% of DEC participants and 85% of DEP participants worked with a contractor or vendor to select equipment.
  - Word of mouth (35% DEC; 38% DEP) was another common source of awareness, suggesting that participants are generally satisfied with their experience and are recommending the program to others.

Barriers to Energy Efficiency and Participation

- Higher cost of energy efficient equipment and access to financing/capital are key barriers to installing energy-efficient equipment.
- Trade allies and participants consider financial considerations; paperwork, application processes, and time required to participate; and incentive levels to be the barriers to program participation. However, a large number of trade allies and participants do not see any barriers to program participation.

Satisfaction

- Participants are highly satisfied with the program overall and all program components, rating no component less than an average score of 8.4 on a scale of 0 to 10. The program overall was rated an average of 8.8 by DEP participants and 9.2 by DEC participants, the highest and second highest rating for the respective territories.
  - 75% of DEC participants and 84% of DEP participants are very or somewhat likely to participate again.
  - 93% of DEC participants and 78% DEP participants are very likely to recommend the program to other businesses.
- Trade allies are somewhat less satisfied with program processes than participants, but still rated their satisfaction with all program factors an average of 6.5 or higher. Trade allies in both territories gave their highest average ratings to program staff interactions and the program overall.

Business Energy Advisor Interactions

- Twenty-five percent of DEC and 27% of DEP participants have had energy efficiency-related interactions with a BEA.
  - The most common reason for interaction with the BEA was for program scoping (54% DEC) and application support (37% DEP).
  - 85% of DEC and 68% of DEP participants who worked with a BEA said the BEA was very or somewhat influential in their decision to participate in the program.

Online Portal

- Relatively few participants (37% DEC; 28% DEP) are aware of the customer online portal. Fewer still have used the portal (16% DEC; 12% DEP). The most common use was to submit applications (63% DEC; 70% DEP).
- Trade ally awareness of the portal is high (76% DEC; 72% DEP). More than half of DEC trade allies (54%) have used the portal, while slightly fewer DEP trade allies (44%) have.

Online Store

- Moderate numbers of main channel participants (46% DEC; 22% DEP) are aware of the online store. Fewer—13% of DEC participants and 1% of DEP participants—have made a purchase from the store. The later rollout of the online store to DEP customers may explain their lower awareness and use of this program channel.
  - 75% of DEC participants and 62% of DEP participants said that they were very or somewhat likely to make a purchase within the next year.
  - Barriers to making a purchase from the online store include existing vendor relationships, specific company purchasing requirements, or having no need for additional equipment.

Trade Ally Business Practices

- Nearly all trade allies reported an increase in one or more high-efficiency aspects of their business, and most of those trade allies said that the program was at least somewhat influential in those increases.
  - The aspect for which the highest share of trade allies reported significant increases was percent of sales recommending high-efficiency equipment (DEC 51%; DEP 41%).
- Trade allies generally credited the program with the highest influence on the increases in sales recommendations and energy-efficient installations (total volume and percentage of jobs).
- Less than half of trade allies have participated in program-sponsored training.
  - Of those who attended any training, the largest share (54% DEC; 79% DEP) attended program training, and about half attended online portal training.
  - The main reasons for not participating in any training were a lack of awareness that the program offered training, a lack of time to participate, and a lack of need for training.

7.2 Recommendations

Through our research, we identified several opportunities for program improvement.

Increase Promotion of Lesser-Known Program Components

While the program is performing well and generating savings, there are program components that can be further promoted and improved to create even higher levels of participation. The BEAs represent a strong opportunity for the program to reach small- and medium-sized businesses and increase program knowledge and participation among this group. Increased operational support could be provided to the BEAs to facilitate more targeted communications and knowledge transfer to customers at the key moment when they are selecting equipment for their projects.

The program should also make attempts to increase promotion of the online store and the online portal, particularly among DEP customers for whom these components are still relatively new. The online store represents an opportunity for customers with relatively simple projects (primarily lighting) to purchase equipment in a streamlined fashion and could drive increased participation. BEAs in particular should promote this option to their customers, as it might be well suited for the needs of smaller businesses. At the same time, the program should emphasize the online portal in communications with customers and trade allies as a mechanism to streamline the application process and as a way for these key stakeholders to receive vital information about the program.

Finally, the program periodically provides training to trade allies in the form of in-person meetings and webinars. However, knowledge of and participation in these trainings was relatively low among surveyed trade allies. Since the trainings address some of the areas of lower trade ally satisfaction (e.g., application processing, the online portal), there is an opportunity for the program to better educate trade allies, remove some of the obstacles to participation, and increase satisfaction. The program might also consider making an introductory training mandatory, to ensure that all trade allies are aware of key program processes and requirements. Some similar programs that have lists of registered trade allies do require this.[19] In some cases, they also require attendance in annual meetings, to inform trade allies of important changes to the program.

Consider More Frequent Updates of Eligible Measure List, Especially for Lighting Measures

Many trade allies install non-incented high-efficiency equipment, and many of these installations are not completed through the program because the measures are not on the program's list of eligible equipment. Trade allies listed multiple types of energy-efficient equipment—mostly lighting measures—that they think should be eligible for a program incentive: tubular LED bulbs; high-output lighting, such as high-bay LEDs and "corn cob LEDs"; LED floodlights; low-wattage TLEDs; and generally, a wider range of LED bulbs and fixtures.

While relying on third-party lists of qualifying equipment, such as those from the DLC and ENERGY STAR®, allows the program to reduce its administrative burden, the program may be missing opportunities for increasing participation and realizing more savings. Lighting still represents an excellent source of program savings, and levels of FR are low compared to non-lighting measures. As such, staying current with newer and better lighting technologies represents an opportunity for the program to continue capturing lighting-related savings.

Continue to Improve and Streamline the Application Process

The program has taken steps to improve the application process, including bringing the application processing system in-house and offering an online application system for participants and trade allies. Nevertheless, the online portal is the lowest-rated program components for trade allies. While the evaluation team did not have direct access to the online portal, we recommend that the program collect specific feedback from portal users and explore implementing solutions to the most commonly cited challenges. Among suggestions provided by trade allies surveyed in support of this evaluation were a function to auto-populate data for customers with multiple sites, allowing a multi-location application, and including an archive or filter function.

Improve Data Collection and Tracking Processes

Our review and processing of program tracking data revealed a number of issues that, if addressed, would allow program staff to better track program activity and would also facilitate evaluation efforts. In particular, areas that can be improved include the following:

- **Create unique identifiers for participants and trade allies.** During interviews and conversations, program staff noted two difficulties related to data tracking: (1) an inability to identify and enumerate unique customers in the participation data and (2) difficulty identifying inactive trade allies for potential removal from the program's trade ally list. Creating a unique identifier for each participating customer and each participating trade ally would solve both of these problems and would allow program staff to easily tabulate program activity, identify top- and low-performing trade allies, identify repeat customers, and better target specific types of customer or trade ally. Assigning unique

[19] Examples of similar business programs that have trade ally training requirements include NIPSCO's Business Energy Efficiency Program, which requires new TAs to complete an orientation session; ComEd's Smart Ideas® Energy Efficiency Program, which requires new TAs to attend a Trade Ally Basic Training class and one launch event per program year; SDG&E's C&I programs, which require new TAs to participate in the Trade Professional Program Essentials training; and PG&E's C&I programs, which require new TAs to attend the Trade Professional Alliance 101 Seminar before participating in the programs.

identifiers could also help with auto-populating certain information in the online portal, as suggested by one trade ally to streamline the application process.

- **Perform additional quality assurance steps on the data entered into the program tracking database.** While our impact analysis generally found few data tracking issues, one major error in quantity significantly affected the realization rate of food service equipment. Additional checks on entered data, e.g., for outlier values, could help prevent such issues in the future.
- **Ensure that information collected on the application is complete and consistently entered into the program tracking database.** Missing data encountered during our evaluation included operational information, such as hours of use, as well as customer contact information. Collecting and entering more complete technical and operational data will enable more accurate estimates of program impacts while more complete customer contact information will support program outreach efforts.

8. Summary Form

Duke Energy Carolinas/Progress Non-Residential Prescriptive Program

The Duke Energy Carolinas/Progress Non-Residential Prescriptive Incentive Program provides incentives to commercial and industrial customers for a range of measures including lighting; HVAC systems; motors, pumps, and variable frequency drives (VFDs); process equipment; food service products; and information technology equipment. The program works with trade allies to promote the program and drive participation. The program also offers an online Business Savings Store where DEC/DEP customers can purchase a subset of products offered by the program main channel at comparable incentive levels. The program also offers a midstream channel that works with distributors to provide incented products to customers.

Date	March 25, 2018
Region(s)	Duke Energy Carolinas/Duke Energy Progress
Evaluation Period	DEC: August 1, 2015 to February 28, 2017 DEP: March 1, 2016 to February 28, 2017
Total kWh Savings	DEC: 286,581,276 kWh (net ex post) DEP: 72,979,800 kWh (net ex post)
Coincident kW Impact (net ex post)	DEC: 48,651 kW (summer); 46,622 kW (winter) DEP: 10,966 kW (summer); 10,393 kW (winter)
Measure Life	Not evaluated
Net-to-Gross Ratio	DEC: 78.7% overall; 81.0% lighting; 59.3% non-lighting DEP: 85.8% overall; 86.4% lighting; 67.9% non-lighting
Process Evaluation	Yes
Previous Evaluation(s)	DEC: Duke Energy Carolinas Smart $aver® Prescriptive Incentive Program, July 17, 2016 DEP: 2014 EM&V Report for the Energy Efficiency for Business Program, October 30, 2015

The evaluation team performed a gross and net impact using a multi-step process.

For the gross impact analysis, we first reviewed program tracking data and develop a comprehensive database of program measures and ex ante savings. We then conducted desk reviews and site visits to confirm database quantities for projects completed through the main program channel. We also reviewed and adjusted, where warranted, ex ante per-unit “deemed” savings. Finally, we estimated ex post gross energy and demand savings, by technology, based on the quantity and per-unit deemed savings adjustments.

The net impact evaluation relied on participant and trade ally interviews in order to quantify free-ridership, participant spillover, and trade ally spillover. We estimated overall net-to-gross ratios for DEC and DEP program, as well as net-to-gross ratios for lighting and non-lighting for each territory. These net-to-gross ratios were multiplied by the ex post gross savings to determine net program impacts for DEC and DEP.

We also performed a process analysis that investigated customer awareness of the program, program satisfaction, barriers to participation and installing energy efficient equipment, program influence on trade ally business practices, and new program features such as the online portal, the online store, and the business energy advisors.

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For more information, please contact:

Antje Flanders
Vice President

617 492 1400 tel
617 497 7944 fax
aflanders@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Carolina/ Duke Energy Progress

Non-Residential Prescriptive Program Evaluation Report – Appendices

March 25, 2018

Opinion Dynamics

Contributors

Antje Flanders
Vice President

Matt Drury
Director, Engineering

John Tortorella
Consultant

Nick McKay
Consultant

Dan Chen
Senior Consultant

Mallorie Gattie-Garza
Managing Consultant, Engineering

Kai Zhou
Managing Consultant, Data Science

Opinion Dynamics

Table of Contents

Opinion Dynamics

Table of Tables

Appendix A. DSMore Table

The Excel spreadsheet containing measure-level inputs for Duke Energy Analytics is provided as a separate file. Per-measure savings values in the spreadsheet are based on the gross and net impact analysis reported above. Measure life estimates have not been updated as part of this evaluation since it was not part of the evaluation scope.

Appendix B. Respondent-Level Free-Ridership Methodology

This appendix outlines our approach for calculating respondent-level FR values based on questions in the telephone participant survey. The approach estimates program influence on project efficiency and allows for two types of adjustments: The first adjustment considers program influence on the quantity and timing of installed equipment, and the second adjustment is applied if the respondent became aware of the Non-Residential Prescriptive Program *after* making the decision to implement the energy efficiency project. The following calculations are used:

- Preliminary FR Value = [(Efficiency Score 1 + Efficiency Score 2 + Efficiency Score 3) ÷ 3] x Quantity and Timing Adjustment Factor
- Preliminary NTG Value = 1 – Preliminary FR Value
- Final NTG Value = Preliminary NTG Value x Program Awareness Adjustment Factor
- Final FR Value = 1 – Final NTG Value

The following sections describe the questions and algorithms used to estimate respondent-level FR values.

Program Influence on Project Efficiency

The telephone survey included a series of questions to determine the influence that the Non-Residential Prescriptive Program had on the efficiency level of the incented project. Based on these questions, we developed three FR efficiency scores for each respondent, which were averaged to calculate the respondent's overall Efficiency FR Score. FR scores can range from 0 to 1, where 0 means no FR (i.e., full credit for the program) and 1 means full FR (i.e., no credit for the program).

The overall Efficiency FR Score is composed of the following sub-scores:

- **Efficiency FR Score 1 – Rating of program factors (Q.N3):** Participants are asked to rate (on a scale of 0 to 10) the importance of several program and non-program factors on their decision to select energy-efficient equipment rather than a less efficient alternative. This FR score is based on the maximum rating given to any of the program factors and is calculated as[1]:

  1 – (Maximum Program Factor Rating ÷ 10)

- **Efficiency FR Score 2 – Allocation of points to the Non-Residential Prescriptive Program (Q.N4):** Participants are asked to allocate a total of 100 points between the Non-Residential Prescriptive Program and other factors that influenced the efficiency level of the incented project. This FR score is calculated as:

  1 – (Points Allocated to Program ÷ 100)

- **Efficiency FR Score 3 – Likelihood to install same level of efficiency without the program (Q.N5):** Participants are asked to rate (on a scale of 0 to 10) the likelihood that they would have installed the same level of efficiency without the program. This FR score is calculated as:

  Likelihood to install without the program ÷ 10

[1] Several factors asked about in the survey can be considered either a program factor or a non-program factor, depending on the response to a follow-up question: previous experience with this type of equipment, financial criteria, expected energy savings.

In addition to the efficiency questions that are direct inputs into the FR algorithm, the survey contains several consistency checks. These are designed to resolve inconsistent responses to the three concepts of efficiency. For example, if the respondent gives a high importance rating to at least one program factor in Q.N3 but also gives a high rating for the likelihood of installing the same equipment without the program in Q.N5, a follow-up question tries to resolve this discrepancy. The consistency checks consist of an open-ended question where the respondent is asked to explain the earlier numeric responses and a question that gives the respondent the opportunity to change one or more of the earlier answers.

Key Survey Questions

N3. My next few questions are about your decision to select energy efficient equipment rather than a less efficient alternative. Specifically, I would like you to rate the importance of Duke Energy's <PROGRAM> as well as other factors that might have influenced your decision to select the energy efficient <TECHNOLOGY> equipment.

For each rating, please use a scale from 0 to 10, where 0 means "not at all important" and 10 means "extremely important". [RECORD 0 to 10; 96=Not Applicable; 98=Don't Know; 99=Refused]

(Interviewer Note: Prompt for a numeric rating if not given, for example "So what rating would that be, on a 0 to 10 scale?"... If respondent says "We would not have done it", prompt with "So would you rate that as extremely important, or a 10 on a 0 to 10 scale?")

a. [ASK IF S2=1] Your previous experience with the <PROGRAM>
b. The availability of the PROGRAM incentive
c. [ASK IF V1a=1] A recommendation from the vendor or contractor who helped you with the choice of the equipment
d. Previous experience with this type of equipment
e. [ASK IF V3a=1 OR V3b=1 OR V3c=1 OR V3d=1 OR V4=4,5,6,7] A recommendation from a Duke Energy representative (IF NEEDED: This could be an Account Manager, Business Advisor, Energy Efficiency Engineer, or <PROGRAM> staff)
f. Information from <PROGRAM> or Duke Energy marketing materials
g. Standard practice in your business or industry
h. Corporate policy or guidelines
i. Financial criteria, such as payback or return on the investment
j. The expected energy savings

N3o. Were there any other factors we haven't discussed that were influential in your decision to select the energy efficient <TECHNOLOGY> equipment? [OPEN END; 96=Nothing else influential]

[ASK IF N3o=00]
N3oo. Using the same 0 to 10 scale, where 0 means "not at all important" and 10 means "extremely important", how would you rate the influence of this factor (IF NEEDED: <N3o RESPONSE>)? [RECORD 0 to 10; 98=Don't Know; 99=Refused]

[ASK IF N3d=8,9,10 AND S2=1]
N3dx. You indicated that previous experience with this type of equipment was important in your decision to select the energy efficient <TECHNOLOGY> equipment. Was this previous experience associated with equipment you installed with an earlier Duke Energy incentive, or did you install that equipment on your own?

1. (With Duke Energy incentive)
2. (On my own/No Duke Energy incentive)
3. (Both)
8. (Don't know)
9. (Refused)

[ASK IF N3i=8,9,10]

N3ix. You indicated that financial criteria were important in your decision to select the <TECHNOLOGY> equipment. Which of the following statements best applies to this project:

01. The <PROGRAM> rebate moved the project within the acceptable range of our financial criteria
02. The project met our required financial criteria even without the rebate
03. The project didn't meet our required financial criteria, even with the rebate
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF N3j=8,9,10]

N3jx. You indicated that the expected energy savings were important in your decision to select the energy efficient <TECHNOLOGY> equipment. How did you find out about the savings this equipment could achieve?

01. (contractor/vendor)
02. (Duke Energy Account Manager)
03. (Duke Energy Business Energy Advisor)
04. (Duke Energy Program Staff)
05. (Prior experience with equipment)
00. (Other, specify)
98. (Don't know)
99. (Refused)

Thinking about this differently, I would like you to compare the importance of the Duke Energy Non-Residential Incentive Program with the importance of other factors in your decision to select the energy efficient <TECHNOLOGY> equipment.

N4. To make this comparison, assume you have a TOTAL of 100 points that reflect the influence on your decision to install the energy efficient <TECHNOLOGY> equipment. I would now like you to SPLIT those 100 points between: (1) the <PROGRAM>, including support from Duke Energy staff; and (2) other factors.

How many points would you give to the importance of… [RECORD 0 to 100; 998=Don't Know; 999=Refused]

N4a. the <PROGRAM>, including support from Duke Energy staff
N4b. other factors

Now I would like you to think about the action you WOULD HAVE taken with regard to the installation of this <TECHNOLOGY> equipment if the Non-Residential Incentive Program HAD NOT BEEN available.

[IF EFFICIENCY LEVEL IS NOT APPLICABLE, SKIP TO N6a]

N5. Without the program, what is the likelihood that the equipment would have had the same efficiency level? Please use a scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely". [RECORD 0-10; 98=Don't Know; 99=Refused]

Quantity and Timing Adjustment Factor

In addition to influencing the efficiency of a project, the Non-Residential Prescriptive Program can affect the quantity and timing of the installed energy-efficient equipment.[2] Because decisions about measure quantity and installation timing are often correlated, we calculated a combined "Quantity and Timing Adjustment Factor." This factor can range from 0 to 1, where a lower value means a greater quantity and timing adjustment, i.e. more credit to the program. The Quantity and Timing Adjustment Factor is multiplied by the Efficiency FR Score.

The survey first asks respondents how much of the installed energy efficient equipment would have been installed at the same time without the program (Q.N6a/b). Only the quantity that would not have been installed at the same time is eligible to receive the quantity and timing credit.

Respondents are then asked if they would have installed the remaining quantity later (Q.N7) and, if so, how much later (QN7a). The response, expressed as the number of months the program accelerated the project, is translated into a timing adjustment, using the following formula:[3]

Timing Adjustment = 1 – (# Months Accelerated – 6) ÷ 42

Substituting the midpoint of the Q.N7a response for *# Months Accelerated* results in the following adjustments:

- Same time: 1.0
- Up to 6 months later: 1.0
- 7–12 months later: 0.93
- 1–2 years later: 0.71
- 2–3 years later: 0.43
- 3–4 years later: 0.14
- More than 4 years later: 0.0
- Don't know/Refused: 1.0

The timing adjustment can range from 0 to 1. A smaller adjustment value means a greater reduction in FR, because the program resulted in a greater acceleration of the project.

The Quantity and Timing Adjustment Factor is then calculated by multiplying the percentage of the project that would not have been installed at the same time without the program by the timing adjustment and

[2] For some measures, the concept of quantity is not applicable. For projects with those measures, questions about quantity are skipped and the quantity adjustment factor is set to 1.0, i.e., no FR adjustment is applied.

[3] The timing adjustment is capped at 1.0, i.e., if the *# Months Accelerated* is 6 months or less, the adjustment is equal to 1.0 and no adjustment is applied. If a respondent cannot provide a valid response, i.e., the response is "Don't know" or "Refused," the adjustment is set to 1.0 as well.

adding this product to the percentage of the project that would have been installed at the same time without the program. We used the following formula for this calculation:

Quantity and Timing Adjustment Factor =

*(% Not Installed at Same Time * Timing Adjustment) + % Installed at Same Time*

If the respondent does not provide valid responses to the initial quantity (Q.N6a) and timing (Q.N7) questions, the Quantity and Timing Adjustment Factor is set to 1.0, i.e., no reduction in FR. If the respondent cannot provide valid responses to the more specific quantity (Q.N6b) and timing (Q.N7a) questions, we apply average values based on the other survey responses.

Key Survey Questions

[IF TUNEUP=1 SKIP TO N7a]

N6a. Without the program, would you have installed the same quantity of energy efficient equipment in <DATE> or would you have installed less?

1. Same quantity
2. Less
3. (More)
8. (Don't know)
9. (Refused)

[ASK IF N6a=2, ELSE SKIP TO CC2a]

N6b. As best as you can, please estimate the percentage of the energy efficient <TECHNOLOGY> equipment that you would have installed in <DATE> without the program. [NUMERIC OPEN END, 0 to 100%; 998=Don't Know; 999=Refused]

[IF N6b<=100% CALCULATE N_INSTALL = 100% – N6b]

[ASK IF N6b<50%]

N6c. Why would you have installed that much less energy efficient equipment? [OPEN END]

[ASK IF N6b<100%]

N7. Without the program, would you have installed the remaining <N_INSTALL> percent of the energy efficient <TECHNOLOGY> equipment at a later time?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF N7=1 OR IF TUNEUP=1]

N7a. Without the program, when do you think you would have installed the energy efficient <TECHNOLOGY> equipment? Please answer relative to the date that you ACTUALLY installed the equipment.

01. (at the same time)
02. (up to 6 months later)
03. (7 months to 1 year later)
04. (more than 1 year up to 2 years later)
05. (more than 2 years up to 3 years later)

06. (more than 3 years up to 4 years later)
07. (more than 4 years later)
08. (Never)
98. (Don't know)
99. (Refused)

[ASK IF N7a=4,5,6,7]
N7b. Why would it have been that much later? [OPEN END]

Program Awareness Adjustment Factor

While the Quantity and Timing Adjustment Factor can *reduce* FR but not increase it, the Program Awareness Adjustment can only *increase* FR. This adjustment is applied if the respondent reports in Q.N1 and Q.N2 that they first learned about the Non-Residential Prescriptive Program *after* making the decision to implement the incented project. Since such a response contradicts that the program could have had a meaningful impact on the decision-making process, the Preliminary NTG Value (based on the overall Efficiency FR Score and the Quantity and Timing Adjustment, calculated as 1 – Preliminary FR Value) is multiplied by 0.5, i.e., program influence is reduced by half. If the respondent reports first learning about the program *before* making the decision to implement the incented project, the adjustment is set to 1.0 (i.e., no reduction in the NTG value and thus no increase in FR).

Key Survey Questions

N1. When did you first learn about Duke Energy's <PROGRAM>? Was it BEFORE or AFTER you selected the <TECHNOLOGY> equipment for which you received the incentive?
1. (Before)
2. (After)
8. (Don't know)
9. (Refused)

[ASK IF N1=2]
N2. Just to confirm, you found out about the incentive available through Duke Energy's <PROGRAM> after you had already decided to implement the energy efficient <TECHNOLOGY> project?
01. Yes, after
02. No, before
00. (Other, specify)
98. (Don't know)
99. (Refused)

Appendix C. Trade Ally Spillover Methodology

The objective of the TA SO analysis was to determine the program's influence on non-incented installations of energy-efficient measures during the evaluation periods. As discussed in Section 5.1.3 of the main report, we used an online survey of trade allies to gather data for this evaluation. We identified SO candidates through questions asked in the survey and determined savings for qualifying projects to develop a quantitative estimate of SO, relative to total program savings. The SO method captures SO as reported by trade allies, which may include SO at participant facilities and at non-participant facilities.

The remainder of this appendix details our methods of determining if a trade ally qualifies for SO savings, and of quantifying SO savings.

Trade Ally Eligibility for Spillover

The trade ally online survey asked a series of questions to determine if any high-efficiency installations completed by respondents outside of the program qualified as SO. We considered non-incented high-efficiency installations of equipment by trade allies to be SO if all five conditions listed in Table C-1 were met.

Table C-1. Non-Residential Prescriptive Program Trade Ally Spillover Qualifiers

Qualifier	Description	Conditions to Satisfy Qualifier
1	The percentage of the trade ally's installations that are high efficiency and/or the total volume of high-efficiency installations increased since the contractor became a trade ally.	*PI1d = 2 or 3 AND/OR PI1e = 2 or 3*
2	The trade ally rated the program as important to at least one of these increases.	*PI3d = 8, 9, or 10 AND/OR PI3e = 8, 9, or 10*
3	The trade ally installed at least some high-efficiency equipment that did not receive an incentive.	*TA1c > 0% OR (TA1c = 998 AND TA2a = 1 AND (TA2b > 0 OR "Don't know"))*
4	The trade ally's recommendation was influential in the customer's choice of high-efficiency equipment over standard efficiency equipment in instances where the equipment did not receive an incentive from the program.	*SO1a = 8, 9, or 10*
5	The open-ended response about why customers with high-efficiency projects did not receive an incentive did not contradict findings from other qualifiers that the non-incented high-efficiency installations can be considered SO.	*SO1c does not contradict that the non-incented high-efficiency installations can be considered SO.*

Qualifier 1 Question

PI1. Since <TRADEALLY_NAME> became a <PROGRAM> trade ally, have any of the following aspects changed and if so, by how much? *[1=Did not increase; 2=Increased Somewhat; 3=Increased Greatly]*

- *d.* *The percentage of jobs in which <TRADEALLY_NAME> installs high efficiency equipment in Duke Energy's <JURISDICTION> service territory*
- *e.* *The total volume of high efficiency equipment <TRADEALLY_NAME> installs in Duke Energy's <JURISDICTION> service territory*

Qualifier 2 Questions

PI3. On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <PROGRAM> on the increase in... [SCALE 0-10; 98=Don't know]

d. The percentage of jobs in which <TRADEALLY_NAME> <u>installs</u> high efficiency equipment in the Duke Energy <JURISDICTION> service territory

e. The total volume of high efficiency equipment <TRADEALLY_NAME> <u>installs</u> in the Duke Energy <JURISDICTION> service territory

Qualifier 3 Questions

TA1. Approximately what percentage of your total equipment installations (in terms of dollars) was... (Please provide your best estimate, if unsure of exact percentages.) (Standard efficiency products meet the Federal minimum standard for energy consumption, but are no more energy-efficient than the standard requires.) [0% TO 100%; 998=DON'T KNOW]

a Standard Efficiency

b High Efficiency – that DID RECEIVE an incentive from Duke Energy

c High Efficiency - that DID NOT RECEIVE an incentive from Duke Energy

[ASK IF TA1c=998]

TA2a. Between <EVALPERIOD>, did <u>any</u> of your customers in Duke Energy's <JURISDICTION> service territory install high efficiency equipment that did not receive a Duke Energy incentive? [1=Yes; 2=No; 8=Don't Know]

[ASK IF TA2a=1]

TA2b. Approximately, how many of your projects in Duke Energy's <JURISDICTION> service territory between <EVALPERIOD> used high efficiency equipment but did not receive a <PROGRAM> incentive? [NUMERIC OPEN END; 998=Don't know]

Qualifier 4 Question

SO1a. How influential was your recommendation on your customers' choice of high efficiency equipment over standard efficiency equipment? (0=Not at all influential; 10=Extremely influential) [SCALE 0-10; 98=Don't know]

Qualifier 5 Question

SO1c. Why do you think that these customers did not participate in the <PROGRAM> even though they installed high efficiency equipment? [OPEN END]

We coded open-ended responses to SO1c. If the respondent's answers conflicted with findings from other qualifiers that the project is SO, we excluded the respondent from SO calculations.

Estimation of Spillover Savings for Individual Trade Allies

For the trade allies who met the five main qualifying conditions outlined above, SO savings were considered to be equal to the savings of their non-incented, high-efficiency installations. SO for each qualifying trade ally (i) is calculated using Equation C-1. Data inputs to this formula are from the online survey and the program tracking database; they are further described below.

Equation C-1

$$\text{TA Spillover Savings (kWh)}_i = \left(\frac{\text{Savings from Program Database}_i}{\text{\% Efficient Installations that Received Incentive}_i} - \text{Savings from Program Database}_i \right) * \text{Size Adjustment}_i$$

Percentage of Eligible Equipment Installations That Received Incentive

We used survey questions TA1b and TA1c to determine the share of efficient installations that received an incentive (Equation C-2).

Equation C-2

$$\textit{\% of Efficient Installations That Received Incentive} = \frac{TA1b}{TA1b + TA1c}$$

Questions

TA1. Approximately what percentage of your total equipment installations (in terms of dollars) was… (Please provide your best estimate, if unsure of exact percentages.) [0% TO 100%; 998=DON'T KNOW]

- *a. Standard Efficiency*
- *b. High Efficiency - that DID RECEIVE an incentive from Duke Energy*
- *c. High Efficiency - that DID NOT RECEIVE an incentive from Duke Energy*

If the respondent was unable to provide the percentage of total equipment installations that were high-efficiency and did not receive an incentive (Q.TA1c), we used responses from questions TA2a and TA2b, as well as the number of respondent projects in the program-tracking database, to estimate this percentage (Equation C-3). If the respondent said that none of the customers installed high efficiency equipment without receiving an incentive, as indicated in TA2a, we set TA2b equal to 0.

TA2a. Between <EVALPERIOD>, did any of your customers in Duke Energy's <JURISDICTION> service territory install high efficiency equipment that did not receive a Duke Energy incentive?

1. *Yes*
2. *No*
8. *Don't know*

[ASK IF TA2a=1]
TA2b. Approximately, how many of your projects in Duke Energy's <JURISDICTION> service territory between <EVALPERIOD> used high efficiency equipment but did not receive a <PROGRAM> incentive? [NUMERIC OPEN END; 998=Don't know]

If the respondent was unable to provide an answer for TA2a or TA2b, we assumed the percentage of high efficiency equipment that did not receive a Duke Energy incentive was equal to the average percentage among all respondents (34%).

Equation C-3

$$\text{\% of High Efficiency Equipment Installations That Did Not Receive Incentive} = \frac{TA2b}{TA2b + \text{Number of Projects from Program Database}}$$

Size Adjustment

High-efficiency projects that did not receive an incentive may not be the same size as those that did receive an incentive. We therefore developed an adjustment to account for this possibility. We adjusted the average size of a respondent's projects in the database up or down using responses to survey questions RS1a, RS1b, and RS1c, as shown in Table C-2.

Table C-2. Size Adjustment for Non-Incented, High-Efficiency Installations

Non-incented, high-efficiency projects are ... compared to incented ones (RS1a)	How much smaller/larger? (RS1b/RS1c)	Analysis Adjustment Value
Smaller	Less than a quarter of the size	12.5%
	A quarter of the size	25%
	Half the size	50%
	Three-quarters of the size	75%
	More than three-quarters of the size	87.5%
	Don't know	32.6% *(average of all respondents RS1a= "Smaller")*
About the Same Size	n/a	100%
Larger	Less than one-and-a-quarter times the size	112.5%
	One-and-a-quarter times the size	125%
	One-and-a-half times the size	150%
	One-and-three-quarters times the size	175%
	Twice the size	200%
	More than twice the size	212.5%
	Don't know	*Not estimated (only one response received for RS1a="Larger")*
Don't Know	Don't know	62.8% *(average of all respondents)*

Questions

RS1a. In terms of cost, how large were the projects that installed high efficiency equipment but did NOT receive an incentive?

1. Smaller than projects that received an incentive
2. About the same size as projects that received an incentive
3. Larger than projects that received an incentive
8. Don't know

[ASK IF RS1a=1]

RS1b. Approximately, how much smaller would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

For example, if the average cost of high efficiency projects that did NOT receive an incentive is $15,000 and the average cost of projects that DID receive an incentive is $20,000, your answer would be $15,000 / $20,000 = 75%, or "three quarters of the size".

1. More than three quarters of the size
2. Three quarters of the size
3. Half the size
4. A quarter of the size
5. Less than a quarter of the size
8. Don't know

[ASK IF RS1a=3]

RS1c. Approximately, how much larger would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

For example, if the average cost of high efficiency projects that did NOT receive an incentive is $25,000 and the average cost of projects that DID receive an incentive is $20,000, your answer would be $25,000 / $20,000 = 125%, or "one and a quarter times the size".

1. Less than one and a quarter times the size
2. One and a quarter times the size
3. One and a half times the size
4. One and three quarters times the size
5. Twice the size
6. More than twice the size
8. Don't know

Estimation of Program-Level Spillover Savings

To estimate the SO savings for all trade allies, respondent-level results were extrapolated using the four steps described below. Note that we excluded one trade ally with outlier SO (Trade Ally #22 in Table 5-3 of the main report) from the first two extrapolation steps. Since the respondent-level SO from this trade ally accounted for 78% of total respondent SO and would have significantly affected overall TA SO results, we attempted to conduct a follow-up interview to confirm key responses. Despite multiple attempts to re-contact this ally, by both Opinion Dynamics and Duke Energy staff, we were not able to confirm the responses. As a result, we decided to include this trade ally's spillover, but not extrapolate it to the population.

Step 1: Respondent SO Rate

We first developed a respondent SO rate by dividing the sum of all respondents' estimated SO savings by the total program savings of all respondents (Equation C-4). Both the numerator and denominator excluded Trade Ally #22.

Equation C-4

$$\textit{Respondent SO Rate} = \frac{\textit{Respondent SO Savings}}{\textit{Respondent Program Savings}}$$

Step 2: Extrapolated TA SO Savings

We then applied the Respondent SO Rate calculated in Equation C-4 to all program savings associated with TAs, excluding Trade Ally #22 (Equation C-5). This calculation derives the Extrapolated TA SO Savings (in kWh).

Equation C-5

$$\textit{Extrapolated TA SO Savings} = \textit{Respondent SO Rate} * \textit{All Trade Ally Program Savings}$$

Step 3: Total TA SO Savings

To account for the SO savings from Trade Ally #22, we added their respondent-level SO savings to the Extrapolated TA SO Savings (Equation C-6).

Equation C-6

$$\textit{Total TA SO Savings} = \textit{Extrapolated TA SO Savings} + \textit{Trade Ally \#22 SO Savings}$$

Step 4: Program TA SO Rate

Finally, we estimated the Program TA SO Rate by dividing the Total TA SO Savings (in kWh), developed in Equation C-6, by total program-level ex post gross savings (in kWh), including savings from projects completed by a trade ally and projects completed without a trade ally (Equation C-7). This step is necessary to allow for the Program TA SO Rate to be applied to the program as a whole, instead of only to projects completed by a trade ally.

Equation C-7

$$\textit{Program TA SO Rate} = \frac{\textit{Total TA SO Savings}}{\textit{All Program Savings}}$$

Appendix D. Participant Telephone Survey Instrument

Opinion Dynamics

DEC Smart $aver® Prescriptive Incentive Program/DEP Energy Efficiency for Business Program

Participant Telephone Survey

May 9, 2017 – FINAL

Sample Variables

<PROGRAM1>	IF DEC: Smart Saver Prescriptive Incentive Program IF DEP: Energy Efficiency for Business Program
<PROGRAM2>	IF DEC: Smart Saver Program IF DEP: Energy Efficiency for Business Program
<NAME>	Customer contact name
<COMPANY>	Company name
<ADDRESS>	Location of project installation
<DATE>	Month and year of incentive
<TECHNOLOGY>	The technology about which free-ridership questions are asked
<MEAS1-4>	Measures installed as part of the <TECHNOLOGY> project
<TUNEUP>	Flag if only measure is tune-up
UTIL	Utility, 1=DEC, 2=DEP
MEAS_COUNT	COUNT OF MEASURES

Introduction

Hello, my name is __________ calling on behalf of Duke Energy. We are speaking with business customers who have participated in Duke Energy's <PROGRAM1> in North and South Carolina.
May I please speak with <NAME>?

[IF NOT AVAILABLE OR NO CONTACT NAME]
May I please speak with the person that is most knowledgeable about an energy efficient project that <COMPANY> undertook at <ADDRESS>?

[READ WHEN CORRECT CONTACT IS ON THE PHONE]

I am calling about an energy efficiency project that <COMPANY> completed through Duke Energy's <PROGRAM1> at <ADDRESS> and for which you received an incentive in <DATE>. We are conducting a short survey with customers who have participated in this program.
[IF NEEDED: Duke Energy plans to use the information from this survey to improve the energy efficiency programs and services it offers to its business customers.]
All responses will remain confidential. Results will only be reported in aggregate with other responses.

For quality control purposes, this call may be monitored or recorded.

[IF NEEDED: THIS SURVEY USUALLY TAKES ABOUT 15 MINUTES.]

Screening/Background

I would first like to verify some information about the project.

SC1. Our records indicate that in <DATE>, <COMPANY> received an incentive from Duke Energy's <PROGRAM1> for a project implemented at <ADDRESS>. Is that correct?
- 01. (Yes, participated as described)
- 02. (Yes, participated but at another location)
- 03. (Yes, participated but at different time)
- 04. (NO, did NOT participate in program)
- 00 (Other, specify)
- 98 (Don't know)
- 99 (Refused)

[ASK IF SC1=4,98,99, ELSE SKIP TO S1]
SC2. Is there someone else within the company who might know more about your company's participation in the <PROGRAM2>?
- 1. Yes
- 2. No [THANK AND TERMINATE]

[ASK IF SC2=1]
SC3. We would like to contact the person who is most knowledgeable about your company's participation in the <PROGRAM2>. Could you give us this person's name and phone number?
- 00. Yes
- 96. No
- 98. (Don't know)
- 99. (Refused)

[IF SC3=1, TAKE DOWN NAME AND NUMBER; ELSE THANK AND TERMINATE, please read "Thank you for your time and help with this study"]

Sources of Information

I first have a few general questions.

S1. How did you first hear about the <PROGRAM2>? (Interviewer note: If respondent says Duke employee or representative, probe if it is an Account Manager or Business Energy Advisor. If not, record under 08 and note the type of Duke employee.)
- 1. (Duke Energy Account Manager)
- 2. (Duke Energy Business Energy Advisor)
- 3. (Duke Energy Website)
- 4. (Contractor/Trade Ally/Vendor)
- 5. (Email)
- 6. (Bill insert)
- 7. (Friend/colleague/word of mouth)
- 08. (Duke Energy Employee – Other, specify)
- 00. (Other, specify)
- 98. (Don't know)
- 99. (Refused)

S2. Had <COMPANY> participated in the <PROGRAM1> before?
- 1. Yes
- 2. No
- 8. (Don't know)
- 9. (Refused)

Free Ridership Module

My next few questions are about the <TECHNOLOGY> project that you implemented through the <PROGRAM2> at <ADDRESS>. Based on my records, the <TECHNOLOGY> project included the following measures:

- <MEAS1>
- <MEAS2>
- <MEAS3>
- <MEAS4>
- [READ IF MEAS_COUNT>4]: As well as other <TECHNOLOGY> measures.

[READ IF TUNEUP=1: Note that some questions in this survey refer to energy efficient "equipment". For those questions, please think about the chiller tune ups for which you received an incentive.]

Selection of the Equipment

V1a. [IF TUNEUP=0: Did a contractor or vendor help you with the SELECTION of this equipment? / IF TUNEUP=1: Did a contractor recommend that you perform the tune up?]
- 1. Yes
- 2. No
- 8. (Don't Know)
- 9. (Refused)

[ASK IF V1a=1]
V1b. Who was the contractor or vendor you worked with? (Interviewer note: We are looking for the company name, not the individual.) [OPEN END]

[SKIP IF TUNEUP=1]
V2a. Did a contractor or vendor help you with the INSTALLATION of this equipment?
1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF V2a=1]
V2b. Who was the contractor or vendor you worked with? (Interviewer note: We are looking for the company name, not the individual.) [OPEN END; 96=SAME CONTRACTOR]

V3. Do you work directly with any of the following Duke Energy representatives regarding energy efficiency? Do you work with ... [1=Yes, 2=No, 8=Don't know, 9=Refused]
a. Duke Energy Account Managers?
b. Duke Energy Business Energy Advisors?
c. Duke Energy Energy Efficiency Engineers?
d. <PROGRAM2> staff?

V4. Thinking about the <TECHNOLOGY> equipment for which you received the incentive from Duke Energy, who was most influential in identifying and recommending the <TECHNOLOGY> equipment? (Note to interviewer: If they mention someone from Duke, please probe for response options 4-7).
01. (me/respondent)
02. (someone else from within the company)
03. (contractor/vendor)
04. (Duke Energy Account Manager)
05. (Duke Energy Business Energy Advisor)
06. (Duke Energy/<PROGRAM2> Staff)
07. (Duke Energy/Energy Efficiency Engineer)
00. (Other, specify)
98. (Don't know)
99. (Refused)

Timing of Decision Making

N1. When did you first learn about Duke Energy's <PROGRAM2>? Was it BEFORE or AFTER you selected the <TECHNOLOGY> equipment for which you received the incentive?
1. (Before)
2. (After)
8. (Don't know)
9. (Refused)

[ASK IF N1=2]
N2. Just to confirm, you found out about the incentive available through Duke Energy's <PROGRAM2> after you had already decided to implement the energy efficient <TECHNOLOGY> project?
01. Yes, after

02. No, before
00. (Other, specify)
98. (Don't know)
99. (Refused)

Rating of Factors

N3. My next few questions are about your decision to select energy efficient equipment rather than a less efficient alternative. Specifically, I would like you to rate the importance of Duke Energy's <PROGRAM2> as well as other factors that might have influenced your decision to select the energy efficient <TECHNOLOGY> equipment.

I will read you a list of factors. For each factor, please rate its importance on a scale from 0 to 10, where 0 means "not at all important" and 10 means "extremely important". If something does not apply, please let me know.

How important in your selection of the energy efficient equipment was… [RECORD 0 to 10; 96=Not Applicable; 98=Don't Know; 99=Refused] [ROTATE]

(Interviewer Note: Prompt for a numeric rating if not given, for example "So what rating would that be, on a 0 to 10 scale?"… If respondent says "We would not have done it", prompt with "So would you rate that as extremely important, or a 10 on a 0 to 10 scale?")

a. [ASK IF S2=1] Your previous experience with the <PROGRAM2>
b. The availability of the PROGRAM incentive
c. [ASK IF V1a=1] A recommendation from the vendor or contractor who helped you with the choice of the equipment
d. Previous experience with this type of equipment
e. [ASK IF V3a=1 OR V3b=1 OR V3c=1 OR V3d=1 OR V4=4,5,6,7] A recommendation from a Duke Energy representative (IF NEEDED: This could be an Account Manager, Business Advisor, Energy Efficiency Engineer, or <PROGRAM2> staff)
f. Information from <PROGRAM2> or Duke Energy marketing materials
g. Standard practice in your business or industry
h. Corporate policy or guidelines
i. Financial criteria, such as payback or return on the investment
j. The expected energy savings

N3o. Were there any other factors I haven't asked about that were influential in your decision to select the energy efficient <TECHNOLOGY> equipment? [OPEN END; 96=Nothing else influential]

[ASK IF N3o=00]
N3oo. Using the same 0 to 10 scale, where 0 means "not at all important" and 10 means "extremely important", how would you rate the influence of this factor (IF NEEDED: <N3o RESPONSE>)? [RECORD 0 to 10; 98=Don't Know; 99=Refused]

[ASK IF N3d=8,9,10 AND S2=1]
N3dx. You indicated that previous experience with this type of equipment was important in your decision to select the energy efficient <TECHNOLOGY> equipment. Was this previous experience associated with

equipment you installed with an earlier Duke Energy incentive, or did you install that equipment on your own?

1. (With Duke Energy incentive)
2. (On my own/No Duke Energy incentive)
3. (Both)
8. (Don't know)
9. (Refused)

[ASK IF N3i=8,9,10]

N3ix. You indicated that financial criteria were important in your decision to select the energy efficient <TECHNOLOGY> equipment. Which of the following statements best applies to this project:

01. The <PROGRAM2> rebate moved the project within the acceptable range of our financial criteria
02. The project met our required financial criteria even without the rebate
03. The project didn't meet our required financial criteria, even with the rebate
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF N3j=8,9,10]

N3jx. You indicated that the expected energy savings were important in your decision to select the energy efficient <TECHNOLOGY> equipment. How did you find out about the savings this equipment could achieve?

01. (contractor/vendor)
02. (Duke Energy Account Manager)
03. (Duke Energy Business Energy Advisor)
04. (Duke Energy Program Staff)
05. (Prior experience with equipment)
00. (Other, specify)
98. (Don't know)
99. (Refused)

Relative Importance of Program and Other Factors

Thinking about this differently, I would like you to compare the importance of the Duke Energy <PROGRAM2> with the importance of other factors in your decision to select the energy efficient <TECHNOLOGY> equipment.

N4. To make this comparison, assume you have a TOTAL of 100 points that reflect the influence on your decision to install the energy efficient <TECHNOLOGY> equipment. I would now like you to SPLIT those 100 points between: (1) the <PROGRAM2>, including support from Duke Energy staff; and (2) other factors.

How many points would you give to the importance of... [RECORD 0 to 100; 998=Don't Know; 999=Refused]

N4a. the <PROGRAM2>, including support from Duke Energy staff
N4b. other factors

[CALCULATE VARIABLE “TOTALPTS” AS: N4a + N4b; IF N4a=998, 999 OR N4b=998, 999, SET “TOTALPTS”=ZERO]

N4x. [READ IF TOTALPTS<>100 OR BLANK] The points you gave to the program and to other factors should add up to 100, but they currently add up to <TOTALPTS>. Let’s go back to the points you would give to the program and to other factors.

1. (Ok, go back) [GO BACK TO N4a AND N4b]
2. (No, don’t go back) [GO TO NEXT QUESTION]

Consistency Check #1: Program Factor Ratings Vs. Relative Importance of Program

[ASK IF (N4a>70 AND ALL OF (N3a, N3b, N3e, N3f)=MISSING,0,1,2)]

CC1a. You just gave <N4a RESPONSE> points to the importance of the program. I would interpret that to mean that the program was quite important to your decision to install the <TECHNOLOGY> equipment. But earlier, when I asked about the importance of individual elements of the program, I recorded some answers that would imply that they were not that important to you.

Specifically, you provided the following importance ratings:

- [SHOW IF N3a<>MISSING] <N3a RESPONSE> for your previous experience with the <PROGRAM2>
- <N3b RESPONSE> for the program incentive
- [SHOW IF N3e<>MISSING] <N3e RESPONSE> for the recommendation from a Duke Energy representative
- <N3f RESPONSE> for the Information from <PROGRAM2> or Duke Energy marketing materials

Just to make sure I understand this properly, can you explain how the <PROGRAM2> was important in your decision to install the energy efficient equipment? [OPEN END]

[ASK IF N4a<30 AND ANY ONE OF (N3a, N3b, N3e, N3f=8,9,10)]

CC1b. You just gave <N4a RESPONSE> points to the importance of the program. I would interpret that to mean that the program was not very important to your decision to install the <TECHNOLOGY> equipment. But earlier, when I asked about the importance of individual elements of the program, I recorded some answers that would imply that they were very important to you.

Specifically, you provided the following importance ratings:

- [SHOW IF N3a>7] <N3a RESPONSE> for your previous experience with the <PROGRAM2>
- [SHOW IF N3b>7] <N3b RESPONSE> for the program incentive
- [SHOW IF N3e>7] <N3e RESPONSE> for the recommendation from a Duke Energy representative
- [SHOW IF N3f>7] <N3f RESPONSE> for the Information from the <PROGRAM2> or Duke Energy marketing materials

Just to make sure I understand this properly, can you explain why the <PROGRAM2> was not very important in your decision to install the energy efficient equipment? [OPEN END]

CC1c. Would you like to provide a new response for either the importance ratings or the points allocation or both?

1 (Change importance ratings)
2 (Change points allocation)
3 (Change both)
4 (No, don't change)
8 (Don't know)
9 (Refused)

[ASK IF CC1c=1,3; READ BACK OLD RESPONSES, IF NECESSARY; RECORD 0 to 10; 96=Not Applicable; 98=Don't Know; 99=Refused]
How important in your selection of the energy efficient equipment was… (Repeat scale, if needed)

[SHOW IF (N4a>70 AND N3a=0,1,2) OR (N4a<30 AND N3a=8,9,10)] N3a_NEW: your previous experience with the <PROGRAM2>
[SHOW IF (N4a>70 AND N3b=0,1,2) OR (N4a<30 AND N3b=8,9,10)] N3b_NEW: the program incentive
[SHOW IF (N4a>70 AND N3e=0,1,2) OR (N4a<30 AND N3e=8,9,10)] N3e_NEW: the recommendation from a Duke Energy representative
[SHOW IF (N4a>70 AND N3f=0,1,2) OR (N4a<30 AND N3f=8,9,10)] N3f_NEW: the Information from the <PROGRAM2> or Duke Energy marketing materials
[ASK IF CC1c=2,3; READ BACK OLD RESPONSES, IF NECESSARY; RECORD 0 to 100; 998=Don't Know; 999=Refused]
N4a_NEW: How many points would you give to the <PROGRAM2>?
N4b_NEW: How many points would you give to other factors?

[MAP ORIGINAL RESPONSES INTO THESE NEW VARIABLES FOR RESPONDENTS WHO DID NOT TRIGGER THE CONSISTENCY CHECK; CREATE NEW VARIABLES= "##_UPD".]

Likelihood of Installation without Program (Counterfactual)

Now I would like you to think about the action you WOULD HAVE taken with regard to the installation of this <TECHNOLOGY> equipment if the <PROGRAM2> HAD NOT BEEN available.

N5. Without the program, what is the likelihood that the equipment would have had the same efficiency level? Please use a scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely". [RECORD 0-10; 98=Don't Know; 99=Refused]

[IF TUNEUP=1 SKIP TO N7a]
N6a. Without the program, would you have installed the same quantity of <u>energy efficient</u> equipment in <DATE> or would you have installed less?
1. Same quantity
2. Less
3. (More)
8. (Don't know)
9. (Refused)

[ASK IF N6a=2, ELSE SKIP TO CC2a]

N6b. As best as you can, please estimate the percentage of the energy efficient <TECHNOLOGY> equipment that you would have installed in <DATE> without the program. [NUMERIC OPEN END, 0 to 100%; 998=Don't Know; 999=Refused]

[IF N6b<=100% CALCULATE N_INSTALL = 100% – N6b]

[ASK IF N6b<50%]

N6c. Why would you have installed that much less energy efficient equipment? [OPEN END]

[ASK IF N6b<100%]

N7. Without the program, would you have installed the remaining <N_INSTALL> percent of the energy efficient <TECHNOLOGY> equipment at a later time?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF N7=1 OR IF TUNEUP=1]

N7a. Without the program, when do you think you would have installed the energy efficient <TECHNOLOGY> equipment? Please answer relative to the date that you ACTUALLY installed the equipment.

01. (at the same time)
02. (up to 6 months later)
03. (7 months to 1 year later)
04. (more than 1 year up to 2 years later)
05. (more than 2 years up to 3 years later)
06. (more than 3 years up to 4 years later)
07. (more than 4 years later)
08. (Never)
98. (Don't know)
99. (Refused)

[ASK IF N7a=4,5,6,7]

N7b. Why would it have been that much later? [OPEN END]

Consistency Check #2: Incentive Rating Vs. Likelihood

[ASK IF N3b_UPD=8,9,10 AND N5=8,9,10; ELSE SKIP TO ADDITIONAL PROJECTS]

I have a follow-up question on one of your earlier responses.

CC2a. When you answered <N3b_UPD RESPONSE> for the question about the influence of the incentive, I would interpret that to mean that the incentive was quite important in your selection of the efficiency level. Then, when you answered <N5 RESPONSE> for how likely you would be to install the same level of efficiency without the incentive, it sounds like the incentive was not very important.

I want to check to see if I am misunderstanding your answers or if the questions may have been unclear. Will you explain the role the incentive played in your decision to install this efficient equipment? [OPEN END]

CC2b. Would you like me to change your score on the importance of the incentive, which you gave a rating of <N3b_UPD RESPONSE>, or change the likelihood you would have installed the same level of efficiency without the incentive which you gave a rating of <N5 RESPONSE>? Or we can change both if you wish?

1. (Change importance of incentive rating)
2. (Change likelihood to install the same equipment rating)
3. (Change both)
4. (No, don't change)
8. (Don't know)
9. (Refused)

[ASK IF CC2b=1,3; READ BACK OLD RESPONSES, IF NECESSARY; RECORD 0 to 10; 98=Don't Know; 99=Refused]
N3b_NEW2: How important in your selection of the energy efficient equipment was the program incentive (Repeat scale, if needed)

[ASK IF CC2b=2,3; READ BACK OLD RESPONSES, IF NECESSARY; RECORD 0 to 10; 98=Don't Know; 99=Refused]
N5_NEW: likelihood of installing the same efficiency level without the program (Repeat scale, if needed)

[MAP ORIGINAL RESPONSES INTO THESE NEW VARIABLES FOR RESPONDENTS WHO DID NOT TRIGGER THE CONSISTENCY CHECK; CREATE NEW VARIABLES= "N3b_FNL" AND "N5_FNL".]

Spillover Module

Thank you for discussing the <TECHNOLOGY> project that you completed through the <PROGRAM2>. Next, I would like to discuss any energy efficiency improvements you might have made without receiving an incentive from Duke Energy.

SP1a. Since receiving the incentive for the project we just discussed, did you make any ADDITIONAL energy efficiency improvements at this facility or at your other facilities within Duke Energy's [IF DEC: Carolinas; IF DEP: Progress] service territory that did NOT receive an incentive from Duke Energy?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF SP1a=1, ELSE SKIP TO PROCESS MODULE]

SP1b. Have you applied, or do you still plan to apply, for a Duke Energy incentive for these energy efficiency improvements?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF SP1b=2, ELSE SKIP TO PROCESS MODULE]

SP2a. On a scale of 0-10, where 0 means “no influence” and 10 means “greatly influenced,” how much did your experience with the <PROGRAM1> influence your decision to install high efficiency equipment on your own? [SCALE 0-10; 98=Don’t know, 99=Refused]

SP2b. If you had NOT participated in the <PROGRAM1>, how likely is it that <COMPANY> would still have installed this additional energy efficient equipment? Please use a 0 to 10 scale, where 0 means you “definitely WOULD NOT have implemented this equipment” and 10 means you “definitely WOULD have implemented this equipment”. [SCALE 0-10; 98=Don’t know, 99=Refused]

[CALCULATE SP_SCORE:

- IF SP2a<>98,99 AND SP2b<>98,99, THEN SP_SCORE = (SP2a+(10-SP2b))/2
- IF SP2a<>98,99 AND SP2b=98,99, THEN SP_SCORE = SP2a
- IF SP2a=98,99 AND SP2b<>98,99, THEN SP_SCORE = 10-SP2b]

[ASK IF SP_SCORE>7, ELSE SKIP TO PROCESS MODULE]

SP2c. How did your experience with the <PROGRAM2> influence your decision to install high efficiency equipment on your own? [OPEN END]

First Spillover Measure

SP3a. What was the first energy efficient improvement that you made without a Duke Energy incentive? (IF RESPONSE IS GENERAL, E.G., “LIGHTING EQUIPMENT”, PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

1. (Lighting: LED lamps)
2. (Lighting: T8 lamps) (Note that this is a type of linear fluorescent lamps)
3. (Lighting: T5 lamps) (Note that this is a type of linear fluorescent lamps)
4. (Lighting: Highbay Fixtures)
5. (Lighting: CFLs)
6. (Lighting: Controls or Occupancy sensors)
7. (Cooling: Chiller)
8. (Cooling: Unitary/Split Air Conditioning System)
9. (Motors: Variable Frequency Drives (VFD/VSD))
10. (Motors: Efficient motors)
11. (Food service products: Anti-sweat controls)

12. (Food service products: EC motor for WALK-IN cooler/freezer)
13. (Food service products: EC motor for REACH-IN cooler/freezer)
14. (Process equipment)
15. (Information technology)
00. (Other, specify)
96. (Didn't install any measures)
98. (Don't know)
99. (Refused)

[SKIP TO PROCESS MODULE IF SP3a=96, 98, 99]
[ASK IF SP3a=1-6, ELSE SKIP TO SP3e]
SP3b. How many <SP3a RESPONSE> did you install without receiving an incentive (IF NEEDED: Probe for best estimate) [NUMERIC OPEN END; 0-995; Don't know=998, Refused=999]
SP3c. Generally, what type of light bulbs did the <SP3a RESPONSE> [READ IF SP3a=1-5: replace; READ IF SP3a=6: control]?
1. (Incandescent lamps)
2. (CFLs)
3. (LEDs)
4. (Halogen lamps)
5. (Linear fluorescent T12s)
6. (Linear fluorescent T8s)
00. (Other – specify)
98. (Don't know)
99. (Refused)

SP3d. Were the majority of <SP3a RESPONSE> installed in areas that use space cooling and heating?
1. (Cooling Only)
2. (Heating Only)
3. (Cooling and Heating)
4. (Neither Cooling nor Heating)
8. (Don't know)
9. (Refused)

SP3e. Why did you purchase the <SP3a RESPONSE> without an incentive from the <PROGRAM2>? [MULTIPLE RESPONSE, UP TO 3]
01. (Takes too long to get approval)
02. (No time to participate, needed equipment immediately)
03. (The equipment did not qualify)
04. (The amount of the incentive wasn't large enough)
05. (Did not know the program was available)
06. (There was no program available)
07. (Had reached the maximum incentive amount)
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF SP3e=3]
SP3ee. Why didn't the equipment qualify? [OPEN END]

SP3f. Did a contractor or vendor help you with the SELECTION of this equipment?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF SP3f=1]

SP3ff. Who was the contractor or vendor you worked with? (Interviewer note: We are looking for the company name, not the individual.) [OPEN END]

Second Spillover Measure

SP4. Did you implement any other energy efficient measures without a Duke Energy incentive?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF SP4=1, ELSE SKIP TO SP6]

SP4a. What other measure did you implement? (IF RESPONSE IS GENERAL, E.G., "LIGHTING EQUIPMENT", PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

1. (Lighting: LED lamps)
2. (Lighting: T8 lamps) (Note that this is a type of linear fluorescent lamps)
3. (Lighting: T5 lamps) (Note that this is a type of linear fluorescent lamps)
4. (Lighting: Highbay Fixtures)
5. (Lighting: CFLs)
6. (Lighting: Controls or Occupancy sensors)

07. (Cooling: Chiller)
08. (Cooling: Unitary/Split Air Conditioning System)
09. (Motors: Variable Frequency Drives (VFD/VSD))
10. (Motors: Efficient motors)
11. (Food service products: Anti-sweat controls)
12. (Food service products: EC motor for WALK-IN cooler/freezer)
13. (Food service products: EC motor for REACH-IN cooler/freezer)
14. (Process equipment)
15. (Information technology)
00. (Other, specify)
96. (There was no second measure)
98. (Don't know)
99. (Refused)

[ASK IF SP4a=1-6, ELSE SKIP TO SP4e]

SP4b. How many <SP4a RESPONSE> did you install without receiving an incentive (IF NEEDED: Probe for best estimate) [NUMERIC OPEN END; 0-995; Don't know=998, Refused=999]

SP4c. Generally, what type of light bulbs did the <SP4a RESPONSE> [READ IF SP4a=1-5: replace; READ IF SP4a=6: control]?
1. (Incandescent lamps)
2. (CFLs)
3. (LEDs)
4. (Halogen lamps)
5. (Linear fluorescent T12s)
6. (Linear fluorescent T8s)
00. (Other – specify)
98. (Don't know)
99. (Refused)

SP4d. Were the majority of <SP4a RESPONSE> installed in areas that use space cooling and heating?
1. (Cooling Only)
2. (Heating Only)
3. (Cooling and Heating)
4. (Neither Cooling nor Heating)
8. (Don't know)
9. (Refused)

SP4e. Why did you purchase the <SP4a RESPONSE> without an incentive from the <PROGRAM2>? [MULTIPLE RESPONSE, UP TO 3]
01. (Takes too long to get approval)
02. (No time to participate, needed equipment immediately)
03. (The equipment did not qualify)
04. (The amount of the incentive wasn't large enough)
05. (Did not know the program was available)
06. (There was no program available)
07. (Had reached the maximum incentive amount)
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF SP4e=3]
SP4ee. Why didn't the equipment qualify? [OPEN END]

SP4f. Did a contractor or vendor help you with the SELECTION of this equipment?
1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF SP4f=1]
SP4ff. Who was the contractor or vendor you worked with? (Interviewer note: We are looking for the company name, not the individual.) [OPEN END; 96=Same as for other measure, 98=Don't know, 99=Refused]

Third Spillover Measure

SP5. Did you implement any other energy efficient measures without a Duke Energy incentive?
1. Yes

2. No
8. (Don’t know)
9. (Refused)

[ASK IF SP5=1, ELSE SKIP TO SP6]

SP5a. What other measure did you implement? (IF RESPONSE IS GENERAL, E.G., “LIGHTING EQUIPMENT”, PROBE FOR SPECIFIC MEASURE. PROBE FROM LIST, IF NECESSARY.)

1. (Lighting: LED lamps)
2. (Lighting: T8 lamps) (Note that this is a type of linear fluorescent lamps)
3. (Lighting: T5 lamps) (Note that this is a type of linear fluorescent lamps)
4. (Lighting: Highbay Fixtures)
5. (Lighting: CFLs)
6. (Lighting: Controls or Occupancy sensors)
07. (Cooling: Chiller)
08. (Cooling: Unitary/Split Air Conditioning System)
09. (Motors: Variable Frequency Drives (VFD/VSD))
10. (Motors: Efficient motors)
11. (Food service products: Anti-sweat controls)
12. (Food service products: EC motor for WALK-IN cooler/freezer)
13. (Food service products: EC motor for REACH-IN cooler/freezer)
14. (Process equipment)
15. (Information technology)
00. (Other, specify)
96. (There was no third measure)
98. (Don't know)
99. (Refused)

[ASK IF SP5a=1-6, ELSE SKIP TO SP5e]

SP5b. How many <SP5a RESPONSE> did you install without receiving an incentive (IF NEEDED: Probe for best estimate) [NUMERIC OPEN END; 0-995; Don’t know=998, Refused=999]

SP5c. Generally, what type of light bulbs did the <SP5a RESPONSE> [READ IF SP5a=1-5: replace; READ IF SP5a=6: control]?

1. (Incandescent lamps)
2. (CFLs)
3. (LEDs)
4. (Halogen lamps)
5. (Linear fluorescent T12s)
6. (Linear fluorescent T8s)
00. (Other – specify)
98. (Don’t know)
99. (Refused)

SP5d. Were the majority of <SP5a RESPONSE> installed in areas that use space cooling and heating?

1. (Cooling Only)
2. (Heating Only)
3. (Cooling and Heating)
4. (Neither Cooling nor Heating)
8. (Don’t know)
9. (Refused)

SP5e. Why did you purchase the <SP5a RESPONSE> without an incentive from the <PROGRAM2>? [MULTIPLE RESPONSE, UP TO 3]

01. (Takes too long to get approval)
02. (No time to participate, needed equipment immediately)
03. (The equipment did not qualify)
04. (The amount of the incentive wasn't large enough)
05. (Did not know the program was available)
06. (There was no program available)
07. (Had reached the maximum incentive amount)
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF SP5e=3]

SP5ee. Why didn't the equipment qualify? [OPEN END]

SP5f. Did a contractor or vendor help you with the SELECTION of this equipment?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

[ASK IF SP5f=1]

SP5ff. Who was the contractor or vendor you worked with? (Interviewer note: We are looking for the company name, not the individual.) [OPEN END; 96=Same as for other measure, 98=Don't know, 99=Refused]

SP6. Thank you for sharing this information with us. We may have follow-up questions about the equipment you installed without an incentive. Would you be willing to speak briefly with a member of our team?

(IF NEEDED: This follow-up survey would happen within a few weeks of this interview and would only take a few minutes.)

00. Yes [RECORD NAME AND PHONE NUMBER]
96. No
98. (Don't know)
99. (Refused)

Process Module

My final set of questions are about your experience and satisfaction with the <PROGRAM1>.

Business Energy Advisors

[ASK IF V3b<>1]
B0. Have you ever communicated with a Duke Energy Business Energy Advisor about energy efficiency or the energy efficiency programs that Duke offers for their business customers? (IF NEEDED: This could be by phone, email, or in person.) (IF NEEDED: Business Energy Advisors are Duke staff that work with small and medium sized businesses to provide them information about energy efficiency opportunities in the <PROGRAM2>, and assist them with the participation process.)
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF B0=1 OR V3b=1, ELSE SKIP TO EE1]
B1. [READ IF V3b=1: You noted earlier that you worked with a Duke Energy Business Energy Advisor.] How did you first come into contact with the Business Energy Advisor? Did you…
01. Receive a call or email from the advisor?
02. Reach out to the advisor via phone or email?
03. Contact the advisor through the Duke Energy website?
00. (Other, specify)
98. (Don't know)
99. (Refused)

B2. Approximately, how many times did you have contact with the Business Energy Advisor, either via phone, email, or in-person? [NUMERIC OPEN END; 1-80; 98=Don't know, 99=Refused]

B3. What aspects of the <TECHNOLOGY> project did the advisor help you with?
01. (Project scoping)
02. (The application process)
03. (Identifying and contacting a trade ally)
04. (Answering questions about available program incentives)
00. (Other, specify)
98. (Don't know)
99. (Refused)

B4. How influential was the Business Energy Advisor in your decision to participate in the <PROGRAM2>. Would you say…
1. Very influential
2. Somewhat influential
3. Not very influential
4. Not at all influential
8. (Don't know)
9. (Refused)

B5a. On a scale of 0 to 10, where 0 is "Extremely Dissatisfied" and 10 is "Extremely Satisfied", how would you rate your satisfaction with the Business Energy Advisor with whom you worked? [SCALE 0-10; 98=Don't know, 99=Refused]

[ASK IF B5a<5]
B5b. Why did you give that rating? [OPEN END]

Energy Efficiency Store

EE1. Are you aware that Duke Energy has an online Energy Efficiency Store for business customers, where customers can purchase energy efficiency products at a discounted price?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF EE1=1]
EE2. Have you ever visited the Energy Efficiency Store's webpage?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF EE2=1]
EE3. Have you ever purchased energy efficient equipment from the online Energy Efficiency Store?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF EE3=1]
EE4a. On a scale of 0 to 10, where 0 is "Extremely Dissatisfied" and 10 is "Extremely Satisfied", how would you rate your satisfaction with your use of the Energy Efficiency Store? [SCALE 0-10; 98=Don't know, 99=Refused]

[ASK IF EE4a<5]
EE4b. Why did you give that rating? [OPEN END]

[READ IF EE1<>1 or EE2<>1: The online Energy Efficiency Store offers customers instant incentives on the purchase of a limited number of measures. The incentives in the Store are consistent with the incentives offered through the regular <PROGRAM1>.]

EE5a. How likely are you to make a purchase through Duke Energy's Energy Efficiency Store within the next year? Would you say...
1. Very likely
2. Somewhat likely
3. Not very likely
4. Not at all likely
6. (Need more information)

8. (Don't know)
9. (Refused)

[ASK IF EE5a=3,4]
EE5b. Why are you not likely to make a purchase through the Energy Efficiency Store?
01. (Don't have enough information)
02. (Don't need any new equipment)
03. (Equipment I need is not available)
04. (Incentives aren't high enough)
00. (Other, specify)
98. (Don't know)
99. (Refused)

Online Customer Portal

OP1. Are you aware that Duke Energy has a customer portal where customers can submit applications for energy efficiency projects and track the status of their applications?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF OP1=1]
OP2. Have you ever used the online portal?
1. Yes
2. No
8. (Don't know)
9. (Refused)

[ASK IF OP2=1]
OP3. How did you use the online portal? [MULTIPLE RESPONSE, UP TO 3]
01. (Submit applications)
02. (Track status of applications)
00. (Other, specify)
98. (Don't know)
99. (Refused)

[ASK IF OP2=2]
OP4. Why have you not used the online portal? [OPEN END; 96=No specific reason, 98=Don't know, 99=Refused]

Satisfaction

SAT1. I'm interested in how satisfied you are with different aspects of the <PROGRAM1>. On a scale of 0 to 10, where 0 is "Extremely Dissatisfied" and 10 is "Extremely Satisfied", how would you rate your satisfaction with… (Interviewer note: these satisfaction questions are asking specifically about Duke's prescriptive, not custom, program. Respondents may have participated in both. If there is uncertainty from the respondent about which we are referring to, please clarify that we are asking about prescriptive) [SCALE 0-10; 96=Not applicable, 98=Don't know, 99=Refused] [ROTATE]

a. The application process
b. The measures that are eligible for incentives through the <PROGRAM1>
c. The incentive levels
d. [ASK IF V2a=1] The contractor who helped you install the equipment
e. Your interactions with <PROGRAM1> staff
f. The <PROGRAM1> overall [ANCHOR]

[ASK IF SAT1a<5]
SAT2a. Your response suggests that you are not fully satisfied with the application process. Why did you give this rating? [OPEN END]

[ASK IF SAT1b<5]
SAT2b. Your response suggests that you are not fully satisfied with the measures eligible for incentives. What specific measures would you like the program to add? [OPEN END]

[ASK IF SAT1c<5]
SAT2c. Your response suggests that you are not fully satisfied with the incentive levels. Which measures do you think should have different incentive levels? [OPEN END]

[ASK IF SAT1d<5]
SAT2d. Your response suggests that you are not fully satisfied with the contractor who helped you install the equipment. Why did you give this rating? [OPEN END]

[ASK IF SAT1e<5]
SAT2e. Your response suggests that you are not fully satisfied with your interactions with <PROGRAM1> staff. Why did you give this rating? [OPEN END]

[ASK IF SAT1f<5]
SAT2f. Your response suggests that you are not fully satisfied with the <PROGRAM1> overall. Why did you give this rating? [OPEN END]

SAT3a. How likely are you to participate in the <PROGRAM1> again, within the next year? Would you say…

1. Very likely
2. Somewhat likely
3. Not very likely
4. Not at all likely
8. (Don't know)
9. (Refused)

[ASK IF SAT3a=3,4]
SAT3b. Why are you not likely to participate in the program again?

01. (Was not satisfied with the program)
02. (Don't need any new equipment)
03. (Equipment I need is not available)
04. (Incentives aren't high enough)
00. (Other, specify)
98. (Don't know)
99. (Refused)

SAT4a. How likely are you to recommend the <PROGRAM1> to other businesses like yours? Would you say…
1. Very likely
2. Somewhat likely
3. Not very likely
4. Not at all likely
8. (Don't know)
9. (Refused)

[ASK IF SAT4a=3,4]
SAT4b. Why are you not likely to recommend the <PROGRAM1> to other businesses?
01. (Was not satisfied with the program)
02. (Selection of eligible equipment)
03. (Incentives levels)
04. (Paperwork/Application process)
00. (Other, specify)
98. (Don't know)
99. (Refused)

Barriers to Participation

BR1a. What do you view as the main barriers, if any, to participating in the <PROGRAM1>? [MULTIPLE RESPONSE, UP TO 5]
01. (Paperwork/Application process/Time required to complete application)
02. (Selection of equipment available through the <PROGRAM1>)
03. (Incentive levels)
04. (Knowledge of incentives and eligible products)
00. (Other, specify)
96. (None – don't see any barriers)
97. (Same as just mentioned)
98. (Don't know)
99. (Refused)

[SKIP IF BR1a=96,98,99]
BR1b. What could Duke Energy do to reduce these barriers to participation in the <PROGRAM1>? [OPEN END]

BR2. And more generally, what do you view as the main barriers to making energy efficient improvements at your facility? [MULTIPLE RESPONSE, UP TO 5] (IF NEEDED: This is independent of participation in the program.)
01. (Higher cost of energy efficient equipment)
02. (Access to financing or capital for energy improvements)

03. (Difficulty finding information on how to improve energy efficiency)
04. (Uncertainty about the savings from energy efficiency improvements)
05. (Lease structure / We are renters)
06. (Difficult to find contractors)
00. (Other, specify)
96. (None – don't see any barriers)
98. (Don't know)
99 (Refused)

Firmographics

You are almost done! I just have a few general questions about your company.

F1. What is the business type of the facility located at <ADDRESS>? (PROBE, IF NECESSARY)
01. (K-12 School)
02. (College/University)
03. (Grocery)
04. (Medical)
05. (Hotel/Motel)
06. (Light Industry)
07. (Heavy Industry)
08. (Office)
09. (Restaurant)
10. (Retail/Service)
11. (Government)
00. (Other, specify)
98. (Don't know)
99. (Refused)

F2. Which of the following best describes the ownership of this facility?
1. My company owns and occupies this facility
2. My company owns this facility but it is rented to someone else
3. My company rents this facility
8. (Don't know)
9. (Refused)

F3a. How many employees, full plus part-time, are employed at this facility? [NUMERIC OPEN END, 0 TO 2000; 9998=Don't know, 9999=Refused]

[ASK IF F3a=9998]

F3b. Do you know the approximate number of employees? Would you say it is…?

1. Less than 10
2. 10-49
3. 50-99
4. 100-249
5. 250-499
6. 500 or more
8. (Don't know)
9. (Refused)

F4. What is the primary heating fuel for your facility?

1. (Electricity)
2. (Gas)

00. (Other – specify)
98. (Don't know)
99. (Refused)

Those are all the questions I have for you today. Thank you again for your participation!

Appendix E. Trade Ally Online Survey Instrument

Opinion Dynamics

DEC Smart $aver® Prescriptive Incentive Program / DEP Energy Efficiency for Business Program

Trade Ally Internet Survey

May 26, 2017 – FINAL

Sample Variables

<PROGRAM1>	IF DEC (1): Smart $aver Prescriptive Incentive Program IF DEP (2): Energy Efficiency for Business Program
<PROGRAM2>	IF DEC (1): Smart $aver Program IF DEP (2): Energy Efficiency for Business Program
<JURISDICTION>	IF DEC (1): Carolinas IF DEP (2): Progress
<NAME>	Trade ally contact name
<TRADEALLY_NAME>	Trade ally company name
<COUNT>	Number of projects completed by trade ally (from tracking database)
<EVALPERIOD>	IF DEC (1): August 2015 and February 2017 IF DEP (2): March 2016 and February 2017

Email Invitation

Email address: DukeEnergyResearch@opiniondynamics.com

Sender name: Duke Energy Research

Subject line: Duke Energy Needs Your Help - Important Trade Ally Survey

Dear <NAME>,

As a valued trade ally of the Duke Energy <JURISDICTION> <PROGRAM2>, we are interested in getting feedback regarding <TRADEALLY_NAME>'s experience in the program. The information collected in this survey is intended to help Duke Energy improve its <PROGRAM2> for both business customers and trade allies like you. To ensure that your responses are anonymous, Duke Energy has hired a third-party research firm, Opinion Dynamics, to conduct this survey.

You can access the survey by clicking on the link below:

[INSERT UNIQUE URL TO SURVEY]

If you would like to complete the survey in more than one session, or if you need to exit out of the survey for any reason, you can return to the last question you answered by clicking on the link from this email. You can use your computer, smart phone, or tablet to complete this survey.

Your assistance is critical to this important study. As a token of our appreciation, we will provide a $50 gift card to the first 30 trade allies that respond to this survey. In addition, we will raffle off ten more $50 gift cards among those responding by June 16th, 2017.

If you have any questions or difficulties completing this survey, please contact Opinion Dynamics, the company administering this survey, at nmckay@opiniondynamics.com. If you have any questions about this study, please feel free to contact Monica Redman at Monica.Redman@duke-energy.com or 513-287-3319.

Thank you in advance for your assistance!

Sincerely,

Monica Redman

Opening Screen

Thank you for agreeing to participate in this survey about Duke Energy's <PROGRAM1>. We are interested in your experience with the program and the impact it may have had on your business. Duke Energy plans to use the information from this survey to improve the energy efficiency programs and services it offers to its business customers.

All responses will remain confidential and will only be reported in aggregate with other responses.

If you experience any technical issues with this survey, please contact Opinion Dynamics, the company administering this survey, at nmckay@opiniondynamics.com.

Screening/Background

The first few questions are about <TRADEALLY_NAME> and its participation in Duke Energy's <PROGRAM 1>.

SC0a. Which of the following best describes your business?
- 01. Contractor
- 02. Engineering Firm
- 03. Energy Service Company (ESCO)
- 04. Equipment Vendor/Distributor
- 05. Equipment Manufacturer
- 00. Other [SPECIFY]

SC0b. What type of equipment, if any, is your company's area of expertise? *Please select all that apply.* [MULTIPLE RESPONSE; UP TO 5]
- 01. Lighting
- 02. HVAC

03. Process equipment
04. Motors, pumps, VFDs
05. Food service products
06. Information technology
07. Compressed air equipment
00. Other [SPECIFY]
96. No area of expertise

SC0c. For how many years has <TRADEALLY_NAME> participated in Duke Energy's <PROGRAM1>?
1. Less than a year
2. One year
3. Two years
4. Three years
5. Four years
6. Five years or more
8. Don't know

SC1. Our records indicate that <TRADEALLY_NAME> completed <COUNT> project(s) through the Duke Energy <JURISDICTION> <PROGRAM 1> between <EVALPERIOD>.

Do you recall <TRADEALLY_NAME> completing this number of projects?
1. Yes
2. No
8. Unsure

[ASK IF SC1=2 OR 8]
SC1a. Approximately how many projects did <TRADEALLY_NAME> complete through the Duke Energy <JURISDICTION> <PROGRAM1> between <EVALPERIOD>? [NUMERIC OPEN END; 9998=Don't know]

[ASK IF SC1a=0, 9998]
SC2. Is there someone else within the company who might know more about your company's involvement in the <PROGRAM1> in North or South Carolina?
1. Yes
2. No [THANK AND TERMINATE]

[ASK IF SC2=1]
SC3. We would like to contact the person who is knowledgeable about your company's involvement in the <PROGRAM1> in North or South Carolina. Could you give us this person's name and email address?
1. Yes [SPECIFY, THANK AND TERMINATE]
2. No [THANK AND TERMINATE]

Market Effects and Spillover Module

Program Influence on Business Practices

The next few questions are about the influence of the <PROGRAM1> on your business in the Duke Energy <JURISDICTION> service territory.

PI1. Since <TRADEALLY_NAME> became a <PROGRAM2> trade ally, have any of the following aspects changed and if so, by how much?

		1 - Did not Increase	2 - Increased Somewhat	3 - Increased Greatly
a	Your knowledge of high efficiency options	❍	❍	❍
b	Your comfort level in discussing the benefits of high efficiency equipment with your customers	❍	❍	❍
c	The percentage of sales situations in which you <u>recommend</u> high efficiency equipment	❍	❍	❍
d	The percentage of jobs in which <TRADEALLY_NAME> <u>installs</u> high efficiency equipment in Duke Energy's <JURISDICTION> service territory	❍	❍	❍
e	The total volume of high efficiency equipment <TRADEALLY_NAME> <u>installs</u> in Duke Energy's <JURISDICTION> service territory	❍	❍	❍

[ASK IF ANY IN PI1a-e=2 OR 3, ELSE SKIP TO Process Module]

PI2. Did the <PROGRAM2> (including the program incentive and any training, information, or other support that the program provided) contribute at all to these increases?

1 Yes
2 No
8 Don't know

[ASK IF PI2=1, ELSE SKIP TO Process Module]

PI3. On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <PROGRAM2> on the increase in… [SHOW ONLY ASPECTS WHERE PI1a-e=2 OR 3]

a	Your knowledge of high efficiency options	[0-10]
b	Your comfort level in discussing the benefits of high efficiency with your customers	[0-10]
c	The percentage of sales situations in which you <u>recommend</u> high efficiency equipment	[0-10]
d	The percentage of jobs in which <TRADEALLY_NAME> <u>installs</u> high efficiency equipment in the Duke Energy <JURISDICTION> service territory	[0-10]
e	The total volume of high efficiency equipment <TRADEALLY_NAME> installs in the Duke Energy <JURISDICTION> service territory	[0-10]

[ASK IF PI3d=6,7,8,9,10 OR PI3e=6,7,8,9,10, ELSE SKIP TO PI5]

PI4. Please describe how the <PROGRAM2> was influential in increasing…

- a. [SHOW IF PI3d=6,7,8,9,10] the **percentage of jobs** in which <TRADEALLY_NAME> installs high efficiency equipment in the Duke Energy <JURISDICTION> service territory? [OPEN END]
- b. [SHOW IF PI3e=6,7,8,9,10] the **total volume of high efficiency equipment** <TRADEALLY_NAME> installs in the Duke Energy <JURISDICTION> service territory? [OPEN END]

PI5. Did any factors, other than the <PROGRAM2>, contribute to the increases you mentioned?

1 Yes
2 No
8 Don't know

[ASK IF PI5=1]

PI5a. What were those factors? [OPEN END]

PI6a. Has your participation in the <PROGRAM2> affected your business practices in any other ways?

1 Yes
2 No
8 Don't know

[ASK IF PI6a=1]

PI6b. How has your participation in the <PROGRAM2> affected your business practices? [OPEN END]

Trade Ally Installations

For the next questions, please think about all of your jobs in Duke Energy's <JURISDICTION> service territory between <EVALPERIOD>.

TA1. Approximately what percentage of your total equipment installations (in terms of dollars) was…

Please provide your best estimate, if unsure of exact percentages. [0% TO 100%; 998=DON'T KNOW]

a Standard Efficiency [REQUIRE RESPONSE]
b High Efficiency - that DID RECEIVE an incentive from Duke Energy [REQUIRE RESPONSE]
c High Efficiency - that DID NOT RECEIVE an incentive from Duke Energy [REQUIRE RESPONSE]

Standard efficiency products meet the Federal minimum standard for energy consumption, but are no more energy-efficient than the standard requires.

IF ANY TA1a-c=MISSING, show error message: Please provide a response to each equipment category listed above. If you are unable to provide an estimate for a particular category, please select 'don't know'.

[CALCULATE "TOTAL %" TA1a+TA1b+TA1c]; IF NONE OF TA1a-c=998 AND TOTAL<>100%, show error message: The equipment breakdown you just provided sums to [TOTAL %] but it should sum to 100%. Would you please revise your answer so that it sums to 100%? If you are unable to provide an estimate for a particular category, please select 'don't know'.

Please click either arrow below to return to the previous page and revise your answer.

[ASK IF TA1c=998]

TA2a. Between <EVALPERIOD>, did <u>any</u> of your customers in Duke Energy's <JURISDICTION> service territory install high efficiency equipment that did not receive a Duke Energy incentive?

1. Yes
2. No
8. Don't know

[ASK IF TA2a=1]

TA2b. Approximately, how many of your projects in Duke Energy's <JURISDICTION> service territory between <EVALPERIOD> used high efficiency equipment but did not receive a <PROGRAM2> incentive? [NUMERIC OPEN END; 998=DON'T KNOW]

Spillover Determination

[SKIP TO PROCESS MODULE, IF TA1b=0% OR 100% OR TA1c=0% OR 100% OR TA2a=2,8]

For the following questions, please think about the [SHOW IF TA1c<>998: TA1c% of] installations <TRADEALLY_NAME> completed in Duke Energy's <JURISDICTION> service territory that were HIGH EFFICIENCY BUT THAT DID NOT RECEIVE AN INCENTIVE from Duke Energy.

SO1a. How influential was your recommendation on your customers' choice of high efficiency equipment over standard efficiency equipment?

Not at all Influential										Extremely Influential
0	1	2	3	4	5	6	7	8	9	10

SO1b. What type of high efficiency equipment did your customers install without an incentive from Duke Energy? [OPEN END]

SO1c. Why do you think that these customers did not participate in the <PROGRAM2> even though they installed high efficiency equipment? [OPEN END]

Relative Size of Projects

[SKIP TO PROCESS MODULE, IF PI3d<6 AND PI3e<6]

RS1a. In terms of cost, how large were the projects that installed high efficiency equipment but did NOT receive an incentive?

1. Smaller than projects that received an incentive
2. About the same size as projects that received an incentive
3. Larger than projects that received an incentive
8. Don't know

[ASK IF RS1a=1]
RS1b. Approximately, how much smaller would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

For example, if the average cost of high efficiency projects that did NOT receive an incentive is $15,000 and the average cost of projects that DID receive an incentive is $20,000, your answer would be $15,000 / $20,000 = 75%, or "three quarters of the size".

1. More than three quarters of the size
2. Three quarters of the size
3. Half the size
4. A quarter of the size
5. Less than a quarter of the size
8. Don't know

[ASK IF RS1a=3]
RS1c. Approximately, how much larger would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

For example, if the average cost of high efficiency projects that did NOT receive an incentive is $25,000 and the average cost of projects that DID receive an incentive is $20,000, your answer would be $25,000 / $20,000 = 125%, or "one and a quarter times the size".

1. Less than one and a quarter times the size
2. One and a quarter times the size
3. One and a half times the size
4. One and three quarters times the size
5. Twice the size
6. More than twice the size
8. Don't know

Process Module

Customer Awareness and Barriers to Participation

The next few questions are about your customers and their awareness of, and interest in, energy efficiency and the <PROGRAM1>.

AW1. How many of your customers are aware of options for energy efficiency upgrades at their facilities?

1. All of my customers (100%)
2. Most of my customers (75% or more)
3. Some of my customers (20% - 74%)
4. Less than 20% of my customers
5. None of my customers

AW2. How many of your customers already know about the <PROGRAM1> before you discuss it with them?
1. All of my customers (100%)
2. Most of my customers (75% or more)
3. Some of my customers (20% - 74%)
4. Less than 20% of my customers
5. None of my customers

AW3a. How often do you promote the <PROGRAM1> to your customers? Would you say you promote it to...
1. All of my customers (100%)
2. Most of my customers (75% or more)
3. Some of my customers (20% - 74%)
4. Less than 20% of my customers
5. None of my customers

[ASK IF AW3a<>1]
AW3b. When you do not promote the <PROGRAM1> to your customers, what are the reasons? [OPEN END]

AW4. What do you view as the main barriers that prevent your customers from installing energy efficient equipment? [OPEN END]

AW5a. What do you view as the main barriers that prevent your customers from participating in the <PROGRAM1>? [OPEN END; 96=No barriers to participation]

[SKIP IF AW5a=96]
AW5b. What could Duke Energy do to reduce these barriers to customer participation in the <PROGRAM1>? [OPEN END]

Trade Ally Training

The next set of questions is about training provided by the <PROGRAM2>.

TR1. Have you participated in any training provided by the <PROGRAM2>?
1. Yes
2. No

[ASK IF TR1=1, ELSE SKIP TO TR4]
TR2. Which of the following trainings have you participated in? Please select all that apply. [ROTATE; MULTIPLE RESPONSE; UP TO 5]
01. Program training
02. Sales training
03. Online application portal training
00. Other [SPECIFY] [ANCHOR]

[LOOP THROUGH TR3a-d FOR EACH TRAINING SELECTED IN TR2]
TR3a. When did you receive the [TRAINING TYPE] from Duke Energy? [MULTIPLE RESPONSE]
1. 2014
2. 2015
3. 2016
4. 2017
8. Don't know

TR3b. How useful was the [TRAINING TYPE]?

Not at all useful										Extremely useful
0	1	2	3	4	5	6	7	8	9	10

[ASK IF TR3b<5]
TR3c. What would have made the [TRAINING TYPE] more useful? [OPEN END]

[ASK IF TR3b>5]
TR3d. What was the most useful about the [TRAINING TYPE]? [OPEN END]

[ASK IF TR1=2]
TR4. Why have you not participated in a <PROGRAM2> training? [OPEN END]

[SKIP IF TR1=2]
TR5a. Is there any other type of training that Duke Energy could provide that would help you promote the <PROGRAM2>?
1. Yes
2. No

[ASK IF TR5a=1]
TR5b. What type of training would be helpful to you? [OPEN END]

Online Application Portal

The next few questions are about your experience with Duke Energy's Online Application Portal.
OP1. Are you aware that Duke Energy has an online portal where trade allies can submit applications for energy efficiency projects, track the status of their applications, and access program information?
1. Yes
2. No

[ASK IF OP1=1, ELSE SKIP TO NEXT SECTION]
OP2. Have you ever used the online portal?
1. Yes
2. No

[ASK IF OP2=1, ELSE SKIP TO OP5]
OP3. How have you used the online portal? Have you used it to… *Please select all that apply.* [MULTIPLE RESPONSE, up to 4]
01. Submit applications
02. Track the status of applications

03. Access program materials
00. (Other, specify)

[ASK IF OP3=1]
OP4. Approximately, what percentage of applications for the <PROGRAM1> do you submit through the online portal? [NUMERIC OPEN END: 0-100%; 998=Don't know]

[ASK IF OP2=2]
OP5. Why have you not used the online portal? [OPEN END]

Contractor Experience and Satisfaction with the Program

The next few questions are about your experience with the <PROGRAM1>.
SAT1. How would you rate your satisfaction with the following components of the <PROGRAM1>? [ROTATE]

Extremely Dissatisfied 0	1	2	3	4	5	6	7	8	9	Extremely Satisfied 10	Not applicable

g. The application process
h. The measures that are eligible for incentives through the <PROGRAM1>
i. The incentive levels
j. The <PROGRAM2> Trade Ally Online Portal
k. Your interactions with <PROGRAM2> staff
l. The <PROGRAM1> overall [ANCHOR]

[ASK IF SAT1a<8]
SAT2a. Your response suggests that you are not fully satisfied with the application process. Why did you give this rating? [OPEN END]

[ASK IF SAT1b<8]
SAT2b. Your response suggests that you are not fully satisfied with the measures eligible for incentives. What specific measures would you like the program to add? [OPEN END]

[ASK IF SAT1c<8]
SAT2c. Your response suggests that you are not fully satisfied with the incentive levels. Which measures do you think should have different incentive levels? [OPEN END]

[ASK IF SAT1d<8]
SAT2d. Your response suggests that you are not fully satisfied with the <PROGRAM2> Trade Ally Online Portal. Why did you give this rating? [OPEN END]

[ASK IF SAT1e<8]
SAT2e. Your response suggests that you are not fully satisfied with your interactions with <PROGRAM2> staff. Why did you give this rating? [OPEN END]

[ASK IF SAT1f<8]
SAT2f. Your response suggests that you are not fully satisfied with the <PROGRAM1> overall. Why did you give this rating? [OPEN END]

Firmographics

You are almost done. The last few questions are general questions about your company.

F1. Approximately how many TOTAL COMMERCIAL OR INDUSTRIAL PROJECTS does your company implement in a typical year in Duke Energy's <JURISDICTION> service territory? *If unsure, please provide your best estimate.* [NUMERIC OPEN END; 1-9000, 9998=Don't know]

F2. How many employees does your company have? [OPEN END]

F3. Would you consider your company to be local, regional, national, or international in size?
1. Local
2. Regional
3. National
4. International

F4. What are the key business sectors your company serves? *Please select all that apply.* [MULTIPLE RESPONSE; UP TO 6]
01. K-12 School
02. College/University
03. Grocery
04. Medical
05. Hotel/Motel
06. Light Industry
07. Heavy Industry
08. Office
09. Restaurant
10. Retail/Service
11. Government
00. Other [SPECIFY]

Final Screen

Gift cards to the first 30 respondents will be awarded based on the date and time this survey is submitted. To be eligible to receive a $50 gift card, please complete the following information.
If you do not wish to provide this information, you may leave this page blank and continue to the next screen to submit your responses.

Name:
Email address:

Electronic gift cards will be emailed to the email address provided above. If you prefer to receive your gift card via mail, please check the box below and provide your mailing address.

□ I prefer to receive a gift card by mail
Mailing address: ____________________

This concludes the survey. Thank you again for your participation!
Please click the SUBMIT button to submit your responses.

[After submitting the survey, respondents will be directed to the Duke Energy Smart $aver® Incentive Program website: https://www.duke-energy.com/business/products/smartsaver]

Appendix F. Participant Telephone Survey Cross-Tabulations

This Appendix contains detailed results from the participant telephone survey. We provide results in the form of Wincross tables with a breakdown of survey results by jurisdiction and technology (lighting and non-lighting).

Survey Summary

Program	Non-Residential Prescriptive Smart $aver Energy Efficiency for Business
Jurisdiction	DEC & DEP
Survey Type	Telephone (CATI)
Target Population	Program participants
Dates Fielded	May 4 - June 14, 2017
Number of Completes[4]	221
Response Rate	20.3%
Average Survey Time for Completes	15 min 33 sec

[4] A total of 221 participants completed the survey. Four records were dropped from questions N1 to N7b to reflect their exclusion from the free-ridership analysis.

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Weighted

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Duke Non-Residential Prescriptive

TABLE OF CONTENTS

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_s1 Page 1

Duke Non-Residential Prescriptive

S1. I first have a few general questions. How did you first hear about the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	125	91	113	13	79	12
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	121	90	70	51	69	21
Contractor/Trade Ally/ Vendor	51 40.7%	33 36.9%	46 40.5%	5 41.9% F	32 40.9% F	1 10.1%
Friend/Colleague/Word of Mouth	43 34.2%	28 31.0%	41 36.2% D	2 16.0%	27 34.0% F	1 11.0%
Duke Energy Account Manager	11 8.9%	2 2.4%	9 8.0%	2 17.1% F	2 2.7%	0 0.9%
Duke Energy Employee - Please Specify Type of	5 3.7%	6 6.3%	4 3.6%	1 4.4%	6 7.1%	0 0.9%
Duke Energy Website	5 4.2%	4 4.5%	4 3.7%	1 8.2%	1 1.4%	3 25.1% E
Past Experience	1 0.9%	6 7.1%	1 0.9%	0 1.3%	3 3.5%	4 31.1% DE
Bill Insert	3 2.1%	4 4.7%	2 1.8%	1 4.9%	3 3.8%	1 11.0%
Other Duke Outreach	4 3.4%	2 2.2%	4 3.5%	0 2.4%	2 2.6%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_s1 Page 2
(Continued)
Duke Non-Residential Prescriptive

S1. I first have a few general questions. How did you first hear about the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Duke Energy Business Energy Advisor	2 1.5%	2 2.3%	2 1.7%	-	2 2.7%	-
Email	0 0.4%	0 0.2%	-	0 3.8%	0 0.3%	-
Other Specify	-	2 2.3%	-	-	1 1.1%	1 10.0%
Don't Know	2 1.3%	3 3.3%	0 0.1%	2 10.8% C	3 3.7%	0 0.9%
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qs2 Page 3

Duke Non-Residential Prescriptive

S2. Had <company> participated in the <program> before?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	32 25.3%	25 26.8%	26 23.1%	6 42.3% c	21 25.3%	4 36.7%
No	84 66.3%	64 67.9%	77 68.3%	7 51.2%	57 69.3%	7 58.3%
(Don't know)	11 8.4%	5 5.4%	10 8.6%	1 6.5%	4 5.4%	1 5.0%
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv1a Page 4

Duke Non-Residential Prescriptive

V1a. Did a contractor or vendor help you with the SELECTION of this equipment?/Did a contractor recommend that you perform the tune up?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	111 87.1%	80 84.6%	99 88.3%	11 77.9%	71 86.1%	9 74.2%
No	16 12.4%	12 12.4%	13 11.6%	3 18.7%	9 10.5%	3 25.8%
(Don't know)	0 0.3%	-	0 0.2%	0 1.2%	-	-
(Refused)	0 0.2%	3 3.0%	-	0 2.2%	3 3.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv1b Page 5

Duke Non-Residential Prescriptive

V1b. Who was the contractor or vendor you worked with?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	111 100.0%	80 100.0%	99 100.0%	11 100.0%	71 100.0%	9 100.0%
Total Responses (Unweighted)	106 100.0%	80 100.0%	63 100.0%	43 100.0%	63 100.0%	17 100.0%
Open ended response	71 64.2%	54 67.5%	60 60.8%	11 94.4% C	46 65.2%	8 85.3%
(Don't know)	40 35.8%	26 32.5%	39 39.2% D	1 5.6%	25 34.8%	1 14.7%
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv2a Page 6

Duke Non-Residential Prescriptive

V2a. Did a contractor or vendor help you with the INSTALLATION of this equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	92 72.6%	69 73.5%	80 70.9%	12 85.5% c	59 72.1%	10 83.2%
No	35 27.4%	25 26.5%	33 29.1% d	2 14.5%	23 27.9%	2 16.8%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv2b Page 7

Duke Non-Residential Prescriptive

V2b. Who was the contractor or vendor you worked with?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	92 100.0%	69 100.0%	80 100.0%	12 100.0%	59 100.0%	10 100.0%
Total Responses (Unweighted)	104 100.0%	72 100.0%	56 100.0%	48 100.0%	55 100.0%	17 100.0%
Open ended response	18 20.0%	20 29.5%	15 18.8%	3 27.9%	17 28.3%	4 37.0%
(Same contractor: <QV1B: O>)	38 41.2%	25 35.7%	31 38.4%	7 59.8% c	21 35.3%	4 38.1%
(Don't know)	35 37.8%	24 34.5%	33 41.7% D	1 12.2%	21 36.1%	2 25.0%
(Refused)	1 1.0%	0 0.3%	1 1.1%	-	0 0.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv3a Page 8

Duke Non-Residential Prescriptive

V3a. Do you work with ... Duke Energy Account Managers?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	28 21.7%	15 15.5%	23 20.0%	5 35.0%	11 13.9%	3 26.8%
No	95 74.9%	74 78.6%	86 76.5%	9 62.9%	66 80.2%	8 68.2%
(Don't know)	0 0.2%	4 3.8%	-	0 2.2%	3 3.7%	1 5.0%
(Refused)	4 3.1%	2 2.0%	4 3.5%	-	2 2.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv3b Page 9

Duke Non-Residential Prescriptive

V3b. Do you work with ... Duke Energy Business Energy Advisors?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	7 5.8%	6 6.7%	6 5.4%	1 8.9%	4 4.8%	2 20.0%
No	117 91.8%	87 92.1%	104 92.7%	12 85.0%	78 94.7% f	9 74.1%
(Don't know)	3 2.4%	1 1.2%	2 1.9%	1 6.1%	0 0.5%	1 5.9%
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv3c Page 10

Duke Non-Residential Prescriptive

V3c. Do you work with ... Duke Energy Energy Efficiency Engineers?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	8 6.3%	6 6.1%	5 4.8%	3 18.2% c	3 3.9%	2 20.9%
No	119 93.6%	85 90.3%	107 95.2% d	12 80.6%	77 93.5% F	8 68.3%
(Don't know)	0 0.1%	3 3.6%	-	0 1.2%	2 2.6%	1 10.8%
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qv3d Page 11

Duke Non-Residential Prescriptive

V3d. Do you work with ... <program> staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	15 11.5%	13 13.5%	11 10.0%	3 23.8%	10 12.2%	3 22.5%
No	111 87.4%	78 82.9%	100 89.1% d	11 73.8%	70 85.3%	8 66.6%
(Don't know)	0 0.3%	3 3.5%	0 0.1%	0 2.4%	2 2.5%	1 10.9%
(Refused)	1 0.7%	-	1 0.8%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_v4 Page 12

Duke Non-Residential Prescriptive

rec_V4. Who was most influential in identifying and recommending the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Contractor/Vendor	82 64.3%	56 59.2%	73 64.5%	9 62.5%	49 60.3%	6 51.5%
Me/Respondent	14 11.0%	15 16.3%	12 10.7%	2 13.6%	14 17.0%	1 11.8%
Someone Else From Within the Company	17 13.0%	8 8.7%	14 12.5%	2 17.4% F	8 9.8%	0 0.9%
Duke Energy Account Manager	4 3.4%	-	4 3.5%	0 2.2%	-	-
Duke Energy/ Staff	1 0.7%	1 1.3%	1 0.8%	-	-	1 9.9%
Duke Energy/Energy Efficiency Engineers	-	1 0.6%	-	-	-	1 5.0%
Duke Energy Business Energy Advisor	0 0.2%	-	-	0 2.2%	-	-
Duke Marketing	-	-	-	-	-	-
Duke Staff (not specified)	-	-	-	-	-	-
Other Specify	9 7.2%	9 9.6%	9 7.9%	0 2.2%	8 10.3%	1 5.0%
Don't Know	-	4 4.3%	-	-	2 2.6%	2 15.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_v4 Page 13
(Continued)
Duke Non-Residential Prescriptive

rec_V4. Who was most influential in identifying and recommending the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Refused	0 0.1%	-	0 0.1%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn1 Page 14

Duke Non-Residential Prescriptive

N1. When did you first learn about Duke Energy's <program>? Was it BEFORE or AFTER you selected the <TECH> equipment for which you received the incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
(Before)	107 84.5%	82 91.4%	98 86.7% D	9 66.6%	71 91.6%	11 90.0% D
(After)	18 14.2%	5 5.9%	15 13.2%	3 22.3% F	5 6.0%	1 5.0%
(Don't know)	2 1.3%	2 1.7%	0 0.1%	2 11.1% C	1 1.2%	1 5.0%
(Refused)	-	1 1.0%	-	-	1 1.2%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn2 Page 15

Duke Non-Residential Prescriptive

N2. Just to confirm, you found out about the incentive available through Duke Energy's <program> after you had already decided to implement the energy efficient <TECH> project?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	18 100.0%	5 100.0%	15 100.0%	3 100.0%	5 100.0%	1 100.0%
Total Responses (Unweighted)	21 100.0%	7 100.0%	8 100.0%	13 100.0%	6 100.0%	1 100.0%
Yes, after	13 72.7%	5 100.0%	11 72.6%	2 73.5%	5 100.0%	1 100.0%
No, before	-	-	-	-	-	-
(Other: Specify)	1 5.1%	-	0 0.6%	1 26.5%	-	-
(Don't know)	4 22.2%	-	4 26.8%	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3a Page 16

Duke Non-Residential Prescriptive

N3a. How important in your selection of the energy efficient equipment was... Your previous experience with the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	32 100.0%	23 100.0%	26 100.0%	6 100.0%	19 100.0%	4 100.0%
Total Valid Responses	30	21	24	6	17	4
Total Responses (Unweighted)	44	22	18	26	14	8
Total Valid Responses (Unweighted)	40	19	16	24	12	7
Net 0-4	2 5.1%	-	1 3.8%	1 10.7%	-	-
0 - Not at all important	-	-	-	-	-	-
1	-	-	-	-	-	-
2	1 4.1%	-	1 3.8%	0 5.4%	-	-
3	0 1.0%	-	-	0 5.4%	-	-
4	-	-	-	-	-	-
Net 5-7	13 43.9%	5 22.4%	13 51.6% D	1 11.3%	3 16.4%	2 49.8% d

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3a Page 17
(Continued)
Duke Non-Residential Prescriptive

N3a. How important in your selection of the energy efficient equipment was... Your previous experience with the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	0 0.6%	2 9.0%	0 0.8%	-	-	2 49.8%
6	4 13.9%	2 9.1%	4 16.5%	0 3.0%	2 11.1%	-
7	9 29.4% b	1 4.3%	8 34.4%	0 8.3%	1 5.3%	-
Net 8-10	15 51.0%	16 77.6%	11 44.6%	5 78.0% c	14 83.6% c	2 50.2%
8	3 10.6%	6 28.2%	2 7.5%	1 23.4%	6 34.5%	-
9	6 19.3%	2 9.1%	4 16.5%	2 31.2%	2 11.1%	-
10 - Extremely important	6 21.1%	8 40.3%	5 20.6%	1 23.4%	6 38.1%	2 50.2%
(Not applicable)	2 6.5%	2 6.5%	2 7.0%	0 4.2%	1 4.8%	1 13.6%
(Don't know)	-	-	-	-	-	-
(Refused)	-	1 3.9%	-	-	1 4.8%	-
Mean	7.7	8.4	7.7	8.0	8.6	7.5

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b Page 18

Duke Non-Residential Prescriptive

N3b. How important in your selection of the energy efficient equipment was... The availability of the PROGRAM incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	127	84	113	14	72	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	126	87	71	55	65	22
Net 0-4	2 1.7%	1 1.5%	-	2 15.1% F	1 1.6%	0 0.9%
0 - Not at all important	2 1.4%	0 0.3%	-	2 12.9%	0 0.3%	-
1	-	0 0.1%	-	-	-	0 0.9%
2	-	-	-	-	-	-
3	0 0.2%	1 1.1%	-	0 2.2%	1 1.3%	-
4	-	-	-	-	-	-
Net 5-7	21 16.2%	19 23.2%	17 14.7%	4 28.3%	16 22.6%	3 26.5%
5	5 3.8%	10 12.0% a	4 3.5%	1 5.7%	7 9.8%	3 25.6% D

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3b Page 19
(Continued)
Duke Non-Residential Prescriptive

N3b. How important in your selection of the energy efficient equipment was... The availability of the PROGRAM incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	3 2.4%	3 3.2%	2 1.6%	1 9.1%	3 3.8%	-
7	13 10.0%	7 7.9%	11 9.6%	2 13.5% f	6 9.1%	0 0.9%
Net 8-10	104 82.1%	63 75.4%	96 85.3% D	8 56.5%	54 75.8%	9 72.6%
8	31 24.3% b	9 11.0%	28 24.9% e	3 19.2%	6 8.7%	3 24.9%
9	9 7.1%	6 6.6%	8 7.4%	1 4.3%	5 6.8%	1 5.0%
10 - Extremely important	64 50.7%	48 57.8%	60 52.9% d	5 33.1%	43 60.3%	5 42.7%
(Not applicable)	-	4 4.2%	-	-	4 4.9%	-
(Don't know)	-	2 2.0%	-	-	2 2.3%	-
(Refused)	-	-	-	-	-	-
Mean	8.7	8.6	8.9 D	7.1	8.7	8.1

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3c Page 20

Duke Non-Residential Prescriptive

N3c. How important in your selection of the energy efficient equipment was... A recommendation from the vendor or contractor who helped you with the choice of the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	110 100.0%	75 100.0%	99 100.0%	11 100.0%	66 100.0%	9 100.0%
Total Valid Responses	110	75	99	11	66	9
Total Responses (Unweighted)	105	77	63	42	60	17
Total Valid Responses (Unweighted)	105	77	63	42	60	17
Net 0-4	1 1.0%	3 4.0%	1 0.9%	0 1.6%	2 3.5%	1 7.9%
0 - Not at all important	-	0 0.3%	-	-	0 0.3%	-
1	-	0 0.3%	-	-	0 0.3%	-
2	1 0.8%	-	1 0.9%	-	-	-
3	-	1 0.9%	-	-	-	1 7.9%
4	0 0.2%	2 2.5%	-	0 1.6%	2 2.9%	-
Net 5-7	12 11.0%	15 20.0%	10 10.5%	2 15.9%	11 17.3%	4 40.1% de

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3c Page 21
(Continued)
Duke Non-Residential Prescriptive

N3c. How important in your selection of the energy efficient equipment was... A recommendation from the vendor or contractor who helped you with the choice of the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	5 4.9%	6 8.1%	5 4.9%	0 4.5%	4 5.6%	2 26.8% de
6	1 1.1%	5 6.5%	1 1.2%	-	4 5.6%	1 13.3%
7	6 5.1%	4 5.3%	4 4.4%	1 11.5%	4 6.1%	-
Net 8-10	97 88.0%	57 76.0%	88 88.6%	9 82.5% F	52 79.2% f	5 52.0%
8	24 21.3%	19 25.5%	21 21.0%	3 24.3%	17 26.2%	2 20.2%
9	17 15.9%	8 10.5%	16 16.0%	2 14.9%	7 11.0%	1 6.7%
10 - Extremely important	56 50.8%	30 40.0%	51 51.6%	5 43.3%	28 42.0%	2 25.0%
(Not applicable)	-	-	-	-	-	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	8.9	8.3	8.9	8.7 f	8.4	7.1

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3d Page 22

Duke Non-Residential Prescriptive

N3d. How important in your selection of the energy efficient equipment was... Previous experience with this type of equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	96	65	85	11	54	10
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	93	64	51	42	46	18
Net 0-4	37 38.6%	21 32.2%	35 41.6% D	2 15.7%	19 35.8% F	1 12.8%
0 - Not at all important	19 19.6%	9 14.3%	18 21.1%	1 8.5%	9 16.7% f	0 1.1%
1	5 5.4%	5 7.3%	5 5.8%	0 2.8%	5 8.6%	-
2	11 11.2% b	2 2.9%	11 12.6%	-	2 3.5%	-
3	2 2.1%	3 4.8%	2 2.1%	0 1.6%	2 3.5%	1 11.7%
4	0 0.3%	2 2.9%	-	0 2.8%	2 3.5%	-
Net 5-7	15 15.5%	16 24.3%	14 16.0%	1 11.6%	14 26.2%	1 14.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3d Page 23
(Continued)
Duke Non-Residential Prescriptive

N3d. How important in your selection of the energy efficient equipment was... Previous experience with this type of equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	5 5.3%	7 11.0%	4 5.0%	1 7.2%	6 10.7%	1 13.0%
6	1 0.7%	5 7.3%	0 0.4%	0 2.8%	5 8.6%	-
7	9 9.6%	4 6.0%	9 10.6%	0 1.6%	4 6.9%	0 1.1%
Net 8-10	44 45.8%	28 43.5%	36 42.4%	8 72.7% C	21 38.0%	7 73.2% E
8	12 12.5%	10 15.4%	10 11.8%	2 18.0%	7 12.7%	3 29.6%
9	7 7.4%	4 6.5%	6 7.2%	1 9.5%	3 5.5%	1 11.7%
10 - Extremely important	25 25.9%	14 21.7%	20 23.4%	5 45.1% c	11 19.8%	3 31.9%
(Not applicable)	25 19.8%	25 27.8%	22 19.6%	3 21.6%	23 29.6%	2 15.9%
(Don't know)	1 0.7%	-	1 0.8%	-	-	-
(Refused)	5 3.9%	-	5 4.3%	-	-	-
Mean	5.6	5.8	5.3	7.6 C	5.4	7.7 E

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3e Page 24

Duke Non-Residential Prescriptive

N3e. How important in your selection of the energy efficient equipment was... A recommendation from a Duke Energy representative?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	35 100.0%	21 100.0%	28 100.0%	8 100.0%	15 100.0%	5 100.0%
Total Valid Responses	33	16	28	6	11	5
Total Responses (Unweighted)	59	28	27	32	17	11
Total Valid Responses (Unweighted)	50	24	25	25	14	10
Net 0-4	8 23.5%	1 4.4%	6 22.1%	2 30.2%	-	1 13.8%
0 - Not at all important	6 19.1%	-	5 18.5%	1 21.9%	-	-
1	0 0.9%	-	-	0 5.4%	-	-
2	1 2.7%	-	1 3.3%	-	-	-
3	0 0.8%	1 4.4%	0 0.3%	0 3.0%	-	1 13.8%
4	-	-	-	-	-	-
Net 5-7	7 21.8%	4 22.0%	5 19.5%	2 32.8%	2 21.5%	1 23.2%
5	1 3.6%	2 10.2%	0 0.3%	1 19.1% c	0 4.0%	1 23.2%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3e Page 25
(Continued)
Duke Non-Residential Prescriptive

N3e. How important in your selection of the energy efficient equipment was... A recommendation from a Duke Energy representative?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	4 12.3%	-	4 14.8%	-	-	-
7	2 5.9%	2 11.9%	1 4.3%	1 13.7%	2 17.5%	-
Net 8-10	18 54.7%	12 73.5%	16 58.4%	2 37.0%	8 78.5%	3 63.0%
8	6 16.7%	2 10.8%	5 18.5%	0 8.2%	1 10.4%	1 11.8%
9	5 16.4%	4 26.5%	5 17.8%	1 9.8%	4 39.0%	-
10 - Extremely important	7 21.6%	6 36.2%	6 22.1%	1 19.1%	3 29.1%	3 51.2%
(Not applicable)	2 5.5%	5 23.2%	0 0.7%	2 23.3% c	5 30.2% Cf	0 2.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	6.4	8.3	6.6	5.5	8.7	7.6

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3f Page 26

Duke Non-Residential Prescriptive

N3f. How important in your selection of the energy efficient equipment was... Information from Smart Saver or Duke Energy marketing materials?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	119	82	105	14	70	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	119	81	65	54	59	22
Net 0-4	26 22.1%	23 28.4%	21 19.8%	5 39.7% C	20 28.9%	3 25.8%
0 - Not at all important	14 12.1%	10 11.6%	12 11.5%	2 16.7%	9 12.8%	1 5.0%
1	5 4.5%	4 4.6%	5 4.8%	0 2.3%	4 5.4%	-
2	1 1.0%	5 5.9%	0 0.1%	1 8.1% c	5 6.7% c	0 0.9%
3	5 3.9%	4 4.9%	4 3.5%	1 6.8%	3 4.0%	1 10.0%
4	1 0.7%	1 1.4%	-	1 5.8%	-	1 9.9%
Net 5-7	33 27.9%	26 32.3%	29 27.9%	4 28.0%	21 30.7%	5 41.5%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3f Page 27
(Continued)
Duke Non-Residential Prescriptive

N3f. How important in your selection of the energy efficient equipment was... Information from Smart Saver or Duke Energy marketing materials?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	8 6.8%	12 14.2%	6 6.1%	2 12.8%	8 11.3%	4 30.8%
6	9 8.0%	4 4.9%	9 8.6%	0 3.5%	4 5.6%	0 0.9%
7	16 13.1%	11 13.2%	14 13.3%	2 11.6%	10 13.7%	1 9.9%
Net 8-10	59 50.0%	32 39.3%	55 52.3% d	4 32.4%	28 40.4%	4 32.7%
8	13 10.7%	16 19.7%	11 10.6%	2 11.2%	14 20.5%	2 15.0%
9	8 6.8%	4 5.0%	7 6.4%	1 9.9%	4 5.7%	0 0.9%
10 - Extremely important	39 32.5% B	12 14.5%	37 35.2% ED	2 11.3%	10 14.1%	2 16.8%
(Not applicable)	4 3.2%	7 7.5%	4 3.3%	0 2.2%	7 8.6%	-
(Don't know)	4 3.1%	1 1.0%	4 3.5%	-	1 1.2%	-
(Refused)	-	-	-	-	-	-
Mean	6.7	5.8	6.9 D	5.2	5.7	6.0

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3g Page 28

Duke Non-Residential Prescriptive

N3g. How important in your selection of the energy efficient equipment was... Standard practice in your business or industry?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	109	73	97	12	63	10
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	107	75	59	48	56	19
Net 0-4	16 14.6%	8 11.1%	14 14.4%	2 16.5%	7 11.0%	1 11.6%
0 - Not at all important	9 8.5%	3 4.4%	8 8.3%	1 9.9%	3 5.1%	-
1	4 4.1%	-	4 4.1%	0 4.0%	-	-
2	0 0.3%	3 3.8%	-	0 2.6%	3 4.5%	-
3	-	1 1.2%	-	-	1 1.4%	-
4	2 1.7%	1 1.6%	2 1.9%	-	-	1 11.6%
Net 5-7	28 26.0%	17 22.8%	26 27.0%	2 17.3%	14 23.1%	2 20.8%
5	21 19.0%	6 7.7%	20 20.6% d	1 6.6%	5 7.7%	1 8.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3g Page 29
(Continued)
Duke Non-Residential Prescriptive

N3g. How important in your selection of the energy efficient equipment was... Standard practice in your business or industry?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	5 5.0%	3 3.9%	5 5.4%	0 1.4%	2 3.4%	1 6.9%
7	2 1.9%	8 11.2% a	1 1.0%	1 9.2%	8 12.1% C	1 5.9%
Net 8-10	65 59.4%	48 66.1%	57 58.6%	8 66.2%	41 65.9%	7 67.6%
8	24 21.9%	11 15.4%	21 21.7%	3 23.9%	10 16.7%	1 6.9%
9	10 9.6%	6 7.7%	9 9.2%	1 12.5%	3 5.1%	2 23.2% e
10 - Extremely important	30 27.9%	31 43.1%	27 27.7%	4 29.8%	28 44.0%	4 37.4%
(Not applicable)	9 6.8%	12 13.1%	7 6.4%	1 10.1%	10 12.9%	2 15.0%
(Don't know)	10 7.5%	3 3.1%	9 7.9%	1 4.4%	3 3.6%	-
(Refused)	-	2 2.1%	-	-	2 2.4%	-
Mean	6.9	7.8	6.9	7.2	7.8	8.1

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3h Page 30

Duke Non-Residential Prescriptive

N3h. How important in your selection of the energy efficient equipment was... Corporate policy or guidelines?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	105	70	94	12	60	11
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	106	72	59	47	52	20
Net 0-4	29 27.3%	17 23.9%	24 25.5%	5 42.0% F	16 26.2% f	1 11.0%
0 - Not at all important	12 11.2%	5 7.6%	11 11.7%	1 6.7%	5 9.0%	-
1	6 6.2%	2 2.7%	5 5.2%	2 13.6%	2 3.2%	-
2	6 6.0%	5 6.6%	5 5.2%	1 12.1%	5 7.7%	-
3	2 2.3%	-	2 2.2%	0 2.7%	-	-
4	2 1.7%	5 7.1%	1 1.1%	1 6.8%	4 6.4%	1 11.0%
Net 5-7	33 31.5%	19 27.5%	31 32.8%	2 21.1%	16 26.2%	4 34.2%
5	25 24.0%	13 18.3%	24 25.3%	2 13.6%	10 16.5%	3 28.6%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3h Page 31
(Continued)
Duke Non-Residential Prescriptive

N3h. How important in your selection of the energy efficient equipment was... Corporate policy or guidelines?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	5 4.8%	3 4.8%	5 5.4%	-	3 4.7%	1 5.6%
7	3 2.7%	3 4.3%	2 2.0%	1 7.5%	3 5.1%	-
Net 8-10	43 41.2%	34 48.6%	39 41.7%	4 36.9%	28 47.5%	6 54.8%
8	14 13.7%	10 14.3%	13 14.1%	1 10.5%	8 13.9%	2 16.7%
9	6 6.0%	6 7.9%	6 6.2%	0 4.1%	4 6.4%	2 16.5%
10 - Extremely important	23 21.5%	19 26.4%	20 21.4%	3 22.3%	16 27.3%	2 21.6%
(Not applicable)	19 15.0%	15 16.9%	17 15.3%	2 12.3%	14 18.0%	1 10.0%
(Don't know)	2 1.3%	3 3.4%	1 0.9%	1 4.4%	3 3.9%	-
(Refused)	1 0.7%	1 1.0%	1 0.8%	-	1 1.2%	-
Mean	5.8	6.4	5.8	5.4	6.3	7.2 D

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3i Page 32

Duke Non-Residential Prescriptive

N3i. How important in your selection of the energy efficient equipment was... Financial criteria, such as payback or return on the investment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	127	88	113	14	76	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	126	89	71	55	67	22
Net 0-4	1 0.9%	2 2.4%	0 0.1%	1 7.9% c	2 2.0%	1 5.0%
0 - Not at all important	0 0.2%	0 0.2%	-	0 2.2%	0 0.3%	-
1	-	0 0.5%	-	-	0 0.6%	-
2	0 0.2%	-	-	0 2.2%	-	-
3	0 0.1%	-	-	0 1.2%	-	-
4	0 0.3%	2 1.7%	0 0.1%	0 2.2%	1 1.2%	1 5.0%
Net 5-7	15 12.1%	8 9.2%	12 10.7%	3 23.8% c	5 6.4%	3 26.5% e

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3i Page 33
(Continued)
Duke Non-Residential Prescriptive

N3i. How important in your selection of the energy efficient equipment was... Financial criteria, such as payback or return on the investment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	5 3.8%	4 4.4%	4 3.5%	1 6.3%	4 5.0%	0 0.9%
6	5 4.0%	0 0.2%	4 3.6%	1 6.9%	0 0.3%	-
7	5 4.3%	4 4.5%	4 3.5%	1 10.7%	1 1.2%	3 25.6% E
Net 8-10	110 86.9%	78 88.4%	101 89.2% D	10 68.3%	70 91.5% f	8 68.5%
8	20 15.8%	19 21.9%	18 16.0%	2 13.5%	16 20.7%	4 30.0%
9	18 14.0%	10 11.8%	15 13.4%	3 19.2% F	10 13.5% f	0 0.9%
10 - Extremely important	72 57.1%	48 54.7%	67 59.8% D	5 35.5%	44 57.4%	4 37.6%
(Not applicable)	-	0 0.2%	-	-	0 0.3%	-
(Don't know)	-	1 1.0%	-	-	1 1.2%	-
(Refused)	-	-	-	-	-	-
Mean	9.0	8.9	9.1 D	8.0	9.0	8.3

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3j Page 34

Duke Non-Residential Prescriptive

N3j. How important in your selection of the energy efficient equipment was... The expected energy savings?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	127	89	113	14	77	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	126	90	71	55	68	22
Net 0-4	6 4.4%	2 2.8%	4 3.7%	1 9.7%	2 2.5%	1 5.0%
0 - Not at all important	0 0.3%	-	-	0 2.8%	-	-
1	0 0.1%	-	0 0.1%	-	-	-
2	0 0.1%	-	-	0 1.2%	-	-
3	0 0.4%	2 2.8%	-	0 3.4%	2 2.5%	1 5.0%
4	4 3.5%	-	4 3.6%	0 2.2%	-	-
Net 5-7	10 8.0%	9 10.0%	7 6.0%	3 23.7% C	8 9.8%	1 10.8%
5	1 0.9%	3 3.5%	0 0.1%	1 7.9% c	3 3.9%	0 0.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3j Page 35
(Continued)
Duke Non-Residential Prescriptive

N3j. How important in your selection of the energy efficient equipment was... The expected energy savings?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	5 3.8%	0 0.5%	4 3.5%	1 5.7%	0 0.6%	-
7	4 3.3%	5 6.0%	3 2.4%	1 10.1%	4 5.4%	1 9.9%
Net 8-10	111 87.6%	78 87.3%	102 90.3% D	9 66.6%	68 87.7%	10 84.2%
8	22 17.2%	19 21.6%	20 17.6%	2 14.1%	15 19.5%	4 34.9% d
9	9 7.1%	7 7.7%	7 6.3%	2 13.3% f	7 8.8%	0 0.9%
10 - Extremely important	80 63.3%	52 57.9%	75 66.3% D	5 39.2%	46 59.4%	6 48.5%
(Not applicable)	-	-	-	-	-	-
(Don't know)	-	0 0.2%	-	-	0 0.3%	-
(Refused)	-	-	-	-	-	-
Mean	9.0	8.9	9.1 D	7.9	9.0	8.6

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_n3om1 Page 36

Duke Non-Residential Prescriptive

N3o. Were there any other factors I haven't asked about that were influential in your decision to select the energy efficient equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	88 100.0%	113 100.0%	14 100.0%	76 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	89 100.0%	71 100.0%	55 100.0%	67 100.0%	22 100.0%
Product performance/ appearance	6 5.0%	8 9.5%	6 5.4%	0 2.2%	7 9.5%	1 9.9%
Maintenance/reliability	0 0.3%	4 4.3%	0 0.1%	0 2.2%	4 5.0%	-
Environmental benefit	1 0.7%	1 1.0%	1 0.8%	-	1 1.2%	-
Pricing/Cost	1 0.8%	1 0.7%	1 0.8%	0 0.6%	-	1 5.0%
Safety	1 0.7%	-	1 0.8%	-	-	-
Equipment warranty	0 0.2%	-	0 0.1%	0 1.2%	-	-
Open ended response	1 0.8%	2 2.1%	-	1 7.5%	2 2.5%	-
Nothing Else Influential	116 91.3%	71 80.6%	104 91.9%	12 86.3%	62 80.7%	10 80.1%
Don't Know	0 0.1%	-	0 0.1%	-	-	-
Refused	-	2 1.7%	-	-	1 1.2%	1 5.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3oo Page 37

Duke Non-Residential Prescriptive

N3oo. How would you rate the influence of this other factor?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	11 100.0%	17 100.0%	9 100.0%	2 100.0%	15 100.0%	2 100.0%
Total Responses (Unweighted)	20 100.0%	15 100.0%	11 100.0%	9 100.0%	13 100.0%	2 100.0%
Net 0-4	-	-	-	-	-	-
0 - Not at all important	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
Net 5-7	6 57.6%	-	6 65.5%	0 20.4%	-	-
5	1 11.9%	-	1 10.1%	0 20.4%	-	-
6	1 8.3%	-	1 10.1%	-	-	-
7	4 37.3%	-	4 45.3%	-	-	-
Net 8-10	5 42.4%	17 100.0% A	3 34.5%	2 79.6%	15 100.0% C	2 100.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3oo Page 38
(Continued)
Duke Non-Residential Prescriptive

N3oo. How would you rate the influence of this other factor?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
8	0 4.4%	5 31.0%	-	0 25.1%	4 26.8%	1 66.3%
9	2 14.3%	2 9.0%	1 10.1%	1 34.1%	1 6.1%	1 33.7%
10 - Extremely important	3 23.6%	10 60.0%	2 24.3%	0 20.4%	10 67.2%	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	7.7	9.3 a	7.6	8.1	9.4 c	8.3

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3dx Page 39

Duke Non-Residential Prescriptive

N3dx. You indicated that previous experience with this type of equipment was important in your decision to select the energy efficient <TECH> equipment. Was this previous experience associated with equipment you installed with an earlier Duke Energy incent

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	12 100.0%	8 100.0%	9 100.0%	3 100.0%	6 100.0%	2 100.0%
Total Responses (Unweighted)	20 100.0%	9 100.0%	5 100.0%	15 100.0%	5 100.0%	4 100.0%
(With Duke Energy incentive)	6 49.4%	2 19.0%	5 54.0%	1 37.1%	1 16.4%	1 25.0%
(On my own/No Duke Energy incentive)	6 46.7%	5 58.1%	4 45.0%	2 51.4%	3 50.7%	2 75.0%
(Both)	0 3.9%	-	0 1.0%	0 11.5%	-	-
(Don't know)	-	1 11.4%	-	-	1 16.4%	-
(Refused)	-	1 11.4%	-	-	1 16.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3ix Page 40

Duke Non-Residential Prescriptive

N3ix. You indicated that financial criteria were important in your decision to select the energy efficient <TECH> equipment. Which of the following statements best applies to this project:

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	110 100.0%	78 100.0%	101 100.0%	10 100.0%	70 100.0%	8 100.0%
Total Responses (Unweighted)	103 100.0%	75 100.0%	66 100.0%	37 100.0%	59 100.0%	16 100.0%
The <program> rebate moved the project within the acceptable range of our financial criteria	96 87.3%	60 76.5%	92 91.4% D	4 44.2%	55 78.9%	5 56.1%
The project met our required financial criteria even without the rebate	8 7.3%	11 13.9%	4 3.7%	4 45.2% C	7 10.4%	4 43.9% E
The project didn't meet our required financial criteria, even with the rebate	5 4.2%	3 3.6%	4 4.0%	1 6.5%	3 4.0%	-
(Other: Specify)	0 0.4%	-	-	0 4.1%	-	-
(Don't know)	1 0.8%	5 6.0% a	1 0.9%	-	5 6.7%	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3jx Page 41

Duke Non-Residential Prescriptive

N3jx. You indicated that the expected energy savings were important in your decision to select the energy efficient <TECH> equipment. How did you find out about the savings this equipment could achieve?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	111 100.0%	78 100.0%	102 100.0%	9 100.0%	68 100.0%	10 100.0%
Total Responses (Unweighted)	100 100.0%	76 100.0%	63 100.0%	37 100.0%	57 100.0%	19 100.0%
(Contractor/Vendor)	57 51.4%	41 53.3%	53 52.5%	4 39.2%	39 57.4% F	3 25.9%
(Duke Energy Account Manager)	1 0.9%	1 1.4%	1 1.0%	-	1 1.7%	-
(Duke Energy Business Energy Advisor)	-	-	-	-	-	-
(Duke Energy Program Staff)	1 0.8%	1 1.2%	1 0.9%	-	1 1.3%	-
(Prior experience with equipment)	11 9.5%	4 4.6%	10 9.7%	1 6.7%	3 4.5%	1 5.9%
(Other: Specify)	40 35.8%	28 35.5%	35 34.1%	5 54.2% c	21 30.7%	7 68.2% E
(Don't know)	-	3 3.9%	-	-	3 4.5%	-
(Refused)	2 1.6%	-	2 1.8%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn4a Page 42

Duke Non-Residential Prescriptive

N4a. How many points would you give to the importance of... the <program>, including support from Duke Energy staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
0	2 1.5%	4 4.2%	1 0.8%	1 7.2%	4 4.9%	-
2	-	1 1.3%	-	-	-	1 9.9%
5	0 0.2%	-	-	0 2.2%	-	-
10	1 0.7%	2 2.1%	0 0.1%	1 5.7%	2 2.4%	-
20	3 2.4%	4 4.4%	2 1.6%	1 8.9%	4 4.9%	0 0.9%
25	0 0.4%	3 3.4%	-	0 3.4%	2 2.4%	1 9.9%
30	7 5.5%	3 2.9%	6 5.2%	1 7.2%	2 2.4%	1 5.9%
40	8 6.6%	6 6.8%	8 7.2%	0 2.2%	4 4.8%	2 19.9% De
50	29 22.6%	13 14.8%	26 23.3%	2 16.6%	12 15.6%	1 10.0%
60	22 17.1%	14 16.1%	21 18.7% D	1 4.7%	13 16.9%	1 10.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn4a Page 43
(Continued)
Duke Non-Residential Prescriptive

N4a. How many points would you give to the importance of... the <program>, including support from Duke Energy staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
65	0 0.2%	-	-	0 2.2%	-	-
70	23 18.2% B	5 5.3%	23 20.1% eD	0 2.2%	4 5.3%	1 5.0%
75	4 3.1%	7 8.3%	2 1.9%	2 12.9% c	7 9.6%	-
80	14 10.7%	6 7.0%	12 10.6%	2 12.3%	6 7.2%	1 5.9%
85	-	2 2.7%	-	-	2 2.3%	1 5.0%
90	4 3.3%	9 9.5%	4 3.5%	0 1.8%	8 10.2%	1 5.0%
95	4 3.3%	-	4 3.5%	0 1.2%	-	-
100	5 4.0%	7 7.6%	4 3.5%	1 7.9%	5 7.0%	1 11.8%
(Don't know)	0 0.1%	-	-	0 1.2%	-	-
(Refused)	-	3 3.4%	-	-	3 3.9%	-
Mean	60.5	58.7	61.6 d	51.3	59.6	52.9

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn4b Page 44

Duke Non-Residential Prescriptive

N4b. And how many points would you give to the importance of... other factors?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
0	4 3.2%	6 6.6%	3 2.7%	1 7.9%	4 5.8%	1 11.8%
5	4 3.3%	-	4 3.5%	0 1.2%	-	-
10	4 3.3%	9 9.5%	4 3.5%	0 1.8%	8 10.2%	1 5.0%
15	-	2 2.7%	-	-	2 2.3%	1 5.0%
20	14 10.7%	6 7.0%	12 10.6%	2 12.3%	6 7.2%	1 5.9%
25	4 3.1%	7 8.3%	2 1.9%	2 12.9% c	7 9.6%	-
30	23 18.2% B	5 5.3%	23 20.1% eD	0 2.2%	4 5.3%	1 5.0%
35	0 0.2%	-	-	0 2.2%	-	-
40	22 17.1%	12 14.0%	21 18.7% D	1 4.7%	11 14.5%	1 10.9%
50	29 22.6%	13 14.8%	26 23.3%	2 16.6%	12 15.6%	1 10.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn4b Page 45
(Continued)
Duke Non-Residential Prescriptive

N4b. And how many points would you give to the importance of... other factors?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
60	8 6.6%	6 6.8%	8 7.2%	0 2.2%	4 4.8%	2 19.9% De
70	3 2.3%	3 2.9%	2 1.7%	1 7.2%	2 2.4%	1 5.9%
75	0 0.4%	3 3.4%	-	0 3.4%	2 2.4%	1 9.9%
80	3 2.4%	4 4.4%	2 1.6%	1 8.9%	4 4.9%	0 0.9%
90	1 0.7%	2 2.1%	0 0.1%	1 5.7%	2 2.4%	-
95	0 0.2%	-	-	0 2.2%	-	-
98	-	1 1.3%	-	-	-	1 9.9%
99	-	1 1.0%	-	-	1 1.2%	-
100	2 1.5%	2 2.1%	1 0.8%	1 7.2%	2 2.4%	-
(Don't know)	0 0.1%	-	-	0 1.2%	-	-
(Refused)	5 3.9%	7 7.6%	5 4.3%	-	7 8.8%	-
Mean	38.8	41.1	37.6	48.7 c	40.0	47.1

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qcc1bm1 Page 46

Duke Non-Residential Prescriptive

CC1b. You just gave <N4a_pts> points to the importance of the program. I would interpret that to mean that the program was not very important to your decision to install the <TECH> equipment. But earlier, when I asked about the importance of individual ele

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	4 100.0%	7 100.0%	3 100.0%	1 100.0%	6 100.0%	1 100.0%
Total Responses (Unweighted)	9 100.0%	4 100.0%	4 100.0%	5 100.0%	3 100.0%	1 100.0%
Open ended response	4 100.0%	7 100.0%	3 100.0%	1 100.0%	6 100.0%	1 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qcc1c Page 47

Duke Non-Residential Prescriptive

CC1c. Would you like to provide a new response for either the importance ratings or the points allocation or both?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	5 100.0%	7 100.0%	3 100.0%	2 100.0%	6 100.0%	1 100.0%
Total Responses (Unweighted)	10 100.0%	4 100.0%	4 100.0%	6 100.0%	3 100.0%	1 100.0%
(Change importance ratings)	1 20.0%	-	1 32.3%	-	-	-
(Change points allocation)	0 3.8%	2 27.6%	-	0 10.0%	2 33.3%	-
(Change both)	-	-	-	-	-	-
(No, don't change)	3 69.4%	5 72.4%	2 67.7%	1 72.0%	4 66.7%	1 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	0 6.8%	-	-	0 18.0%	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3a_fnl Page 48

Duke Non-Residential Prescriptive

N3a_FINAL: How important in your selection of the energy efficient equipment was... your previous experience with the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	32 100.0%	23 100.0%	26 100.0%	6 100.0%	19 100.0%	4 100.0%
Total Valid Responses	30	21	24	6	17	4
Total Responses (Unweighted)	44	22	18	26	14	8
Total Valid Responses (Unweighted)	40	19	16	24	12	7
Net 0-4	2 5.1%	-	1 3.8%	1 10.7%	-	-
0 - Not at all important	-	-	-	-	-	-
1	-	-	-	-	-	-
2	1 4.1%	-	1 3.8%	0 5.4%	-	-
3	0 1.0%	-	-	0 5.4%	-	-
4	-	-	-	-	-	-
Net 5-7	13 43.9%	5 22.4%	13 51.6% D	1 11.3%	3 16.4%	2 49.8% d

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3a_fnl Page 49
(Continued)
Duke Non-Residential Prescriptive

N3a_FINAL: How important in your selection of the energy efficient equipment was... your previous experience with the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	0 0.6%	2 9.0%	0 0.8%	-	-	2 49.8%
6	4 13.9%	2 9.1%	4 16.5%	0 3.0%	2 11.1%	-
7	9 29.4% b	1 4.3%	8 34.4%	0 8.3%	1 5.3%	-
Net 8-10	15 51.0%	16 77.6%	11 44.6%	5 78.0% c	14 83.6% c	2 50.2%
8	3 10.6%	6 28.2%	2 7.5%	1 23.4%	6 34.5%	-
9	6 19.3%	2 9.1%	4 16.5%	2 31.2%	2 11.1%	-
10 - Extremely important	6 21.1%	8 40.3%	5 20.6%	1 23.4%	6 38.1%	2 50.2%
(Not applicable)	2 6.5%	2 6.5%	2 7.0%	0 4.2%	1 4.8%	1 13.6%
(Don't know)	-	-	-	-	-	-
(Refused)	-	1 3.9%	-	-	1 4.8%	-
Mean	7.7	8.4	7.7	8.0	8.6	7.5

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b_upd Page 50

Duke Non-Residential Prescriptive

N3b_UPDATED: How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	127	84	113	14	72	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	126	87	71	55	65	22
Net 0-4	2 1.7%	1 1.5%	-	2 15.1% F	1 1.6%	0 0.9%
0 - Not at all important	2 1.4%	0 0.3%	-	2 12.9%	0 0.3%	-
1	-	0 0.1%	-	-	-	0 0.9%
2	-	-	-	-	-	-
3	0 0.2%	1 1.1%	-	0 2.2%	1 1.3%	-
4	-	-	-	-	-	-
Net 5-7	21 16.2%	19 23.2%	17 14.7%	4 28.3%	16 22.6%	3 26.5%
5	5 3.8%	10 12.0% a	4 3.5%	1 5.7%	7 9.8%	3 25.6% D

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b_upd Page 51
(Continued)
Duke Non-Residential Prescriptive

N3b_UPDATED: How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	3 2.4%	3 3.2%	2 1.6%	1 9.1%	3 3.8%	-
7	13 10.0%	7 7.9%	11 9.6%	2 13.5% f	6 9.1%	0 0.9%
Net 8-10	104 82.1%	63 75.4%	96 85.3% D	8 56.5%	54 75.8%	9 72.6%
8	31 24.3% b	9 11.0%	28 24.9% e	3 19.2%	6 8.7%	3 24.9%
9	9 7.1%	6 6.6%	8 7.4%	1 4.3%	5 6.8%	1 5.0%
10 - Extremely important	64 50.7%	48 57.8%	60 52.9% d	5 33.1%	43 60.3%	5 42.7%
(Not applicable)	-	4 4.2%	-	-	4 4.9%	-
(Don't know)	-	2 2.0%	-	-	2 2.3%	-
(Refused)	-	-	-	-	-	-
Mean	8.7	8.6	8.9 D	7.1	8.7	8.1

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3e_fnl Page 52

Duke Non-Residential Prescriptive

N3e_FINAL: How important in your selection of the energy efficient equipment was... the recommendation from a Duke Energy representative?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	35 100.0%	21 100.0%	28 100.0%	8 100.0%	15 100.0%	5 100.0%
Total Valid Responses	33	16	28	6	11	5
Total Responses (Unweighted)	59	28	27	32	17	11
Total Valid Responses (Unweighted)	50	24	25	25	14	10
Net 0-4	8 23.5%	1 4.4%	6 22.1%	2 30.2%	-	1 13.8%
0 - Not at all important	6 19.1%	-	5 18.5%	1 21.9%	-	-
1	0 0.9%	-	-	0 5.4%	-	-
2	1 2.7%	-	1 3.3%	-	-	-
3	0 0.8%	1 4.4%	0 0.3%	0 3.0%	-	1 13.8%
4	-	-	-	-	-	-
Net 5-7	7 21.8%	4 22.0%	5 19.5%	2 32.8%	2 21.5%	1 23.2%
5	1 3.6%	2 10.2%	0 0.3%	1 19.1% c	0 4.0%	1 23.2%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3e_fnl Page 53
(Continued)
Duke Non-Residential Prescriptive

N3e_FINAL: How important in your selection of the energy efficient equipment was... the recommendation from a Duke Energy representative?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	4 12.3%	-	4 14.8%	-	-	-
7	2 5.9%	2 11.9%	1 4.3%	1 13.7%	2 17.5%	-
Net 8-10	18 54.7%	12 73.5%	16 58.4%	2 37.0%	8 78.5%	3 63.0%
8	6 16.7%	2 10.8%	5 18.5%	0 8.2%	1 10.4%	1 11.8%
9	5 16.4%	4 26.5%	5 17.8%	1 9.8%	4 39.0%	-
10 - Extremely important	7 21.6%	6 36.2%	6 22.1%	1 19.1%	3 29.1%	3 51.2%
(Not applicable)	2 5.5%	5 23.2%	0 0.7%	2 23.3% c	5 30.2% Cf	0 2.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	6.4	8.3	6.6	5.5	8.7	7.6

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3f_fnl Page 54

Duke Non-Residential Prescriptive

N3f_FINAL: How important in your selection of the energy efficient equipment was... the Information from <program> or Duke Energy marketing materials?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	119	82	105	14	70	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	119	81	65	54	59	22
Net 0-4	26 22.1%	23 28.4%	21 19.8%	5 39.7% C	20 28.9%	3 25.8%
0 - Not at all important	14 12.1%	10 11.6%	12 11.5%	2 16.7%	9 12.8%	1 5.0%
1	5 4.5%	4 4.6%	5 4.8%	0 2.3%	4 5.4%	-
2	1 1.0%	5 5.9%	0 0.1%	1 8.1% c	5 6.7% c	0 0.9%
3	5 3.9%	4 4.9%	4 3.5%	1 6.8%	3 4.0%	1 10.0%
4	1 0.7%	1 1.4%	-	1 5.8%	-	1 9.9%
Net 5-7	34 28.7%	26 32.3%	30 28.8%	4 28.0%	21 30.7%	5 41.5%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3f_fnl Page 55
(Continued)
Duke Non-Residential Prescriptive

N3f_FINAL: How important in your selection of the energy efficient equipment was... the Information from <program> or Duke Energy marketing materials?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	9 7.6%	12 14.2%	7 6.9%	2 12.8%	8 11.3%	4 30.8%
6	9 8.0%	4 4.9%	9 8.6%	0 3.5%	4 5.6%	0 0.9%
7	16 13.1%	11 13.2%	14 13.3%	2 11.6%	10 13.7%	1 9.9%
Net 8-10	58 49.2%	32 39.3%	54 51.4% d	4 32.4%	28 40.4%	4 32.7%
8	13 10.7%	16 19.7%	11 10.6%	2 11.2%	14 20.5%	2 15.0%
9	7 6.0%	4 5.0%	6 5.5%	1 9.9%	4 5.7%	0 0.9%
10 - Extremely important	39 32.5% B	12 14.5%	37 35.2% ED	2 11.3%	10 14.1%	2 16.8%
(Not applicable)	4 3.2%	7 7.5%	4 3.3%	0 2.2%	7 8.6%	-
(Don't know)	4 3.1%	1 1.0%	4 3.5%	-	1 1.2%	-
(Refused)	-	-	-	-	-	-
Mean	6.6	5.8	6.8 D	5.2	5.7	6.0

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn4a_upd Page 56

Duke Non-Residential Prescriptive

N4a_UPDATED: How many points would you give to the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
0	2 1.5%	2 2.1%	1 0.8%	1 7.2%	2 2.4%	-
2	-	1 1.3%	-	-	-	1 9.9%
5	0 0.2%	-	-	0 2.2%	-	-
10	1 0.7%	2 2.1%	0 0.1%	1 5.7%	2 2.4%	-
20	3 2.4%	4 4.4%	2 1.6%	1 8.9%	4 4.9%	0 0.9%
25	0 0.2%	3 3.4%	-	0 2.2%	2 2.4%	1 9.9%
30	7 5.5%	3 2.9%	6 5.2%	1 7.2%	2 2.4%	1 5.9%
40	9 6.7%	6 6.8%	8 7.2%	0 3.4%	4 4.8%	2 19.9% de
50	29 22.6%	13 14.8%	26 23.3%	2 16.6%	12 15.6%	1 10.0%
60	22 17.1%	14 16.1%	21 18.7% D	1 4.7%	13 16.9%	1 10.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn4a_upd Page 57
(Continued)
Duke Non-Residential Prescriptive

N4a_UPDATED: How many points would you give to the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
65	0 0.2%	-	-	0 2.2%	-	-
70	23 18.2% B	5 5.3%	23 20.1% eD	0 2.2%	4 5.3%	1 5.0%
75	4 3.1%	7 8.3%	2 1.9%	2 12.9% c	7 9.6%	-
80	14 10.7%	6 7.0%	12 10.6%	2 12.3%	6 7.2%	1 5.9%
85	-	2 2.7%	-	-	2 2.3%	1 5.0%
90	4 3.3%	9 9.5%	4 3.5%	0 1.8%	8 10.2%	1 5.0%
95	4 3.3%	-	4 3.5%	0 1.2%	-	-
100	5 4.0%	9 9.7%	4 3.5%	1 7.9%	7 9.4%	1 11.8%
998	0 0.1%	-	-	0 1.2%	-	-
999	-	3 3.4%	-	-	3 3.9%	-
Mean	60.49	60.89	61.59 d	51.51	62.18	52.87

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn4b_upd Page 58

Duke Non-Residential Prescriptive

N4b_NEW: How many points would you give to other factors?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
0	4 3.2%	8 8.7%	3 2.7%	1 7.9%	6 8.2%	1 11.8%
5	4 3.3%	-	4 3.5%	0 1.2%	-	-
10	4 3.3%	9 9.5%	4 3.5%	0 1.8%	8 10.2%	1 5.0%
15	-	2 2.7%	-	-	2 2.3%	1 5.0%
20	14 10.7%	6 7.0%	12 10.6%	2 12.3%	6 7.2%	1 5.9%
25	4 3.1%	7 8.3%	2 1.9%	2 12.9% c	7 9.6%	-
30	23 18.2% B	5 5.3%	23 20.1% eD	0 2.2%	4 5.3%	1 5.0%
35	0 0.2%	-	-	0 2.2%	-	-
40	22 17.1%	12 14.0%	21 18.7% D	1 4.7%	11 14.5%	1 10.9%
50	29 22.6%	13 14.8%	26 23.3%	2 16.6%	12 15.6%	1 10.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn4b_upd Page 59
(Continued)
Duke Non-Residential Prescriptive

N4b_NEW: How many points would you give to other factors?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
60	9 6.7%	6 6.8%	8 7.2%	0 3.4%	4 4.8%	2 19.9% de
70	3 2.3%	3 2.9%	2 1.7%	1 7.2%	2 2.4%	1 5.9%
75	0 0.2%	3 3.4%	-	0 2.2%	2 2.4%	1 9.9%
80	3 2.4%	4 4.4%	2 1.6%	1 8.9%	4 4.9%	0 0.9%
90	1 0.7%	2 2.1%	0 0.1%	1 5.7%	2 2.4%	-
95	0 0.2%	-	-	0 2.2%	-	-
98	-	1 1.3%	-	-	-	1 9.9%
99	-	1 1.0%	-	-	1 1.2%	-
100	2 1.5%	-	1 0.8%	1 7.2%	-	-
998	0 0.1%	-	-	0 1.2%	-	-
999	5 3.9%	7 7.6%	5 4.3%	-	7 8.8%	-
Mean	38.81	38.78	37.57	48.49 c	37.36	47.13

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn5 Page 60

Duke Non-Residential Prescriptive

N5. Without the program, what is the likelihood that the equipment would have had the same efficiency level? Please use a scale from 0 to 10, where 0 is 'Not at all likely' and 10 is 'Extremely likely'.

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
Net 0-4	49 38.6%	46 51.6%	46 41.0% D	3 19.0%	45 57.9% F	1 10.9%
0 - Not at all likely	28 22.1%	22 24.2%	26 23.2%	2 13.3%	20 26.4% f	1 10.0%
1	1 0.7%	4 4.2%	1 0.8%	-	4 4.9%	-
2	10 7.9%	7 8.1%	10 8.9%	-	7 9.3%	-
3	0 0.1%	8 8.5% A	0 0.2%	-	8 9.8% C	-
4	10 7.7%	6 6.6%	9 8.0%	1 5.7%	6 7.5%	0 0.9%
Net 5-7	29 22.5%	16 18.1%	26 22.9%	3 19.8%	12 15.4%	4 35.8%
5	17 13.5%	8 8.6%	16 14.0%	1 9.1%	6 8.4%	1 10.0%
6	5 4.1%	1 1.0%	4 3.5%	1 8.5%	1 1.2%	-
7	6 5.0%	8 8.5%	6 5.3%	0 2.2%	5 5.8%	3 25.8% De

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn5 Page 61
(Continued)
Duke Non-Residential Prescriptive

N5. Without the program, what is the likelihood that the equipment would have had the same efficiency level? Please use a scale from 0 to 10, where 0 is 'Not at all likely' and 10 is 'Extremely likely'.

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Net 8-10	41	25	33	8	19	6
	32.4%	28.1%	29.1%	58.8%	25.0%	48.3%
				C		e
8	5	12	4	1	11	1
	3.9%	13.5%	3.6%	5.9%	14.8%	5.0%
		a			C	
9	6	0	6	1	-	0
	5.1%	0.2%	5.2%	4.4%		1.8%
10 - Extremely likely	30	13	23	7	8	5
	23.4%	14.3%	20.3%	48.5%	10.1%	41.5%
				C		E
(Don't know)	4	1	4	0	0	1
	3.3%	1.2%	3.5%	1.2%	0.6%	5.0%
(Refused)	4	1	4	0	1	-
	3.3%	1.0%	3.5%	1.2%	1.2%	
Mean	5.2	4.4	4.9	7.2	4.0	7.4
				C		E

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn6a Page 62

Duke Non-Residential Prescriptive

N6a. Without the program, would you have installed the same quantity of energy efficient equipment in <date> or would you have installed less?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
Same quantity	29 22.5%	26 29.3%	18 16.4%	10 71.9% C	18 23.5%	8 66.6% E
Less	94 74.1%	60 67.6%	91 80.4% D	3 23.7%	56 72.9% F	4 33.4%
(More)	0 0.2%	-	-	0 2.2%	-	-
(Don't know)	2 1.4%	2 2.1%	2 1.6%	-	2 2.4%	-
(Refused)	2 1.7%	1 1.0%	2 1.6%	0 2.2%	1 1.2%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn6b Page 63

Duke Non-Residential Prescriptive

N6b. As best as you can, please estimate the percentage of the energy efficient <TECH> equipment that you would have installed in <date> without the program.

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	94 100.0%	60 100.0%	91 100.0%	3 100.0%	56 100.0%	4 100.0%
Total Responses (Unweighted)	61 100.0%	62 100.0%	49 100.0%	12 100.0%	53 100.0%	9 100.0%
0	29 30.5%	26 42.7%	28 30.4%	1 33.3%	25 43.6%	1 29.9%
7	-	-	-	-	-	-
10	1 1.0%	5 8.0%	1 1.0%	-	5 8.6%	-
20	13 13.7% b	2 3.3%	13 14.2% e	-	2 3.4%	0 2.7%
25	4 4.7%	7 11.6%	4 4.5%	0 9.4%	6 10.3%	1 29.5%
33	0 0.3%	-	-	0 9.4%	-	-
50	8 8.1%	5 7.5%	7 7.7%	1 18.8%	4 7.9%	0 2.7%
55	-	-	-	-	-	-
70	4 4.2%	1 1.4%	4 4.4%	-	0 0.4%	1 15.0%
75	0 0.1%	1 1.5%	0 0.1%	-	1 1.6%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn6b Page 64
(Continued)
Duke Non-Residential Prescriptive

N6b. As best as you can, please estimate the percentage of the energy efficient <TECH> equipment that you would have installed in <date> without the program.

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
80	0 0.3%	3 4.3%	-	0 9.4%	2 3.4%	1 17.6%
100	-	-	-	-	-	-
(Don't know)	4 4.4%	-	4 4.4%	0 5.2%	-	-
(Refused)	8 8.5%	1 1.9%	8 8.8%	-	1 2.0%	-
Mean	18.2	17.0	17.8	27.8	15.4	34.7

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn6cm1 Page 65

Duke Non-Residential Prescriptive

N6c. Why would you have installed that much less energy efficient equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	69 100.0%	48 100.0%	67 100.0%	2 100.0%	46 100.0%	2 100.0%
Total Responses (Unweighted)	42 100.0%	45 100.0%	34 100.0%	8 100.0%	41 100.0%	4 100.0%
Open ended response	69 100.0%	48 100.0%	67 100.0%	2 100.0%	46 100.0%	2 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn7 Page 66

Duke Non-Residential Prescriptive

N7. Without the program, would you have installed the remaining <N_INSTALL> percent of the energy efficient <TECH> equipment at a later time?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	82 100.0%	59 100.0%	79 100.0%	3 100.0%	55 100.0%	4 100.0%
Total Responses (Unweighted)	57 100.0%	60 100.0%	46 100.0%	11 100.0%	51 100.0%	9 100.0%
Yes	46 56.4%	36 61.6%	44 56.3%	2 60.4%	34 61.1%	3 67.4%
No	25 30.0%	19 31.7%	24 30.0%	1 29.7%	17 31.6%	1 32.6%
(Don't know)	11 13.6%	2 3.6%	11 13.7%	0 9.9%	2 3.8%	-
(Refused)	-	2 3.2%	-	-	2 3.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn7a Page 67

Duke Non-Residential Prescriptive

N7a. Without the program, when do you think you would have installed the energy efficient <TECH> equipment? Please answer relative to the date that you ACTUALLY installed the equipment.

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	46 100.0%	36 100.0%	44 100.0%	2 100.0%	34 100.0%	3 100.0%
Total Responses (Unweighted)	29 100.0%	37 100.0%	22 100.0%	7 100.0%	31 100.0%	6 100.0%
(at the same time)	-	-	-	-	-	-
(up to 6 months later)	4 9.3%	-	4 9.0%	0 16.4%	-	-
(7 months to 1 year later)	13 27.6%	8 23.3%	12 27.0%	1 41.8%	7 19.9%	2 66.0% e
(more than 1 year up to 2 years later)	11 23.8%	10 26.6%	10 23.4%	1 32.7%	10 28.1%	0 7.9%
(more than 2 years up to 3 years later)	1 2.2%	10 27.7% A	1 2.3%	-	10 28.1% C	1 22.2%
(more than 3 years up to 4 years later)	-	0 0.6%	-	-	0 0.6%	-
(more than 4 years later)	5 10.8%	4 11.3%	5 11.3%	-	4 12.2%	-
(Never)	-	-	-	-	-	-
(Don't know)	4 9.0%	2 5.3%	4 9.0%	0 9.1%	2 5.4%	0 3.9%
(Refused)	8 17.3%	2 5.2%	8 18.0%	-	2 5.6%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_n7bm1 Page 68

Duke Non-Residential Prescriptive

N7b. Why would it have been that much later?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	17 100.0%	24 100.0%	16 100.0%	1 100.0%	23 100.0%	1 100.0%
Total Responses (Unweighted)	17 100.0%	25 100.0%	15 100.0%	2 100.0%	22 100.0%	3 100.0%
Financial considerations	9 52.4%	21 87.5% A	8 50.6%	1 100.0%	20 87.1% c	1 100.0%
Replace on failure	-	3 11.6%	-	-	3 12.0%	-
Timing with other projects/installations	4 24.0%	0 0.9%	4 25.0%	-	0 0.9%	-
Lower priority	4 23.5%	-	4 24.4%	-	-	-
Open ended response	-	-	-	-	-	-
Don't Know	-	-	-	-	-	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qcc2am1 Page 69

Duke Non-Residential Prescriptive

CC2a. When you answered <qN3b_upd> for the question about the influence of the incentive, I would interpret that to mean that the incentive was quite important in your selection of the efficiency level. Then, when you answered <qN5> for

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	22 100.0%	16 100.0%	18 100.0%	4 100.0%	14 100.0%	3 100.0%
Total Responses (Unweighted)	32 100.0%	18 100.0%	15 100.0%	17 100.0%	12 100.0%	6 100.0%
Open ended response	13 61.2%	9 57.1%	11 60.6%	3 64.2%	8 57.7%	1 54.1%
(Don't know)	8 34.6%	7 42.9%	6 34.4%	1 35.8%	6 42.3%	1 45.9%
(Refused)	1 4.1%	-	1 5.1%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qcc2b Page 70

Duke Non-Residential Prescriptive

CC2b. Would you like me to change your score on the importance of the incentive or change the likelihood, or both?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	22 100.0%	16 100.0%	18 100.0%	4 100.0%	14 100.0%	3 100.0%
Total Responses (Unweighted)	32 100.0%	18 100.0%	15 100.0%	17 100.0%	12 100.0%	6 100.0%
(Change importance of incentive rating)	7 30.6%	2 11.6%	6 32.3%	1 23.1%	2 13.8%	-
(Change likelihood to install the same equipment rating)	1 4.1%	0 0.7%	1 5.1%	-	-	0 4.1%
(Change both)	0 1.8%	2 11.6%	-	0 9.7%	2 13.8%	-
(No, don't change)	9 39.8%	11 65.1%	6 35.4%	2 59.5%	8 59.3%	2 95.9% d
(Don't know)	0 1.4%	-	-	0 7.7%	-	-
(Refused)	5 22.2%	2 11.1%	5 27.2%	-	2 13.2%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b_new2 Page 71

Duke Non-Residential Prescriptive

N3b _NEW2. How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	7 100.0%	4 100.0%	6 100.0%	1 100.0%	4 100.0%	-
Total Valid Responses	3	4	2	1	4	-
Total Responses (Unweighted)	8	2	3	5	2	-
Total Valid Responses (Unweighted)	7	2	2	5	2	-
Net 0-4	1 39.4%	-	-	1 93.8%	-	-
0 - Not at all important	1 19.7%	-	-	1 46.9%	-	-
1	0 9.9%	-	-	0 23.4%	-	-
2	-	-	-	-	-	-
3	0 9.9%	-	-	0 23.4%	-	-
4	-	-	-	-	-	-
Net 5-7	-	-	-	-	-	-
5	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b_new2 Page 72
(Continued)
Duke Non-Residential Prescriptive

N3b _NEW2. How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	-	-	-	-	-	-
7	-	-	-	-	-	-
Net 8-10	2 60.6%	4 100.0% a	2 100.0% D	0 6.2%	4 100.0%	-
8	0 2.6%	-	-	0 6.2%	-	-
9	-	-	-	-	-	-
10 - Extremely important	2 58.0%	4 100.0% A	2 100.0%	-	4 100.0%	-
(Don't know)	-	-	-	-	-	-
(Refused)	4 55.9%	-	4 68.6%	-	-	-
Mean	6.4	10.0	10.0 D	1.4	10.0	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn5_new Page 73

Duke Non-Residential Prescriptive

N5_NEW. Without the program, what is the likelihood that the equipment would have had the same efficiency level?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	2 100.0%	1 100.0%	0 100.0%	2 100.0%	0 100.0%
Total Responses (Unweighted)	3 100.0%	2 100.0%	1 100.0%	2 100.0%	1 100.0%	1 100.0%
Net 0-4	-	-	-	-	-	-
0 - Not at all likely	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
Net 5-7	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
Net 8-10	1 100.0%	2 100.0%	1 100.0%	0 100.0%	2 100.0%	0 100.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn5_new Page 74
(Continued)
Duke Non-Residential Prescriptive

N5_NEW. Without the program, what is the likelihood that the equipment would have had the same efficiency level?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
8	0 6.3%	-	-	0 20.9%	-	-
9	1 69.9%	-	1 100.0%	-	-	-
10 - Extremely likely	0 23.8%	2 100.0% A	-	0 79.1%	2 100.0%	0 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	9.2	10.0	9.0	9.6	10.0	10.0

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn3b_fnl Page 75

Duke Non-Residential Prescriptive

N3b _FINAL. How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Valid Responses	127	84	113	14	72	12
Total Responses (Unweighted)	126	91	71	55	69	22
Total Valid Responses (Unweighted)	126	87	71	55	65	22
Net 0-4	3 2.6%	1 1.5%	-	3 24.0% F	1 1.6%	0 0.9%
0 - Not at all important	2 1.9%	0 0.3%	-	2 17.3%	0 0.3%	-
1	0 0.2%	0 0.1%	-	0 2.2%	-	0 0.9%
2	-	-	-	-	-	-
3	1 0.5%	1 1.1%	-	1 4.4%	1 1.3%	-
4	-	-	-	-	-	-
Net 5-7	21 16.2%	19 23.2%	17 14.7%	4 28.3%	16 22.6%	3 26.5%
5	5 3.8%	10 12.0% a	4 3.5%	1 5.7%	7 9.8%	3 25.6% D

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qn3b_fnl Page 76
(Continued)
Duke Non-Residential Prescriptive

N3b _FINAL. How important in your selection of the energy efficient equipment was... the program incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	3 2.4%	3 3.2%	2 1.6%	1 9.1%	3 3.8%	-
7	13 10.0%	7 7.9%	11 9.6%	2 13.5% f	6 9.1%	0 0.9%
Net 8-10	103 81.1%	63 75.4%	96 85.3% D	7 47.7%	54 75.8%	9 72.6% d
8	29 23.2% B	7 8.8%	27 24.1% E	2 15.4%	4 6.1%	3 24.9% e
9	9 7.1%	6 6.6%	8 7.4%	1 4.3%	5 6.8%	1 5.0%
10 - Extremely important	64 50.9%	50 60.1%	61 53.7% D	4 28.0%	45 62.9%	5 42.7%
(Not applicable)	-	4 4.2%	-	-	4 4.9%	-
(Don't know)	-	2 2.0%	-	-	2 2.3%	-
(Refused)	-	-	-	-	-	-
Mean	8.6	8.7	8.9 D	6.4	8.8	8.1 D

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn5_fnl Page 77

Duke Non-Residential Prescriptive

N5_FINAL. Without the program, what is the likelihood that the equipment would have had the same efficiency level?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	89 100.0%	113 100.0%	14 100.0%	77 100.0%	12 100.0%
Total Responses (Unweighted)	126 100.0%	91 100.0%	71 100.0%	55 100.0%	69 100.0%	22 100.0%
Net 0-4	49 38.6%	46 51.6%	46 41.0% D	3 19.0%	45 57.9% F	1 10.9%
0 - Not at all likely	28 22.1%	22 24.2%	26 23.2%	2 13.3%	20 26.4% f	1 10.0%
1	1 0.7%	4 4.2%	1 0.8%	-	4 4.9%	-
2	10 7.9%	7 8.1%	10 8.9%	-	7 9.3%	-
3	0 0.1%	8 8.5% A	0 0.2%	-	8 9.8% C	-
4	10 7.7%	6 6.6%	9 8.0%	1 5.7%	6 7.5%	0 0.9%
Net 5-7	29 22.5%	16 18.1%	26 22.9%	3 19.8%	12 15.4%	4 35.8%
5	17 13.5%	8 8.6%	16 14.0%	1 9.1%	6 8.4%	1 10.0%
6	5 4.1%	1 1.0%	4 3.5%	1 8.5%	1 1.2%	-
7	6 5.0%	8 8.5%	6 5.3%	0 2.2%	5 5.8%	3 25.8% De

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qn5_fnl Page 78
(Continued)
Duke Non-Residential Prescriptive

N5_FINAL. Without the program, what is the likelihood that the equipment would have had the same efficiency level?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Net 8-10	41 32.4%	25 28.1%	33 29.1%	8 58.8% C	19 25.0%	6 48.3% e
8	5 3.9%	10 11.4%	4 3.6%	1 5.9%	10 12.4% c	1 5.0%
9	6 5.1%	0 0.1%	6 5.2%	1 4.4%	-	0 0.9%
10 - Extremely likely	30 23.4%	15 16.6%	23 20.3%	7 48.5% C	10 12.6%	5 42.4% E
(Don't know)	4 3.3%	1 1.2%	4 3.5%	0 1.2%	0 0.6%	1 5.0%
(Refused)	4 3.3%	1 1.0%	4 3.5%	0 1.2%	1 1.2%	-
Mean	5.2	4.5	4.9	7.2 C	4.0	7.4 E

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp1a Page 79

Duke Non-Residential Prescriptive

SP1a. Since receiving the incentive for the project we just discussed, did you make any ADDITIONAL energy efficiency improvements at this facility or at your other facilities within Duke Energy's [IF DEC: Carolinas; IF DEP: Progress] service territory that did NOT receive an incentive from Duke Energy?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	30 23.4%	21 22.0%	26 23.2%	4 24.9%	16 19.0%	5 42.6% e
No	93 72.9%	71 76.0%	83 73.3%	10 69.5%	65 78.7%	7 57.4%
(Don't know)	5 3.6%	2 2.0%	4 3.5%	1 4.3%	2 2.3%	-
(Refused)	0 0.1%	-	-	0 1.2%	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp1b Page 80

Duke Non-Residential Prescriptive

SP1b. Have you applied, or do you still plan to apply, for a Duke Energy incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	30 100.0%	21 100.0%	26 100.0%	4 100.0%	16 100.0%	5 100.0%
Total Responses (Unweighted)	33 100.0%	23 100.0%	19 100.0%	14 100.0%	13 100.0%	10 100.0%
Yes	10 34.5%	7 31.5%	9 34.3%	1 35.8%	4 25.1%	3 51.2%
No	18 61.8%	10 49.2%	17 65.7% d	1 33.3%	8 49.3%	2 48.8%
(Don't know)	1 2.7%	4 19.3%	-	1 22.2%	4 25.6%	-
(Refused)	0 1.0%	-	-	0 8.7%	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qsp2a Page 81

Duke Non-Residential Prescriptive

SP2a. How much did your experience with the program influence your decision to install high efficiency equipment on your own?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	18 100.0%	10 100.0%	17 100.0%	1 100.0%	8 100.0%	2 100.0%
Total Responses (Unweighted)	20 100.0%	10 100.0%	15 100.0%	5 100.0%	6 100.0%	4 100.0%
Net 0-4	10 52.6%	3 26.3%	9 54.4%	0 26.2%	1 11.8%	2 71.6% e
0 - No influence	10 52.1%	3 26.3%	9 53.9%	0 26.2%	1 11.8%	2 71.6% e
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	0 0.5%	-	0 0.5%	-	-	-
Net 5-7	2 12.6%	2 24.4%	2 10.6%	0 40.7%	2 24.6%	1 24.1%
5	1 7.6%	-	1 5.3%	0 40.7%	-	-
6	-	-	-	-	-	-
7	1 5.0%	2 24.4%	1 5.3%	-	2 24.6%	1 24.1%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp2a Page 82
(Continued)
Duke Non-Residential Prescriptive

SP2a. How much did your experience with the program influence your decision to install high efficiency equipment on your own?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Net 8-10	6 34.8%	5 49.2%	6 34.9%	0 33.1%	5 63.7% f	0 4.3%
8	0 2.1%	1 8.9%	-	0 33.1%	1 11.8%	-
9	4 22.2%	-	4 23.8%	-	-	-
10 - Greatly influenced	2 10.4%	4 40.3%	2 11.2%	-	4 51.9%	0 4.3%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	3.96	6.45	3.91	4.68	7.85	2.12

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qsp2b Page 83

Duke Non-Residential Prescriptive

SP2b. If you had NOT participated in the program, how likely is it that <COMPANY> would still have installed this additional energy efficient equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	18 100.0%	10 100.0%	17 100.0%	1 100.0%	8 100.0%	2 100.0%
Total Responses (Unweighted)	20 100.0%	10 100.0%	15 100.0%	5 100.0%	6 100.0%	4 100.0%
Net 0-4	5 28.2%	5 46.2%	5 30.1%	-	4 51.9%	1 28.4%
0 - definitely WOULD NOT have implemented this equipment	1 6.0%	1 6.9%	1 6.4%	-	-	1 28.4%
1	-	-	-	-	-	-
2	-	2 20.7%	-	-	2 27.4%	-
3	0 0.5%	2 18.6%	0 0.5%	-	2 24.6%	-
4	4 21.7%	-	4 23.2%	-	-	-
Net 5-7	4 21.8%	3 27.5%	4 21.8%	0 21.4%	3 36.3%	-
5	3 15.4%	2 18.6%	3 16.5%	-	2 24.6%	-
6	0 0.9%	-	-	0 14.5%	-	-
7	1 5.4%	1 8.9%	1 5.3%	0 6.9%	1 11.8%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp2b Page 84
(Continued)
Duke Non-Residential Prescriptive

SP2b. If you had NOT participated in the program, how likely is it that <COMPANY> would still have installed this additional energy efficient equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Net 8-10	9 50.0%	3 26.3%	8 48.1%	1 78.6%	1 11.8%	2 71.6% e
8	-	-	-	-	-	-
9	0 0.5%	1 5.9%	0 0.5%	-	-	1 24.1%
10 - definitely WOULD have implemented this equipment	9 49.5%	2 20.5%	8 47.5%	1 78.6%	1 11.8%	1 47.5%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-
Mean	7.09	5.10	6.94	9.21	4.51	6.92

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp2cm1 Page 85

Duke Non-Residential Prescriptive

SP2c. How did your experience with the program influence your decision to install high efficiency equipment on your own?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	6 100.0%	4 100.0%	6 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	4 100.0%	4 100.0%	4 100.0%	-	3 100.0%	1 100.0%
Open ended response	6 100.0%	4 97.4%	6 100.0%	-	4 100.0%	-
(Don't know)	-	0 2.6%	-	-	-	0 100.0%
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qsp3a Page 86

Duke Non-Residential Prescriptive

SP3a. What was the first energy efficient improvement that you made without a Duke Energy incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	6 100.0%	4 100.0%	6 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	4 100.0%	4 100.0%	4 100.0%	-	3 100.0%	1 100.0%
(Lighting: LED lamps)	0 1.6%	2 46.1%	0 1.6%	-	2 47.3%	-
(Lighting: T8 lamps)(Note that this is a type of linear fluorescent lamps)	-	2 46.1%	-	-	2 47.3%	-
(Lighting: T5 lamps)(Note that this is a type of linear fluorescent lamps)	-	-	-	-	-	-
(Lighting: Highbay Fixtures)	-	-	-	-	-	-
(Lighting: CFLs)	-	-	-	-	-	-
(Lighting: Controls or Occupancy sensors)	2 30.9%	-	2 30.9%	-	-	-
(Cooling: Chiller)	-	-	-	-	-	-
(Cooling: Unitary/Split Air Conditioning System)	-	-	-	-	-	-
(Motors: Variable Frequency Drives (VFD/ VSD))	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3a Page 87
(Continued)
Duke Non-Residential Prescriptive

SP3a. What was the first energy efficient improvement that you made without a Duke Energy incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
(Motors: Efficient motors)	-	-	-	-	-	-
(Food service products: Anti-sweat controls)	-	-	-	-	-	-
(Food service products: EC motor for WALK-IN cooler/freezer)	-	-	-	-	-	-
(Food service products: EC motor for REACH-IN cooler/freezer)	-	-	-	-	-	-
(Process equipment)	-	-	-	-	-	-
(Information technology)	-	-	-	-	-	-
(Other, specify)	-	0 7.9%	-	-	0 5.4%	0 100.0%
(Didn't install any measures)	-	-	-	-	-	-
(Don't know)	-	-	-	-	-	-
(Refused)	4 67.5%	-	4 67.5%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3b Page 88

Duke Non-Residential Prescriptive

SP3b. How many of this equipment did you install without receiving an incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	-
Total Responses (Unweighted)	3 100.0%	2 100.0%	3 100.0%	-	2 100.0%	-
3	1 47.6%	-	1 47.6%	-	-	-
4	-	2 50.0%	-	-	2 50.0%	-
20	0 4.8%	-	0 4.8%	-	-	-
40	1 47.6%	-	1 47.6%	-	-	-
500	-	2 50.0%	-	-	2 50.0%	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3c Page 89

Duke Non-Residential Prescriptive

SP3c. Generally, what type of light bulbs did the <SP3a RESPONSE> replace/control?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	-
Total Responses (Unweighted)	3 100.0%	2 100.0%	3 100.0%	-	2 100.0%	-
(Incandescent lamps)	-	-	-	-	-	-
(CFLs)	-	-	-	-	-	-
(LEDs)	1 52.4%	2 50.0%	1 52.4%	-	2 50.0%	-
(Halogen lamps)	-	-	-	-	-	-
(Linear fluorescent T12s)	-	-	-	-	-	-
(Linear fluorescent T8s)	1 47.6%	-	1 47.6%	-	-	-
(Other, specify:)	-	2 50.0%	-	-	2 50.0%	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3d Page 90

Duke Non-Residential Prescriptive

SP3d. Were the majority of the <SP3a RESPONSE> installed in areas that use space cooling and heating?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	-
Total Responses (Unweighted)	3 100.0%	2 100.0%	3 100.0%	-	2 100.0%	-
(Cooling Only)	-	-	-	-	-	-
(Heating Only)	-	-	-	-	-	-
(Cooling and Heating)	2 100.0%	2 50.0%	2 100.0%	-	2 50.0%	-
(Neither Cooling nor Heating)	-	2 50.0%	-	-	2 50.0%	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3em1 Page 91

Duke Non-Residential Prescriptive

SP3e. Why did you purchase the <SP3a RESPONSE> without an incentive from the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	3 100.0%	4 100.0%	3 100.0%	-	3 100.0%	1 100.0%
(Takes too long to get approval)	-	-	-	-	-	-
(No time to participate, needed equipment immediately)	-	-	-	-	-	-
(The equipment did not qualify)	-	-	-	-	-	-
(The amount of the incentive wasn't large enough)	1 47.6%	-	1 47.6%	-	-	-
(Did not know the program was available)	-	2 46.1%	-	-	2 47.3%	-
(There was no program available)	-	0 5.3%	-	-	0 5.4%	-
(Had reached the maximum incentive amount)	-	-	-	-	-	-
(Other: Specify)	1 52.4%	2 48.6%	1 52.4%	-	2 47.3%	0 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3f Page 92

Duke Non-Residential Prescriptive

SP3f. Did a contractor or vendor help you with the SELECTION of this equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	3 100.0%	4 100.0%	3 100.0%	-	3 100.0%	1 100.0%
Yes	1 52.4%	2 51.4%	1 52.4%	-	2 52.7%	-
No	1 47.6%	2 48.6%	1 47.6%	-	2 47.3%	0 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp3ffm1 Page 93

Duke Non-Residential Prescriptive

SP3ff. Who was the contractor or vendor you worked with?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	2 100.0%	1 100.0%	-	2 100.0%	-
Total Responses (Unweighted)	2 100.0%	2 100.0%	2 100.0%	-	2 100.0%	-
Open ended response	1 100.0% B	0 10.3%	1 100.0% E	-	0 10.3%	-
(Don't know)	-	2 89.7%	-	-	2 89.7%	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp4 Page 94

Duke Non-Residential Prescriptive

SP4. Did you implement any other energy efficient measures without a Duke Energy incentive?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	3 100.0%	4 100.0%	3 100.0%	-	3 100.0%	1 100.0%
Yes	-	-	-	-	-	-
No	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp4a Page 95

Duke Non-Residential Prescriptive

SP4a. What other measure did you implement?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	-	1 100.0%	-	-	-
Total Responses (Unweighted)	1 100.0%	-	1 100.0%	-	-	-
(Lighting: LED lamps)	1 100.0%	-	1 100.0%	-	-	-
(Lighting: T8 lamps)	-	-	-	-	-	-
(Lighting: T5 lamps)	-	-	-	-	-	-
(Lighting: Highbay Fixture Replacement)	-	-	-	-	-	-
(Lighting: CFLs)	-	-	-	-	-	-
(Lighting: Controls / Occupancy sensors)	-	-	-	-	-	-
(Cooling: Chiller)	-	-	-	-	-	-
(Cooling: Unitary/Split Air Conditioning System)	-	-	-	-	-	-
(Motors: Variable Frequency Drives (VFD/ VSD))	-	-	-	-	-	-
(Motors: Efficient motors)	-	-	-	-	-	-
(Food service products: Anti-sweat controls)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp4a Page 96
(Continued)
Duke Non-Residential Prescriptive

SP4a. What other measure did you implement?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
(Food service products: EC motor for WALK-IN cooler/freezer)	-	-	-	-	-	-
(Food service products: EC motor for REACH-IN cooler/freezer)	-	-	-	-	-	-
(Process equipment)	-	-	-	-	-	-
(Information technology)	-	-	-	-	-	-
(Other, specify)	-	-	-	-	-	-
(Didn't install any additional measures)	-	-	-	-	-	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsp6 Page 97

Duke Non-Residential Prescriptive

SP6. Thank you for sharing this information with us. We may have follow-up questions about the equipment you installed without an incentive. Would you be willing to speak briefly with a member of our team?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
Total Responses (Unweighted)	3 100.0%	4 100.0%	3 100.0%	-	3 100.0%	1 100.0%
Yes	2 100.0%	4 100.0%	2 100.0%	-	4 100.0%	0 100.0%
No	-	-	-	-	-	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qb0 Page 98

Duke Non-Residential Prescriptive

B0. Have you ever communicated with a Duke Energy Business Energy Advisor about energy efficiency or the energy efficiency programs that Duke offers for their business customers?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	120 100.0%	88 100.0%	107 100.0%	13 100.0%	78 100.0%	10 100.0%
Total Responses (Unweighted)	115 100.0%	86 100.0%	65 100.0%	50 100.0%	68 100.0%	18 100.0%
Yes	24 20.0%	19 21.4%	16 15.2%	8 58.8% C	16 19.9%	3 33.5%
No	91 76.0%	66 75.4%	86 80.8% D	5 36.4%	60 76.5%	6 66.5% d
(Don't know)	5 4.0%	2 2.2%	4 3.9%	1 4.8%	2 2.4%	-
(Refused)	-	1 1.0%	-	-	1 1.2%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_b1 Page 99

Duke Non-Residential Prescriptive

B1. You noted earlier that you worked with a Duke Energy Business Energy Advisor. How did you first come into contact with the Business Energy Advisor?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total	31 100.0%	25 100.0%	22 100.0%	9 100.0%	19 100.0%	6 100.0%
Total Responses (Unweighted)	55 100.0%	29 100.0%	20 100.0%	35 100.0%	18 100.0%	11 100.0%
Receive a Call or Email From the Advisor?	11 36.2%	4 14.6%	8 37.1%	3 34.0%	2 12.7%	1 21.4%
Reach Out to the Advisor Via Phone or	4 13.9%	15 59.0% A	2 8.6%	2 27.2%	12 63.7% C	2 42.8%
contact the advisor through the duke energy website?	1 4.0%	1 2.4%	-	1 13.9%	-	1 10.7%
Referral from other Duke staff	5 16.1%	1 2.8%	4 17.8%	1 11.7%	-	1 12.6%
Onsite visit	-	1 4.0%	-	-	1 4.7%	0 1.9%
Referral from contractor/ vendor	5 15.3%	-	4 18.7%	1 6.9%	-	-
Other Specify	4 14.3%	2 7.5%	4 17.8%	0 5.4%	2 9.7%	-
Don't know	0 0.3%	2 9.6%	-	0 0.9%	2 9.3%	1 10.7%
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qb2 Page 100

Duke Non-Residential Prescriptive

B2. Approximately, how many times did you have contact with the Business Energy Advisor?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total	31 100.0%	25 100.0%	22 100.0%	9 100.0%	19 100.0%	6 100.0%
Total Responses (Unweighted)	55 100.0%	29 100.0%	20 100.0%	35 100.0%	18 100.0%	11 100.0%
1	6 18.2% b	1 2.4%	5 21.9%	1 8.9%	-	1 10.7%
2	9 27.9%	12 49.1%	6 26.4%	3 31.6%	12 63.3% c	-
3	7 21.8%	2 7.5%	5 22.8%	2 19.3%	2 9.7%	-
4	1 4.7%	1 3.6%	1 4.5%	0 5.3%	1 4.7%	-
5	1 2.4%	1 3.3%	0 0.4%	1 7.3%	0 1.1%	1 10.7%
6	0 0.8%	3 10.4%	0 0.4%	0 1.9%	2 9.7%	1 12.6%
7	-	0 0.9%	-	-	0 1.1%	-
8	0 1.3%	-	-	0 4.4%	-	-
10	5 14.6%	1 2.4%	4 19.1%	0 3.5%	-	1 10.7%
12	1 2.5%	2 9.7%	-	1 8.9%	1 5.8%	1 23.3%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qb2 Page 101
(Continued)
Duke Non-Residential Prescriptive

B2. Approximately, how many times did you have contact with the Business Energy Advisor?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
15	1 2.9%	-	1 4.1%	-	-	-
20	0 1.0%	-	-	0 3.5%	-	-
24	0 0.5%	-	-	0 1.9%	-	-
30	0 1.0%	-	-	0 3.5%	-	-
(Don't know)	0 0.3%	2 8.4%	0 0.4%	-	1 4.7%	1 21.4%
(Refused)	-	1 2.4%	-	-	-	1 10.7%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_b3m1_1 Page 102

Duke Non-Residential Prescriptive

B3m1. What aspects of the project did the advisor help you with?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	31 100.0%	25 100.0%	22 100.0%	9 100.0%	19 100.0%	6 100.0%
Total Responses (Unweighted)	55 100.0%	29 100.0%	20 100.0%	35 100.0%	18 100.0%	11 100.0%
Project Scoping	17 53.5% B	6 22.8%	15 67.0% ED	2 19.7%	4 20.1%	2 32.1%
The Application Process	9 30.0%	9 36.7%	7 30.5%	3 28.7%	7 34.9%	2 42.8%
Identifying and Contacting a Trade Ally	0 1.0%	2 9.9%	-	0 3.5%	2 9.7%	1 10.7%
Answering Questions About Available Program Incentives	7 22.3%	1 5.8%	4 19.9%	3 28.5% F	1 6.9%	0 1.9%
Identifying eligible equipment	-	-	-	-	-	-
Helped with participation at all stages	1 4.5%	1 3.6%	1 4.1%	0 5.4%	1 4.7%	-
Increased awareness of the program or answerwed general questions	-	0 0.4%	-	-	-	0 1.9%
Savings/incentive estimation	-	1 4.5%	-	-	1 5.8%	-
Other Specify	1 2.0%	-	-	1 6.9%	-	-
Don't Know	2 7.3%	5 19.5%	0 1.6%	2 21.6%	4 19.0%	1 21.4%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_b3m1_1 Page 103
(Continued)
Duke Non-Residential Prescriptive

B3m1. What aspects of the project did the advisor help you with?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Refused	0 1.0%	-	-	0 3.5%	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qb4 Page 104

Duke Non-Residential Prescriptive

B4. How influential was the Business Energy Advisor in your decision to participate in the <program>. Would you say...

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	31 100.0%	25 100.0%	22 100.0%	9 100.0%	19 100.0%	6 100.0%
Total Responses (Unweighted)	55 100.0%	29 100.0%	20 100.0%	35 100.0%	18 100.0%	11 100.0%
Very influential	8 26.2%	10 38.9%	5 23.3%	3 33.5%	8 40.3%	2 34.0%
Somewhat influential	19 59.3% B	7 29.3%	17 75.9% ED	2 17.7%	6 31.0%	1 23.3%
Not very influential	1 4.3%	2 6.0%	-	1 15.2%	1 4.7%	1 10.7%
Not at all influential	3 9.2%	5 19.9%	0 0.8%	3 30.1% C	4 19.4%	1 21.4%
(Don't know)	0 1.0%	1 2.4%	-	0 3.5%	-	1 10.7%
(Refused)	-	1 3.6%	-	-	1 4.7%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qb5a Page 105

Duke Non-Residential Prescriptive

B5a. On a scale of 0 to 10, where 0 is 'Extremely Dissatisfied' and 10 is 'Extremely Satisfied', how would you rate your satisfaction with the Business Energy Advisor with whom you worked?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	31 100.0%	25 100.0%	22 100.0%	9 100.0%	19 100.0%	6 100.0%
Total Responses (Unweighted)	55 100.0%	29 100.0%	20 100.0%	35 100.0%	18 100.0%	11 100.0%
Net 0-4	5 16.1%	2 7.5%	4 18.3%	1 10.8%	2 9.7%	-
0 - Extremely dissatisfied	4 12.8%	2 7.5%	4 17.8%	-	2 9.7%	-
1	-	-	-	-	-	-
2	1 2.5%	-	-	1 8.9%	-	-
3	0 0.8%	-	0 0.4%	0 1.9%	-	-
4	-	-	-	-	-	-
Net 5-7	5 15.6%	4 15.6%	4 18.3%	1 8.9%	2 10.8%	2 32.1%
5	0 1.3%	-	0 0.4%	0 3.5%	-	-
6	-	0 0.9%	-	-	0 1.1%	-
7	4 14.3%	4 14.7%	4 17.8%	0 5.4%	2 9.7%	2 32.1% d

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qb5a Page 106
(Continued)
Duke Non-Residential Prescriptive

B5a. On a scale of 0 to 10, where 0 is 'Extremely Dissatisfied' and 10 is 'Extremely Satisfied', how would you rate your satisfaction with the Business Energy Advisor with whom you worked?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Net 8-10	21 66.3%	19 76.9%	14 63.5%	7 73.4%	15 79.4%	4 67.9%
8	1 3.5%	4 15.6%	1 4.1%	0 1.9%	4 20.1%	-
9	2 5.5%	2 6.9%	1 4.1%	1 8.9%	1 5.8%	1 10.7%
10 - Extremely Satisfied	18 57.4%	14 54.4%	12 55.3%	6 62.6%	10 53.5%	3 57.2%
(Don't know)	0 1.0%	-	-	0 3.5%	-	-
(Refused)	0 1.0%	-	-	0 3.5%	-	-
Mean	7.8	8.4	7.5	8.6	8.2	8.9

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_b5bm1 Page 107

Duke Non-Residential Prescriptive

B5bm1. Why did you give that rating?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	5 100.0%	2 100.0%	4 100.0%	1 100.0%	2 100.0%	-
Total Responses (Unweighted)	6 100.0%	1 100.0%	2 100.0%	4 100.0%	1 100.0%	-
Interaction was minimal	1 14.8%	2 100.0% A	0 2.2%	1 67.8%	2 100.0% C	-
Insufficient information from BEA	4 85.2%	-	4 97.8%	0 32.2%	-	-
Open ended response	-	-	-	-	-	-
Don't Know	-	-	-	-	-	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qee1 Page 108

Duke Non-Residential Prescriptive

EE1. Are you aware that Duke Energy has an online Energy Efficiency Store, where customers can purchase energy efficiency products at a discounted price?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	59 46.4% B	21 22.1%	50 44.5% E	9 61.2%	15 17.7%	6 52.6% E
No	68 53.6%	73 77.9% A	63 55.5%	6 38.8%	68 82.3% CF	6 47.4%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qee2 Page 109

Duke Non-Residential Prescriptive

EE2. Have you ever visited the Energy Efficiency Store's webpage?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	59 100.0%	21 100.0%	50 100.0%	9 100.0%	15 100.0%	6 100.0%
Total Responses (Unweighted)	68 100.0%	29 100.0%	33 100.0%	35 100.0%	17 100.0%	12 100.0%
Yes	46 78.4% B	7 36.0%	39 77.7% E	7 81.9% F	5 37.7%	2 31.9%
No	13 21.6%	13 64.0% A	11 22.3%	2 18.1%	9 62.3% C	4 68.1% D
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qee3 Page 110

Duke Non-Residential Prescriptive

EE3. Have you ever purchased energy efficient equipment from the online Energy Efficiency Store?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	46 100.0%	7 100.0%	39 100.0%	7 100.0%	5 100.0%	2 100.0%
Total Responses (Unweighted)	52 100.0%	13 100.0%	23 100.0%	29 100.0%	8 100.0%	5 100.0%
Yes	16 35.6%	1 17.9%	14 35.8%	2 34.6%	1 24.5%	-
No	30 64.2%	6 82.1%	25 64.0%	5 65.4%	4 75.5%	2 100.0% D
(Don't know)	0 0.2%	-	0 0.2%	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qee4a Page 111

Duke Non-Residential Prescriptive

EE4a. On a scale of 0 to 10, where 0 is 'Extremely Dissatisfied' and 10 is 'Extremely Satisfied', how would you rate your satisfaction with your use of the Energy Efficiency Store?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	16 100.0%	1 100.0%	14 100.0%	2 100.0%	1 100.0%	-
Total Responses (Unweighted)	15 100.0%	3 100.0%	7 100.0%	8 100.0%	3 100.0%	-
Net 0-4	0 0.6%	-	0 0.7%	-	-	-
0 - Extremely dissatisfied	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	0 0.6%	-	0 0.7%	-	-	-
4	-	-	-	-	-	-
Net 5-7	1 7.4%	-	1 6.5%	0 12.5%	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	1 7.4%	-	1 6.5%	0 12.5%	-	-
Net 8-10	14 86.5%	1 100.0%	12 86.3%	2 87.5%	1 100.0%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qee4a Page 112
(Continued)
Duke Non-Residential Prescriptive

EE4a. On a scale of 0 to 10, where 0 is 'Extremely Dissatisfied' and 10 is 'Extremely Satisfied', how would you rate your satisfaction with your use of the Energy Efficiency Store?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
8	5 28.6%	0 16.2%	4 29.2%	1 25.0%	0 16.2%	-
9	-	1 67.5%	-	-	1 67.5%	-
10 - Extremely Satisfied	10 57.9%	0 16.2%	8 57.1%	2 62.5%	0 16.2%	-
(Don't know)	1 5.5%	-	1 6.5%	-	-	-
(Refused)	-	-	-	-	-	-
Mean	9.1	9.0	9.1	9.1	9.0	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_ee4bm1 Page 113

Duke Non-Residential Prescriptive

EE4bm1. Why did you give that rating?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	0 100.0%	-	0 100.0%	-	-	-
Total Responses (Unweighted)	1 100.0%	-	1 100.0%	-	-	-
Issue with order, equipment not received	0 100.0%	-	0 100.0%	-	-	-
Open ended response	-	-	-	-	-	-
Don't Know	-	-	-	-	-	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qee5a Page 114

Duke Non-Residential Prescriptive

EE5a. How likely are you to make a purchase through Duke Energy's Energy Efficiency Store within the next year? Would you say...

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Very likely	35 27.3%	21 22.3%	32 28.3%	3 19.1%	18 22.3%	3 21.8%
Somewhat likely	60 47.3%	38 40.0%	55 48.6%	5 37.2% f	36 43.5% F	2 15.9%
Not very likely	22 17.3%	8 8.1%	19 17.0%	3 19.4%	6 7.6%	1 11.8%
Not at all likely	5 4.0%	19 20.6% A	3 2.8%	2 13.8%	15 18.4% C	4 35.6% d
(Need more information)	1 0.9%	0 0.2%	0 0.1%	1 7.7% c	0 0.3%	-
(Don't know)	1 1.0%	5 4.9%	1 0.8%	0 2.7%	3 3.4%	2 14.9%
(Refused)	3 2.2%	4 3.9%	3 2.4%	-	4 4.5%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_ee5b Page 115

Duke Non-Residential Prescriptive

EE5b. Why are you not likely to make a purchase through the Energy Efficiency Store?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	27 100.0%	27 100.0%	22 100.0%	5 100.0%	21 100.0%	6 100.0%
Total Responses (Unweighted)	38 100.0%	32 100.0%	19 100.0%	19 100.0%	22 100.0%	10 100.0%
Don't Have Enough Information	0 1.5%	2 8.6%	0 0.4%	0 6.5%	2 10.9%	-
Don't Need Any New Equipment	12 46.2%	7 27.1%	11 49.4%	1 31.5%	7 31.0%	1 12.4%
Equipment I Need is Not Available	0 0.3%	-	0 0.4%	-	-	-
Incentives Aren't High Enough	1 2.3%	-	-	1 13.1%	-	-
Difficulty using website/ finding information	-	-	-	-	-	-
Existing supplier/ Company purchasing rules	7 24.5%	12 42.8%	5 23.7%	1 28.6%	8 39.7%	3 54.3%
Preference for avoiding self installation	-	-	-	-	-	-
Pricing	-	1 5.2%	-	-	0 1.0%	1 20.8%
Lack of time to research	-	-	-	-	-	-
Other Specify	6 21.7%	3 13.0%	5 22.0%	1 20.3%	3 13.1%	1 12.4%
Don't Know	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_ee5b Page 116
(Continued)
Duke Non-Residential Prescriptive

EE5b. Why are you not likely to make a purchase through the Energy Efficiency Store?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Refused	1 3.4%	1 3.4%	1 4.1%	-	1 4.2%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qop1 Page 117

Duke Non-Residential Prescriptive

OP1. Are you aware that Duke Energy has a customer portal where customers can submit applications for energy efficiency projects and track the status of their applications?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Yes	48 37.4%	27 28.3%	40 35.4%	8 53.1%	18 21.6%	9 74.2% dE
No	79 62.6%	67 71.7%	73 64.6%	7 46.9% f	64 78.4% F	3 25.8%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qop2 Page 118

Duke Non-Residential Prescriptive

OP2. Have you ever used the online portal?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	48 100.0%	27 100.0%	40 100.0%	8 100.0%	18 100.0%	9 100.0%
Total Responses (Unweighted)	62 100.0%	36 100.0%	31 100.0%	31 100.0%	19 100.0%	17 100.0%
Yes	20 42.1%	11 41.4%	15 38.2%	5 62.8%	5 27.2%	6 69.6% E
No	28 57.9%	16 58.6%	25 61.8%	3 37.2%	13 72.8% F	3 30.4%
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_op3m1 Page 119

Duke Non-Residential Prescriptive

OP3m1. How did you use the online portal?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	20 100.0%	11 100.0%	15 100.0%	5 100.0%	5 100.0%	6 100.0%
Total Responses (Unweighted)	33 100.0%	16 100.0%	12 100.0%	21 100.0%	5 100.0%	11 100.0%
Submit Applications	5 23.2%	8 69.9% A	1 9.0%	3 68.7% C	2 43.7%	6 90.3% e
Track Status of Applications	7 35.0% b	1 5.4%	6 38.7%	1 23.1%	-	1 9.7%
Researching options	0 1.5%	1 8.2%	-	0 6.5%	1 18.8%	-
Other, Specify	8 40.2% B	1 8.2%	8 52.3% D	0 1.7%	1 18.8%	-
Don't Know	-	1 8.2%	-	-	1 18.8%	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_op4m1 Page 120

Duke Non-Residential Prescriptive

OP4m1.Why have you not used the online portal?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	28 100.0%	16 100.0%	25 100.0%	3 100.0%	13 100.0%	3 100.0%
Total Responses (Unweighted)	29 100.0%	20 100.0%	19 100.0%	10 100.0%	14 100.0%	6 100.0%
No Need	1 3.4%	2 11.6%	-	1 32.9%	2 14.1%	-
Insufficient time	1 4.3%	1 7.2%	1 4.1%	0 6.1%	1 8.7%	-
Lack of information about use	-	-	-	-	-	-
Vendor's responsibility	6 20.7%	5 33.6%	5 20.6%	1 22.0%	5 39.8%	0 3.9%
Not the account holder/ No access	1 3.6%	2 13.0%	1 4.1%	-	2 15.7%	-
Prefer paper application	1 3.6%	1 7.6%	1 4.1%	-	-	1 43.8%
Recently learned about it/No opportunity	1 3.6%	1 5.8%	1 4.1%	-	1 7.0%	-
Difficult to use	-	0 0.7%	-	-	-	0 3.9%
Open ended response	1 3.3%	1 3.8%	1 3.7%	-	-	1 22.2%
No Specific Reason	11 39.0%	2 16.0%	10 39.7%	1 32.9%	2 14.7%	1 22.2%
Don't Know	4 15.1%	0 0.7%	4 16.1%	0 6.1%	-	0 3.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_op4m1 Page 121
(Continued)
Duke Non-Residential Prescriptive

OP4m1.Why have you not used the online portal?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Refused	1 3.3%	-	1 3.7%	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1a Page 122

Duke Non-Residential Prescriptive

SAT1a. how would you rate your satisfaction with... The application process?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	113	88	100	13	76	12
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	118	90	65	53	68	22
Net 0-4	2 1.7%	0 0.2%	0 0.2%	2 12.9% C	0 0.3%	-
0 - Extremely dissatisfied	0 0.3%	0 0.2%	-	0 2.3%	0 0.3%	-
1	-	-	-	-	-	-
2	0 0.3%	-	-	0 2.3%	-	-
3	1 0.5%	-	0 0.1%	0 3.6%	-	-
4	1 0.6%	-	0 0.1%	1 4.6%	-	-
Net 5-7	18 16.2%	16 17.6%	15 15.3%	3 23.2%	13 17.2%	2 19.9%
5	5 4.6%	5 5.6%	4 4.5%	1 5.9%	4 4.9%	1 10.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1a Page 123
(Continued)
Duke Non-Residential Prescriptive

SAT1a. how would you rate your satisfaction with... The application process?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	6 5.5%	2 2.1%	6 5.9%	0 2.3%	2 2.5%	-
7	7 6.1%	9 9.8%	5 4.9%	2 15.0%	7 9.8%	1 9.9%
Net 8-10	93 82.1%	73 82.2%	84 84.5% D	9 63.9%	63 82.5%	10 80.1%
8	24 21.3%	24 26.8%	21 21.2%	3 22.0%	20 26.2%	4 30.6%
9	24 21.1%	11 12.0%	22 21.8%	2 16.1%	10 12.9%	1 5.9%
10 - Extremely Satisfied	45 39.7%	38 43.5%	41 41.6%	3 25.8%	33 43.5%	5 43.6%
(Don't know)	10 7.9%	4 3.9%	9 8.0%	1 6.5%	4 4.5%	-
(Refused)	4 3.1%	2 2.0%	4 3.5%	-	2 2.3%	-
Mean	8.6	8.7	8.7 D	7.6	8.7	8.5 d

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1b Page 124

Duke Non-Residential Prescriptive

SAT1b. how would you rate your satisfaction with... The measures that are eligible for incentives through the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	115	86	101	14	75	11
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	118	87	64	54	66	21
Net 0-4	3 2.3%	2 2.4%	1 1.1%	1 10.8% c	2 2.8%	-
0 - Extremely dissatisfied	0 0.3%	0 0.3%	-	0 2.2%	0 0.3%	-
1	-	-	-	-	-	-
2	1 0.6%	-	0 0.1%	1 4.5%	-	-
3	1 0.9%	-	1 0.9%	0 1.2%	-	-
4	0 0.4%	2 2.2%	0 0.1%	0 2.8%	2 2.5%	-
Net 5-7	12 10.6%	16 18.6%	10 9.8%	2 16.2%	12 16.5%	4 32.2%
5	2 1.5%	2 2.9%	0 0.3%	1 10.5% c	2 2.5%	1 5.3%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1b Page 125
(Continued)
Duke Non-Residential Prescriptive

SAT1b. how would you rate your satisfaction with... The measures that are eligible for incentives through the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	0 0.4%	5 5.4%	0 0.2%	0 2.2%	5 6.2%	-
7	10 8.6%	9 10.3%	9 9.3%	0 3.4%	6 7.7%	3 27.0% De
Net 8-10	100 87.2%	68 79.0%	90 89.1%	10 73.0%	61 80.7%	8 67.8%
8	23 20.4%	24 27.5%	20 19.7%	4 25.5%	21 27.4%	3 28.2%
9	20 17.6%	10 11.5%	18 17.4%	3 19.5%	9 11.6%	1 10.5%
10 - Extremely Satisfied	56 49.2%	35 40.0%	53 52.1% D	4 28.0%	31 41.6%	3 29.0%
(Don't know)	10 8.2%	8 8.1%	10 8.8%	0 3.4%	7 8.5%	1 5.0%
(Refused)	2 1.4%	-	2 1.6%	-	-	-
Mean	8.9	8.5	9.1 D	7.7	8.5	8.3

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1c Page 126

Duke Non-Residential Prescriptive

SAT1c. how would you rate your satisfaction with... The incentive levels?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	123	88	109	14	76	12
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	125	88	70	55	67	21
Net 0-4	2 1.9%	4 5.0%	1 0.8%	1 10.3% c	4 5.0%	1 5.1%
0 - Extremely dissatisfied	0 0.3%	2 2.8%	-	0 2.2%	2 2.5%	1 5.1%
1	-	-	-	-	-	-
2	0 0.1%	-	-	0 1.2%	-	-
3	0 0.1%	-	-	0 1.2%	-	-
4	2 1.4%	2 2.1%	1 0.8%	1 5.7%	2 2.5%	-
Net 5-7	19 15.8%	14 15.5%	15 14.1%	4 28.6%	10 12.5%	4 34.9% E

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1c Page 127
(Continued)
Duke Non-Residential Prescriptive

SAT1c. how would you rate your satisfaction with... The incentive levels?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
5	2 1.2%	3 3.3%	0 0.2%	1 9.5% c	1 1.5%	2 15.0% e
6	9 7.4%	5 5.2%	8 7.4%	1 7.2%	5 6.0%	-
7	9 7.1%	6 7.0%	7 6.5%	2 11.9%	4 5.0%	2 19.9% e
Net 8-10	101 82.3%	70 79.5%	92 85.1% D	9 61.0%	63 82.6% f	7 60.0%
8	32 25.7%	19 22.0%	28 25.9%	3 23.7%	16 21.2%	3 27.0%
9	15 12.4%	17 18.7%	13 11.8%	2 17.0%	15 20.1%	1 10.1%
10 - Extremely Satisfied	54 44.3%	34 38.8%	51 47.3% D	3 20.4%	31 41.2%	3 22.9%
(Don't know)	4 3.1%	4 4.3%	4 3.5%	-	4 4.8%	0 0.9%
(Refused)	0 0.2%	2 2.0%	-	0 2.2%	2 2.3%	-
Mean	8.7	8.4	8.8 D	7.5	8.5	7.5

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1d Page 128

Duke Non-Residential Prescriptive

SAT1d. how would you rate your satisfaction with... The contractor who helped you install the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	92 100.0%	69 100.0%	80 100.0%	12 100.0%	59 100.0%	10 100.0%
Total Valid Responses	92	69	80	12	59	10
Total Responses (Unweighted)	104	72	56	48	55	17
Total Valid Responses (Unweighted)	102	71	56	46	54	17
Net 0-4	1 0.7%	4 5.5%	-	1 5.3%	4 6.4%	-
0 - Extremely dissatisfied	0 0.3%	-	-	0 2.6%	-	-
1	-	-	-	-	-	-
2	0 0.3%	2 2.7%	-	0 2.6%	2 3.2%	-
3	-	-	-	-	-	-
4	-	2 2.7%	-	-	2 3.2%	-
Net 5-7	5 5.7%	9 13.2%	4 5.3%	1 8.2%	8 13.4%	1 12.0%
5	-	1 1.2%	-	-	0 0.4%	1 6.0%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1d Page 129
(Continued)
Duke Non-Residential Prescriptive

SAT1d. how would you rate your satisfaction with... The contractor who helped you install the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	1 0.7%	-	0 0.2%	0 4.1%	-	-
7	5 5.0%	8 12.0%	4 5.1%	0 4.1%	8 13.1%	1 6.0%
Net 8-10	86 93.6% b	56 81.3%	76 94.7% e	10 86.5%	47 80.2%	9 88.0%
8	9 10.3%	10 14.5%	8 10.1%	1 11.8%	10 16.7% f	0 1.1%
9	9 9.4%	15 22.4%	6 7.8%	2 19.9%	12 21.0%	3 30.8%
10 - Extremely Satisfied	68 73.9% B	31 44.4%	61 76.7% Ed	6 54.8%	25 42.4%	6 56.1%
(Don't know)	0 0.2%	0 0.3%	-	0 1.4%	0 0.4%	-
(Refused)	0 0.3%	-	-	0 2.5%	-	-
Mean	9.5 B	8.7	9.6 Ed	8.8	8.6	9.2

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1e Page 130

Duke Non-Residential Prescriptive

SAT1e. how would you rate your satisfaction with... Your interactions with <program> staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	95	67	84	11	57	11
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	103	71	56	47	50	21
Net 0-4	1 1.6%	4 5.9%	1 1.2%	0 4.2%	4 7.1%	-
0 - Extremely dissatisfied	1 1.3%	2 3.1%	1 1.1%	0 2.7%	2 3.7%	-
1	-	-	-	-	-	-
2	0 0.3%	-	0 0.1%	0 1.5%	-	-
3	-	-	-	-	-	-
4	-	2 2.8%	-	-	2 3.3%	-
Net 5-7	7 7.6%	12 18.2%	5 6.2%	2 18.0%	10 18.5%	2 16.7%
5	1 1.1%	2 2.8%	0 0.1%	1 8.4% c	2 3.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qsat1e Page 131
(Continued)
Duke Non-Residential Prescriptive

SAT1e. how would you rate your satisfaction with... Your interactions with <program> staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	0	1	0	-	1	-
	0.2%	1.7%	0.2%		2.0%	
7	6	9	5	1	7	2
	6.3%	13.7%	5.8%	9.6%	13.2%	16.7%
Net 8-10	87	51	78	9	42	9
	90.8%	75.9%	92.6%	77.8%	74.4%	83.3%
	b		e			
8	18	14	17	1	14	0
	19.3%	20.3%	20.5%	9.9%	24.0%	1.0%
					F	
9	15	9	14	2	6	3
	16.0%	13.3%	16.4%	13.8%	10.5%	28.4%
10 - Extremely Satisfied	53	28	47	6	23	6
	55.5%	42.2%	55.7%	54.2%	40.0%	53.9%
(Not applicable)	23	23	21	2	23	-
	17.9%	24.9%	18.5%	13.0%	28.6%	
(Don't know)	4	3	4	0	2	1
	3.4%	3.3%	3.5%	2.2%	2.3%	9.9%
(Refused)	5	-	4	1	-	-
	3.6%		3.5%	4.3%		
Mean	9.1	8.4	9.1	8.6	8.2	9.2
			e			E

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1f Page 132

Duke Non-Residential Prescriptive

SAT1f. how would you rate your satisfaction with... The <program> overall?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Valid Responses	127	94	113	14	82	12
Total Responses (Unweighted)	127	94	71	56	72	22
Total Valid Responses (Unweighted)	127	93	71	56	71	22
Net 0-4	1 1.0%	1 1.0%	-	1 8.7%	1 1.1%	-
0 - Extremely dissatisfied	0 0.2%	-	-	0 2.2%	-	-
1	1 0.5%	-	-	1 4.3%	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	0 0.2%	1 1.0%	-	0 2.2%	1 1.1%	-
Net 5-7	8 6.6%	13 14.3%	6 5.7%	2 13.4%	13 15.7%	1 5.0%
5	1 0.7%	1 1.2%	0 0.1%	1 5.8%	1 1.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1f Page 133
(Continued)
Duke Non-Residential Prescriptive

SAT1f. how would you rate your satisfaction with... The <program> overall?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
6	0 0.4%	0 0.2%	0 0.1%	0 2.7%	0 0.3%	-
7	7 5.5%	12 12.9%	6 5.6%	1 4.9%	11 14.0%	1 5.0%
Net 8-10	117 92.4%	79 84.7%	106 94.3% d	11 77.9%	68 83.2%	11 95.0% D
8	16 12.5%	23 24.0%	13 11.8%	3 17.6%	18 21.6%	5 40.6% d
9	33 26.3%	15 16.1%	30 26.2%	4 27.3%	13 15.5%	2 20.8%
10 - Extremely Satisfied	68 53.6%	42 44.6%	63 56.3% D	5 33.0%	38 46.2%	4 33.6%
(Don't know)	-	0 0.2%	-	-	0 0.3%	-
(Refused)	-	-	-	-	-	-
Mean	9.2	8.8	9.3 eD	8.1	8.8	8.8 d

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_sat2am Page 134

Duke Non-Residential Prescriptive

SAT2a. Your response suggests that you are not fully satisfied with the application process?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	0 100.0%	0 100.0%	2 100.0%	0 100.0%	-
Total Responses (Unweighted)	8 100.0%	1 100.0%	2 100.0%	6 100.0%	1 100.0%	-
Difficult to understand	1 53.6%	-	0 50.0%	1 54.0%	-	-
Difficult to compile information	1 46.4%	0 100.0%	0 50.0%	1 46.0%	0 100.0%	-
Open ended response	-	-	-	-	-	-
Don't Know	-	-	-	-	-	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qsat2bm1 Page 135

Duke Non-Residential Prescriptive

SAT2b. Your response suggests that you are not fully satisfied with the measures that are eligible for incentives through the <program>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	3 100.0%	2 100.0%	1 100.0%	1 100.0%	2 100.0%	-
Total Responses (Unweighted)	9 100.0%	2 100.0%	3 100.0%	6 100.0%	2 100.0%	-
Open ended response	3 100.0% B	0 10.3%	1 100.0% E	1 100.0%	0 10.3%	-
(Don't know)	-	2 89.7%	-	-	2 89.7%	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2cm1 Page 136

Duke Non-Residential Prescriptive

SAT2c. Your response suggests that you are not fully satisfied with the incentive levels?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	4 100.0%	1 100.0%	1 100.0%	4 100.0%	1 100.0%
Total Responses (Unweighted)	7 100.0%	3 100.0%	1 100.0%	6 100.0%	2 100.0%	1 100.0%
Open ended response	2 79.6%	2 56.8%	1 100.0%	1 66.7%	2 50.0%	1 100.0%
(Don't know)	0 20.4%	2 43.2%	-	0 33.3%	2 50.0%	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2dm1 Page 137

Duke Non-Residential Prescriptive

SAT2d. Your response suggests that you are not fully satisfied with the contractor who helped you install the equipment?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	4 100.0%	-	1 100.0%	4 100.0%	-
Total Responses (Unweighted)	2 100.0%	2 100.0%	-	2 100.0%	2 100.0%	-
Open ended response	1 100.0%	4 100.0%	-	1 100.0%	4 100.0%	-
(Don't know)	-	-	-	-	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2em1 Page 138

Duke Non-Residential Prescriptive

SAT2e. Your response suggests that you are not fully satisfied with your interactions with <program> staff?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	4 100.0%	1 100.0%	0 100.0%	4 100.0%	-
Total Responses (Unweighted)	4 100.0%	3 100.0%	2 100.0%	2 100.0%	3 100.0%	-
Open ended response	1 100.0% b	2 47.3%	1 100.0% e	0 100.0%	2 47.3%	-
(Don't know)	-	2 52.7%	-	-	2 52.7%	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2fm1 Page 139

Duke Non-Residential Prescriptive

SAT2f. Your response suggests that you are not fully satisfied with the <program> overall?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	1 100.0%	1 100.0%	-	1 100.0%	1 100.0%	-
Total Responses (Unweighted)	4 100.0%	1 100.0%	-	4 100.0%	1 100.0%	-
Open ended response	1 75.0%	1 100.0%	-	1 75.0%	1 100.0%	-
(Don't know)	0 25.0%	-	-	0 25.0%	-	-
(Refused)	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat3a Page 140

Duke Non-Residential Prescriptive

SAT3a. How likely are you to participate in the <program> again, within the next year? Would you say...

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Very likely	55 43.0%	43 46.1%	46 41.0%	8 59.1% c	37 44.6%	7 56.7%
Somewhat likely	40 31.3%	32 34.2%	37 32.6%	3 21.0%	30 36.1%	3 21.7%
Not very likely	22 17.6% B	6 6.8%	22 19.4% eD	1 3.9%	6 7.1%	1 5.0%
Not at all likely	9 6.9%	7 8.0%	7 6.2%	2 12.6%	7 8.9%	0 1.8%
(Don't know)	0 0.4%	3 2.9%	-	0 3.4%	1 1.1%	2 14.9% e
(Refused)	1 0.7%	2 2.0%	1 0.8%	-	2 2.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_sat3b Page 141

Duke Non-Residential Prescriptive

SAT3b. Why are you not likely to participate in the program again?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	31 100.0%	14 100.0%	29 100.0%	2 100.0%	13 100.0%	1 100.0%
Total Responses (Unweighted)	26 100.0%	18 100.0%	15 100.0%	11 100.0%	15 100.0%	3 100.0%
Was Not Satisfied with the Program	1 2.0%	-	-	1 26.3%	-	-
Don't Need Any New Equipment	27 88.0%	10 73.4%	27 92.7% D	1 30.8%	9 71.7%	1 100.0%
Equipment I Need is Not Available	1 2.9%	-	1 3.2%	-	-	-
Incentives Aren't High Enough	0 1.3%	3 20.1%	0 0.3%	0 13.1%	3 21.4%	-
Moving	-	-	-	-	-	-
Funding	-	-	-	-	-	-
Other Specify	1 4.8%	-	1 3.8%	0 16.6%	-	-
Don't Know	-	1 6.5%	-	-	1 6.9%	-
Refused	0 1.0%	-	-	0 13.1%	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat4a Page 142

Duke Non-Residential Prescriptive

SAT4a. How likely are you to recommend the <program> to other businesses like yours? Would you say...

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Very likely	118 93.1% B	73 78.0%	107 94.5% Ed	12 81.8%	64 78.4%	9 75.3%
Somewhat likely	6 5.0%	16 16.8% A	5 4.5%	1 8.9%	14 17.1% C	2 14.9%
Not very likely	0 0.3%	-	0 0.1%	0 2.2%	-	-
Not at all likely	1 0.9%	1 1.0%	0 0.1%	1 7.1% c	1 1.1%	-
(Don't know)	-	1 1.3%	-	-	-	1 9.9%
(Refused)	1 0.7%	3 3.0%	1 0.8%	-	3 3.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_sat4b Page 143

Duke Non-Residential Prescriptive

SAT4b. Why are you not likely to recommend the program to other businesses?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	2 100.0%	1 100.0%	0 100.0%	1 100.0%	1 100.0%	-
Total Responses (Unweighted)	7 100.0%	1 100.0%	2 100.0%	5 100.0%	1 100.0%	-
Was Not Satisfied with the Program	1 67.9%	-	0 50.0%	1 70.3%	-	-
Selection of Eligible Equipment	-	-	-	-	-	-
Incentives Levels	-	1 100.0%	-	-	1 100.0%	-
Paperwork/Application Process	-	-	-	-	-	-
Not in communication with other businesses	0 26.7%	-	0 50.0%	0 23.4%	-	-
Other Specify	0 5.4%	-	-	0 6.2%	-	-
Don't Know	-	-	-	-	-	-
Refused	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_br1am1 Page 144

Duke Non-Residential Prescriptive

BR1a. What do you view as the main barriers, if any, to participating in the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Paperwork/Application Process/Time Required to Complete Application	25 19.6%	8 8.8%	22 19.7% e	3 18.7%	6 7.1%	2 20.8%
Selection of Equipment Available Through the	3 2.2%	3 3.4%	2 1.8%	1 5.2%	2 2.3%	1 10.9%
Incentive Levels	11 8.4%	7 7.9%	10 8.9%	1 4.3%	7 9.1%	-
Knowledge of Incentives and Eligible Products	12 9.6%	8 8.1%	10 9.0%	2 13.8%	7 8.5%	1 5.0%
Financial considerations besides incentive levels	12 9.8%	8 8.2%	11 9.8%	1 9.5%	8 9.3%	0 0.9%
Availability/Selection of Trade Allies	-	-	-	-	-	-
Timeline for submission/ eligibility	0 0.1%	2 2.0%	0 0.1%	-	-	2 15.8%
No need for equipment	1 0.5%	1 1.0%	-	1 4.3%	1 1.1%	-
Lack of awareness of program	2 1.4%	2 2.6%	2 1.6%	-	2 2.3%	1 5.0%
Other, Specify	9 7.4%	9 9.4%	9 8.0%	0 3.4%	9 10.8%	-
None - Don't See Any Barriers	47 36.8%	43 45.2%	41 36.0%	6 42.9%	38 45.9%	5 40.8%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_br1am1 Page 145
(Continued)
Duke Non-Residential Prescriptive

BR1a. What do you view as the main barriers, if any, to participating in the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Same as Just Mentioned	-	-	-	-	-	-
Don't Know	4 3.4%	3 3.1%	4 3.5%	0 2.2%	3 3.4%	0 0.9%
Refused	3 2.2%	0 0.2%	3 2.4%	-	0 0.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_br1bm1 Page 146

Duke Non-Residential Prescriptive

BR1b. What could Duke Energy do to reduce these barriers to participation in the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	73 100.0%	48 100.0%	65 100.0%	8 100.0%	41 100.0%	7 100.0%
Total Responses (Unweighted)	78 100.0%	50 100.0%	45 100.0%	33 100.0%	37 100.0%	13 100.0%
Increase incentives	7 9.6%	7 14.8%	7 10.4%	0 3.2%	7 17.3%	-
Simplify applications/ paperwork requirements/ time commitment to participate	6 8.2%	2 4.8%	5 7.6%	1 13.3%	0 1.1%	2 27.0% e
Provide more guidance and assistance/increased program contact during process	16 22.3% b	5 9.7%	16 24.4% D	0 5.4%	5 11.3%	-
Provide program training and information more readily to participants	9 12.1%	3 6.2%	8 12.6%	1 7.9%	3 7.3%	-
Market the program more extensively/effectively	4 6.1%	9 19.2%	4 5.6%	1 10.1%	9 21.0%	1 8.6%
Improve selection of measures	6 8.7%	2 3.9%	5 7.6%	1 18.0%	2 4.6%	-
Improve processing times	1 1.4%	-	1 1.5%	-	-	-
Adjust the participation timeframe	0 0.3%	0 0.2%	0 0.3%	-	-	0 1.5%
Open ended response	6 8.7%	3 6.6%	5 7.9%	1 15.1%	2 4.6%	1 18.7%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_br1bm1 Page 147
(Continued)
Duke Non-Residential Prescriptive

BR1b. What could Duke Energy do to reduce these barriers to participation in the program?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Don't Know	17 22.6%	12 24.5%	14 22.0%	2 26.9%	10 24.0%	2 27.3%
Refused	-	3 5.8%	-	-	3 6.8%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_br2m11 Page 148

Duke Non-Residential Prescriptive

BR2. And more generally, what do you view as the main barriers, if any, to making energy efficient improvements at your facility?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Higher Cost of Energy Efficient Equipment	65 51.4% B	28 30.3%	59 52.5% E	6 43.3%	20 25.0%	8 66.6% dE
Access to Financing or Capital for Energy Improvements	6 4.8%	9 10.0%	5 4.5%	1 6.7%	9 11.3%	0 0.9%
Difficulty Finding Information on How to Improve Energy	0 0.3%	2 2.2%	0 0.1%	0 2.2%	2 2.6%	-
Uncertainty About the Savings From Energy Efficiency Improvements	6 4.9%	4 4.7%	6 5.3%	0 1.2%	3 3.9%	1 9.9%
Lease Structure / We are Renters	6 4.6%	1 1.0%	6 5.2%	-	1 1.1%	-
Difficult to Find Contractors	-	-	-	-	-	-
Lack of knowledge/ information	1 0.9%	5 5.3%	1 0.8%	0 1.2%	4 4.6%	1 10.0%
No need for new equipment	0 0.2%	1 1.0%	-	0 2.2%	1 1.1%	-
Corporate approval process	-	-	-	-	-	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_br2m11 Page 149
(Continued)
Duke Non-Residential Prescriptive

BR2. And more generally, what do you view as the main barriers, if any, to making energy efficient improvements at your facility?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Keeping up with technological changes	-	-	-	-	-	-
Other, Specify	7 5.4%	9 9.3%	6 5.2%	1 7.1%	9 10.5%	0 0.9%
None - Don't See Any Barriers	29 23.0%	31 32.8%	24 21.3%	5 36.2%	28 34.5%	3 21.7%
Don't Know	5 4.1%	4 3.9%	5 4.3%	0 2.2%	4 4.5%	-
Refused	2 1.4%	2 2.0%	2 1.6%	-	2 2.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_f1 Page 150

Duke Non-Residential Prescriptive

F1. What is the business type of the facility located at <ADDRESSS>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
K-12 School	1 0.8%	3 3.2%	0 0.3%	1 4.6%	3 3.7%	-
College/University	-	1 1.4%	-	-	-	1 10.9%
Grocery	0 0.1%	2 1.9%	0 0.1%	-	2 2.2%	-
Medical	1 0.4%	2 1.6%	0 0.2%	0 2.4%	1 1.1%	1 5.0%
Hotel/Motel	8 6.5%	12 12.4%	7 6.1%	1 9.5%	11 13.1%	1 7.7%
Light Industry	8 6.2%	2 2.5%	7 6.1%	1 6.5%	2 2.8%	-
Heavy Industry	4 3.5%	-	4 3.6%	0 2.2%	-	-
Office	16 12.7%	6 6.3%	14 12.3%	2 15.4%	5 5.7%	1 10.0%
Restaurant	2 1.6%	6 6.9%	-	2 14.2%	5 5.7%	2 14.9%
Retail/Service	43 33.5%	24 25.0%	41 36.0% D	2 13.8%	20 24.2%	4 30.8%
Government	2 1.3%	2 2.0%	1 1.0%	1 3.9%	2 2.3%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_f1 Page 151
(Continued)
Duke Non-Residential Prescriptive

F1. What is the business type of the facility located at <ADDRESSS>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Manufacturing	5 4.1%	3 2.7%	5 4.4%	0 1.8%	3 3.1%	-
Church/Religious Building	10 8.0%	4 4.6%	9 7.9%	1 8.7%	4 4.5%	1 5.0%
Agriculture	0 0.2%	2 2.0%	-	0 2.2%	2 2.3%	-
Automotive Service/Gas Station	6 5.0%	5 5.0%	6 5.2%	1 3.9%	5 5.7%	-
Non-profit	4 3.5%	3 3.0%	4 3.6%	0 2.2%	2 2.7%	1 5.0%
Storage/Warehouse	9 7.0%	4 4.0%	9 7.9%	-	4 4.6%	-
Garage	1 0.7%	-	1 0.8%	-	-	-
Hospitality/Hotel	0 0.3%	0 0.3%	0 0.1%	0 2.2%	0 0.3%	0 0.9%
Residential community	0 0.2%	3 3.0%	-	0 2.2%	3 3.4%	-
K-12 Education	0 0.3%	-	0 0.1%	0 2.2%	-	-
Contractor/Construction	5 3.9%	3 3.0%	5 4.3%	-	3 3.4%	-
Other Specify	0 0.2%	5 5.0% a	-	0 2.2%	5 5.7%	-
Don't Know	-	1 1.3%	-	-	-	1 9.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qrec_f1 Page 152
(Continued)
Duke Non-Residential Prescriptive

F1. What is the business type of the facility located at <ADDRESSS>?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Refused	-	3 3.0%	-	-	3 3.4%	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qf2 Page 153

Duke Non-Residential Prescriptive

F2. Which of the following best describes the ownership of this facility?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
My company owns and occupies this facility	60 47.1%	59 62.6% a	48 43.0%	11 80.0% C	50 61.5% c	8 70.3%
My company owns this facility but it is rented to someone else	33 26.2% B	6 6.9%	32 28.1% ED	2 11.1%	6 7.9%	-
My company rents this facility	33 25.6%	22 23.3%	32 28.2% D	1 5.5%	20 23.8%	2 19.9%
(Don't know)	0 0.4%	1 1.0%	-	0 3.4%	1 1.1%	-
(Refused)	1 0.7%	6 6.2% a	1 0.8%	-	5 5.7%	1 9.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qf3a Page 154

Duke Non-Residential Prescriptive

F3a. How many employees, full plus part-time, are employed at this facility?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
0-29	79 62.2%	64 68.5%	72 64.1%	7 47.2%	57 69.3%	8 63.5%
30-69	23 18.4%	7 7.7%	20 17.7%	3 23.7% f	6 7.3%	1 9.9%
70-99	5 3.8%	1 0.7%	4 3.6%	1 5.5%	1 0.8%	-
100-249	10 8.0%	7 7.3%	8 7.0%	2 15.6%	7 8.3%	-
250-700	2 1.7%	5 5.3%	2 1.4%	1 3.9%	4 4.6%	1 10.0%
(Don't know)	7 5.5%	5 5.4%	7 6.0%	0 1.2%	3 3.9%	2 15.8% d
(Refused)	0 0.3%	5 5.0%	0 0.1%	0 2.2%	5 5.7% c	-

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qf3b Page 155

Duke Non-Residential Prescriptive

F3b. Do you know the approximate number of employees? Would you say it is...?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	7 100.0%	5 100.0%	7 100.0%	0 100.0%	3 100.0%	2 100.0%
Total Responses (Unweighted)	6 100.0%	7 100.0%	5 100.0%	1 100.0%	4 100.0%	3 100.0%
Less than 10	4 57.1%	-	4 58.5%	-	-	-
10-49	0 2.5%	1 19.8%	-	0 100.0%	1 28.0%	0 5.6%
50-99	0 1.3%	0 4.3%	0 1.3%	-	0 6.7%	-
100-249	2 26.1%	-	2 26.8%	-	-	-
250-499	-	-	-	-	-	-
500 or more	1 13.1%	-	1 13.4%	-	-	-
(Don't know)	-	3 52.9%	-	-	2 65.3%	1 31.8%
(Refused)	-	1 23.1%	-	-	-	1 62.6%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix F. Participant Telephone Survey Cross-Tabulations

Table qemp_ct Page 156

Duke Non-Residential Prescriptive

Employee Count: Categorized

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Less Than 10	53 41.6%	39 41.1%	49 43.8% D	3 24.1%	36 43.3%	3 25.9%
10-49	47 37.1%	30 32.2%	42 36.9%	6 39.1%	25 29.9%	6 48.3%
50-99	11 9.0%	5 4.9%	9 8.3%	2 14.5%	5 5.6%	-
100-249	12 9.4%	7 7.3%	10 8.6%	2 15.6%	7 8.3%	-
250-499	2 1.8%	5 5.4%	2 1.5%	1 4.5%	4 4.6%	1 10.9%
500 or More	1 0.7%	-	1 0.8%	-	-	-
Don't Know	-	3 2.9%	-	-	2 2.6%	1 5.0%
Refused	0 0.3%	6 6.2% a	0 0.1%	0 2.2%	5 5.7% c	1 9.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrec_f4 Page 157

Duke Non-Residential Prescriptive

rec_f4. What is the primary heating fuel for your facility?

	Jurisdiction		DEC Technology		DEP Technology	
	DEC	DEP	Lighting	Non-Lighting	Lighting	Non-Lighting
	(A)	(B)	(C)	(D)	(E)	(F)
Total Responses	127 100.0%	94 100.0%	113 100.0%	14 100.0%	82 100.0%	12 100.0%
Total Responses (Unweighted)	127 100.0%	94 100.0%	71 100.0%	56 100.0%	72 100.0%	22 100.0%
Electricity	56 44.2%	38 40.4%	52 45.8%	4 31.4%	34 41.4%	4 33.6%
Gas	54 42.7%	37 38.8%	48 42.7%	6 42.7%	32 38.7%	5 39.8%
Electric and Gas	9 7.4%	5 4.8%	7 6.4%	2 15.4%	3 3.9%	1 10.9%
Heating oil	0 0.2%	-	-	0 2.2%	-	-
No heat	1 1.0%	5 5.0%	1 0.8%	0 2.2%	5 5.7%	-
Other, Please Specify	-	-	-	-	-	-
Don't Know	6 4.5%	3 3.7%	5 4.3%	1 6.1%	3 3.4%	1 5.9%
Refused	-	7 7.2%	-	-	6 6.8%	1 9.9%

Comparison Groups: AB/CD/EF/CE/DF
Independent T-Test for Means (unequal variances), Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

This Appendix contains detailed results from the trade ally online survey. We provide results in the form of Wincross tables with a breakdown of survey results by jurisdiction.

Survey Summary

Program	Non-Residential Prescriptive Smart $aver Energy Efficiency for Business
Jurisdiction	DEC & DEP
Survey Type	Internet
Target Population	Participating Trade Allies
Dates Fielded	June 1 - June 21, 2017
Number of Completes[5]	143
Response Rate	18.2%
Average Survey Time for Completes	21 min
Number of Reminders (web)	2

[5] A total of 143 trade allies completed the entire survey; however, an additional five trade allies completed all of the questions in the spillover section and were included in the trade ally spillover analysis. As a result, the responses of these five trade allies are included in the cross-tabulations for the spillover questions, increasing the total number of responses to those questions to 148.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Duke Trade Ally Tables

TABLE OF CONTENTS

Duke Trade Ally Tables

TABLE OF CONTENTS

Duke Trade Ally Tables

TABLE OF CONTENTS

Duke Trade Ally Tables

TABLE OF CONTENTS

Duke Trade Ally Tables

TABLE OF CONTENTS

Table qsc0a_rec Page 1

Duke Trade Ally Tables

Which of the following best describes your business?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Contractor	48 43.2%	13 40.6%
Equipment Vendor/ Distributor	46 41.4% B	7 21.9%
Energy Service Company (ESCO)	4 3.6%	6 18.8% A
Equipment Manufacturer	4 3.6%	2 6.2%
Engineering Firm	2 1.8%	1 3.1%
Rebate administrator/ processor	2 1.8%	1 3.1%
Building owner/property manager	1 0.9%	1 3.1%
Other	4 3.6%	1 3.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsc0bm1_re1 Page 2

Duke Trade Ally Tables

What type of equipment, if any, is your company's area of expertise? Please select all that apply.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Lighting	95 85.6%	25 78.1%
HVAC	23 20.7%	11 34.4%
Process equipment	8 7.2%	5 15.6%
Motors, pumps, VFDs	25 22.5%	8 25.0%
Food service products	8 7.2%	2 6.2%
Information technology	6 5.4%	1 3.1%
Compressed air equipment	12 10.8%	2 6.2%
Roofing	1 0.9%	-
Solar	2 1.8%	-
Window treatment	-	1 3.1%
Water heating	1 0.9%	-
Wiring (commerical or industrial)	1 0.9%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsc0bm1_re1 Page 3
(Continued)
Duke Trade Ally Tables

What type of equipment, if any, is your company's area of expertise? Please select all that apply.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Air purification	1 0.9%	-
Water purification	1 0.9%	-
Other	4 3.6%	1 3.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsc0c Page 4

Duke Trade Ally Tables

For how many years has <TRADEALLY_NAME> participated in Duke Energy's <program>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Less Than a Year	4 3.6%	1 3.1%
One Year	16 14.4%	4 12.5%
Two Years	18 16.2%	6 18.8%
Three Years	18 16.2%	7 21.9%
Four Years	17 15.3% b	2 6.2%
Five Years or More	28 25.2%	11 34.4%
Don't Know	10 9.0%	1 3.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qpi1_a Page 5

Duke Trade Ally Tables

Since <tradeally_name> became a <program> trade ally, have any of the following aspects changed and if so, by how much?
Your knowledge of high efficiency options...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	116 100.0%	32 100.0%
Did Not Increase	14 12.1%	6 18.8%
Increased Somewhat	62 53.4%	14 43.8%
Increased Greatly	40 34.5%	12 37.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi1_b Page 6

Duke Trade Ally Tables

Since <tradeally_name> became a <program> trade ally, have any of the following aspects changed and if so, by how much?
Your comfort level in discussing the benefits of high efficiency equipment with your customers...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	116 100.0%	32 100.0%
Did Not Increase	14 12.1%	5 15.6%
Increased Somewhat	50 43.1%	17 53.1%
Increased Greatly	52 44.8%	10 31.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi1_c Page 7

Duke Trade Ally Tables

Since <tradeally_name> became a <program> trade ally, have any of the following aspects changed and if so, by how much?
The percentage of sales situations in which you recommend high efficiency equipment...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	116 100.0%	32 100.0%
Did Not Increase	14 12.1%	5 15.6%
Increased Somewhat	43 37.1%	14 43.8%
Increased Greatly	59 50.9%	13 40.6%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi1_d Page 8

Duke Trade Ally Tables

Since <tradeally_name> became a <program> trade ally, have any of the following aspects changed and if so, by how much?
The percentage of jobs in which <tradeally_name> installs high efficiency equipment in Duke Energy's <jurisdiction> service territory...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	116 100.0%	32 100.0%
Did Not Increase	18 15.5%	8 25.0%
Increased Somewhat	57 49.1%	15 46.9%
Increased Greatly	41 35.3%	9 28.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi1_e Page 9

Duke Trade Ally Tables

Since <tradeally_name> became a <program> trade ally, have any of the following aspects changed and if so, by how much?
The total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	116 100.0%	32 100.0%
Did Not Increase	22 19.0%	7 21.9%
Increased Somewhat	53 45.7%	15 46.9%
Increased Greatly	41 35.3%	10 31.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi2 Page 10

Duke Trade Ally Tables

Did the <program> (including the program incentive and any training, information, or other support that the program provided) contribute at all to these increases?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	112 100.0%	31 100.0%
Yes	93 83.0% B	18 58.1%
No	8 7.1%	3 9.7%
Don't Know	11 9.8%	10 32.3% A

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_a Page 11

Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… Your knowledge of high efficiency options.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	85 100.0%	16 100.0%
Net 0-4	14 16.5%	4 25.0%
0 - Not at All Influential	1 1.2%	1 6.2%
1	1 1.2%	-
2	2 2.4%	-
3	5 5.9%	3 18.8%
4	5 5.9%	-
Net 5-7	39 45.9%	6 37.5%
5	18 21.2% B	1 6.2%
6	12 14.1%	1 6.2%
7	9 10.6%	4 25.0%
Net 8-10	32 37.6%	6 37.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_a Page 12
(Continued)
Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… Your knowledge of high efficiency options.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
8	11 12.9%	3 18.8%
9	6 7.1%	-
10 - Extremely Influential	15 17.6%	3 18.8%
Mean	6.6	6.4

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_b Page 13

Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… Your comfort level in discussing the benefits of high efficiency with your customers.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	86 100.0%	17 100.0%
Net 0-4	9 10.5%	3 17.6%
0 - Not at All Influential	1 1.2%	1 5.9%
1	1 1.2%	-
2	2 2.3%	-
3	4 4.7%	-
4	1 1.2%	2 11.8%
Net 5-7	37 43.0%	8 47.1%
5	14 16.3%	3 17.6%
6	8 9.3%	1 5.9%
7	15 17.4%	4 23.5%
Net 8-10	40 46.5%	6 35.3%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_b Page 14
(Continued)
Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… Your comfort level in discussing the benefits of high efficiency with your customers.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
8	12 14.0%	3 17.6%
9	8 9.3%	1 5.9%
10 - Extremely Influential	20 23.3%	2 11.8%
Mean	7.1	6.5

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_c Page 15

Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… The percentage of sales situations in which you recommend high efficiency equipment.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	85 100.0%	17 100.0%
Net 0-4	8 9.4%	2 11.8%
0 - Not at All Influential	1 1.2%	1 5.9%
2	1 1.2%	-
3	2 2.4%	-
4	4 4.7%	1 5.9%
Net 5-7	28 32.9%	5 29.4%
5	9 10.6%	3 17.6%
6	8 9.4%	-
7	11 12.9%	2 11.8%
Net 8-10	49 57.6%	10 58.8%
8	14 16.5%	4 23.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_c Page 16
(Continued)
Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… The percentage of sales situations in which you recommend high efficiency equipment.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	10 11.8%	4 23.5%
10 - Extremely Influential	25 29.4% b	2 11.8%
Mean	7.6	7.1

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_d Page 17

Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is “not at all influential” and 10 is “extremely influential,” please rate the influence of the <program> on the increase in… The percentage of jobs in which <tradeally_name> installs high efficiency equipment in Duke Energy's <jurisdiction> service territory.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	84 100.0%	16 100.0%
Net 0-4	11 13.1%	2 12.5%
0 - Not at All Influential	1 1.2%	-
1	1 1.2%	1 6.2%
2	4 4.8%	-
3	3 3.6%	-
4	2 2.4%	1 6.2%
Net 5-7	31 36.9%	5 31.2%
5	14 16.7%	1 6.2%
6	5 6.0%	2 12.5%
7	12 14.3%	2 12.5%
Net 8-10	42 50.0%	9 56.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_d Page 18
(Continued)
Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is “not at all influential” and 10 is “extremely influential,” please rate the influence of the <program> on the increase in… The percentage of jobs in which <tradeally_name> installs high efficiency equipment in Duke Energy's <jurisdiction> service territory.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
8	11 13.1%	3 18.8%
9	9 10.7%	1 6.2%
10 - Extremely Influential	22 26.2%	5 31.2%
Mean	7.1	7.4

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_e Page 19

Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… The total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	82 100.0%	16 100.0%
Net 0-4	9 11.0%	2 12.5%
1	-	1 6.2%
2	3 3.7%	-
3	1 1.2%	-
4	5 6.1%	1 6.2%
Net 5-7	36 43.9%	4 25.0%
5	13 15.9%	2 12.5%
6	10 12.2%	1 6.2%
7	13 15.9%	1 6.2%
Net 8-10	37 45.1%	10 62.5%
8	8 9.8%	1 6.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi3_e Page 20
(Continued)
Duke Trade Ally Tables

On a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential," please rate the influence of the <program> on the increase in… The total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	8 9.8%	2 12.5%
10 - Extremely Influential	21 25.6%	7 43.8%
Mean	7.2	7.8

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi4_a1_re1 Page 21

Duke Trade Ally Tables

How was the <program> influential in increasing… the percentage of jobs in which <tradeally_name> installs high efficiency equipment in Duke Energy's <jurisdiction> service territory?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	41 100.0%	8 100.0%
Rebate offer helps to close the sale with the customer	8 19.5%	2 25.0%
The incentive saves the customer money	7 17.1%	2 25.0%
Enabled the installation of higher efficiency equipment	4 9.8%	3 37.5%
We are able to offer the customer higher energy savings	1 2.4%	-
Mentioned the incentive or rebate (non-specific)	8 19.5%	-
We are able to recommend reliable vendors	1 2.4%	-
Other	14 34.1%	1 12.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi4_b1_re1 Page 22

Duke Trade Ally Tables

How was the <program> influential in increasing… the total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	92 100.0%	28 100.0%
.	1 1.1%	-
0	34 37.0%	16 57.1% a
1	8 8.7%	1 3.6%
1,000,000	42 45.7%	17 60.7%
2	2 2.2%	3 10.7%
2m	1 1.1%	-
4	5 5.4%	-
5	7 7.6%	1 3.6%
5%	1 1.1%	-
6	1 1.1%	-
10	-	1 3.6%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qpi4_b1_re1 Page 23
(Continued)
Duke Trade Ally Tables

How was the <program> influential in increasing… the total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
25%	-	1 3.6%
35	1 1.1%	-
40-50%	8 8.7%	1 3.6%
48	1 1.1%	-
50	2 2.2%	-
50%	1 1.1%	-
60	1 1.1%	-
64 plus	-	1 3.6%
70	1 1.1%	-
97	19 20.7%	3 10.7%
100	3 3.3%	1 3.6%
500000	1 1.1%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi4_b1_re1 Page 24
(Continued)
Duke Trade Ally Tables

How was the <program> influential in increasing… the total volume of high efficiency equipment <tradeally_name> installs in Duke Energy's <jurisdiction> service territory?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
?	1 1.1%	-
all	1 1.1%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi5 Page 25

Duke Trade Ally Tables

Did any factors, other than the <program>, contribute to the increases you mentioned?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	93 100.0%	18 100.0%
Yes	49 52.7%	12 66.7%
No	26 28.0%	3 16.7%
Don't Know	18 19.4%	3 16.7%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi5am1_re1 Page 26

Duke Trade Ally Tables

What were those factors?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	23 100.0%	4 100.0%
Increased knowledge or training of energy efficient products	11 47.8%	1 25.0%
Mentioned the incentive or rebate (non-specific)	3 13.0%	1 25.0%
Price decreases for energy efficient products	7 30.4%	-
Increased quality of energy efficient products	6 26.1%	1 25.0%
Improvements to the process of upgrading for the customer	1 4.3%	-
New regulations were enacted	1 4.3%	1 25.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QPI6A Page 27

Duke Trade Ally Tables

Has your participation in the <program> affected your business practices in any other ways?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	93 100.0%	18 100.0%
Yes	41 44.1%	8 44.4%
No	41 44.1%	9 50.0%
Don't know	11 11.8%	1 5.6%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qpi6bm1_re1 Page 28

Duke Trade Ally Tables

Has your participation in the <PROGRAM2> affected your business practices in any other ways?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	41 100.0%	8 100.0%
Provided more options for customers	5 12.2%	-
Allowed me to provide more information to customers	8 19.5%	-
Improved the purchasing process for customers	1 2.4%	-
Allowed me to make more sales	8 19.5%	3 37.5%
Increased outreach	11 26.8%	-
Participation in the program takes up more of my time	1 2.4%	-
Other	10 24.4%	5 62.5% A

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta1_a_1 Page 29

Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… Standard Efficiency?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	76 100.0%	17 100.0%
0	14 18.4%	4 23.5%
5	1 1.3%	-
10	5 6.6%	2 11.8%
15	1 1.3%	-
20	3 3.9%	1 5.9%
25	3 3.9%	1 5.9%
30	4 5.3%	-
40	5 6.6%	-
50	4 5.3%	-
60	2 2.6%	1 5.9%
70	-	1 5.9%
80	1 1.3%	1 5.9%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta1_a_1 Page 30
(Continued)
Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… Standard Efficiency?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Don't Know	33 43.4%	6 35.3%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qta1_b_1 Page 31

Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… High Efficiency - that DID RECEIVE an incentive from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	87 100.0%	16 100.0%
2	1 1.1%	-
5	1 1.1%	1 6.2%
10	3 3.4%	1 6.2%
20	3 3.4%	1 6.2%
30	3 3.4%	-
40	2 2.3%	-
50	8 9.2%	-
60	2 2.3%	-
65	1 1.1%	-
70	4 4.6%	2 12.5%
75	3 3.4%	2 12.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta1_b_1 Page 32
(Continued)
Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… High Efficiency - that DID RECEIVE an incentive from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
80	6 6.9%	2 12.5%
90	5 5.7%	-
95	1 1.1%	-
100	17 19.5%	2 12.5%
Don't Know	27 31.0%	5 31.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qta1_c_1 Page 33

Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… High Efficiency - that DID NOT RECEIVE an incentive from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	73 100.0%	17 100.0%
0	5 6.8%	1 5.9%
1	1 1.4%	1 5.9%
5	1 1.4%	1 5.9%
10	9 12.3%	2 11.8%
20	10 13.7%	3 17.6%
25	6 8.2%	2 11.8%
30	2 2.7%	1 5.9%
40	3 4.1%	-
50	4 5.5%	1 5.9%
70	2 2.7%	-
90	1 1.4%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta1_c_1 Page 34
(Continued)
Duke Trade Ally Tables

Approximately what percentage of your total equipment installations (in terms of dollars) was… High Efficiency - that DID NOT RECEIVE an incentive from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Don't Know	29 39.7%	5 29.4%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta2a Page 35

Duke Trade Ally Tables

Between <evalperiod>, did any of your customers in Duke Energy's <jurisdiction> service territory install equipment that was eligible for a <program> incentive but that did not receive an incentive?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	29 100.0%	5 100.0%
Yes	13 44.8%	2 40.0%
No	9 31.0%	-
Don't Know	7 24.1%	3 60.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qta2b Page 36

Duke Trade Ally Tables

Approximately, how many of your projects in Duke Energy’s <jurisdiction> service territory between <evalperiod> used high efficiency equipment but did not receive a <program>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	11 100.0%	2 100.0%
1	1 9.1%	1 50.0%
10	1 9.1%	-
Don't Know	9 81.8%	1 50.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qso1a Page 37

Duke Trade Ally Tables

How influential was your recommendation on your customers' choice of high efficiency equipment over standard efficiency equipment?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	55 100.0%	13 100.0%
Net 0-4	4 7.3%	3 23.1%
0 - Not at All Influential	1 1.8%	-
2	1 1.8%	1 7.7%
3	1 1.8%	2 15.4%
4	1 1.8%	-
Net 5-7	21 38.2%	5 38.5%
5	8 14.5%	3 23.1%
6	10 18.2%	1 7.7%
7	3 5.5%	1 7.7%
Net 8-10	30 54.5%	5 38.5%
8	10 18.2%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qso1a Page 38
(Continued)
Duke Trade Ally Tables

How influential was your recommendation on your customers' choice of high efficiency equipment over standard efficiency equipment?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	6 10.9%	1 7.7%
10 - Extremely Influential	14 25.5%	4 30.8%
Mean	7.3	6.5

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qso1bm1_rec Page 39

Duke Trade Ally Tables

What type of high efficiency equipment did your customers install without an incentive from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	41 100.0%	10 100.0%
Lack of Awareness or Knowledge	36 87.8%	9 90.0%
Products Not Eligible	2 4.9%	1 10.0%
Time or Effort Required	1 2.4%	-
Project Costs	1 2.4%	-
Didn't Qualify	1 2.4%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrs1a Page 40

Duke Trade Ally Tables

In terms of cost, how large were the projects that installed high efficiency equipment but did NOT receive an incentive?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	38 100.0%	10 100.0%
Smaller Than Projects That Received an Incentive	21 55.3%	5 50.0%
About the Same Size as Projects That Received	11 28.9%	5 50.0%
Larger Than Projects That Received an Incentive	1 2.6%	-
Don't Know	5 13.2%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qrs1b Page 41

Duke Trade Ally Tables

Approximately, how much smaller would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	18 100.0%	5 100.0%
Three Quarters of the Size	3 16.7%	1 20.0%
Half the Size	3 16.7%	-
A Quarter of the Size	7 38.9%	1 20.0%
Less Than a Quarter of the Size	5 27.8%	3 60.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qrs1c Page 42

Duke Trade Ally Tables

Approximately, how much larger would you say were high efficiency projects that DID NOT receive a Duke Energy incentive compared to projects that DID receive an incentive?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	1 100.0%	-
More Than Twice the Size	1 100.0%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw1 Page 43

Duke Trade Ally Tables

How many of your customers are aware of options for energy efficiency upgrades at their facilities?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
All of My Customers 100%	16 14.4%	9 28.1%
Most of My Customers 75% or More	43 38.7%	10 31.2%
Some of My Customers 20% - 74%	48 43.2%	11 34.4%
Less Than 20% of My Customers	4 3.6%	2 6.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw2 Page 44

Duke Trade Ally Tables

How many of your customers already know about the <program> before you discuss it with them?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
All of My Customers 100%	4 3.6%	-
Most of My Customers 75% or More	19 17.1%	7 21.9%
Some of My Customers 20% - 74%	58 52.3%	18 56.2%
Less Than 20% of My Customers	27 24.3%	6 18.8%
None of My Customers	3 2.7%	1 3.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw3a Page 45

Duke Trade Ally Tables

How often do you promote the <program> to your customers? Would you say you promote it to…

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
All of My Customers 100%	59 53.2%	15 46.9%
Most of My Customers 75% or More	32 28.8%	8 25.0%
Some of My Customers 20% - 74%	16 14.4%	9 28.1%
Less Than 20% of My Customers	4 3.6%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw3bm1_re1 Page 46

Duke Trade Ally Tables

When you do not promote the <program> to your customers, what are the reasons?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	52 100.0%	17 100.0%
The customer is not interested in the program or high efficiency equipment	4 7.7%	1 5.9%
I do promote to all customers	2 3.8%	3 17.6%
When a project needs to be done quickly	2 3.8%	2 11.8%
Not big enough financial savings for the customer	2 3.8%	2 11.8%
The customer is not in Duke territory or not a Duke customer	3 5.8%	-
Equipment does not qualify for the program	2 3.8%	1 5.9%
The customer is not a home owner	2 3.8%	-
The customer already has high efficiency equipment installed	1 1.9%	-
Other	34 65.4%	9 52.9%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qaw4m1_rec2 Page 47

Duke Trade Ally Tables

What do you view as the main barriers that prevent your customers from installing energy efficient equipment?

	Jurisdiction	
	DEC (A)	DEP (B)
Total	111 100.0%	32 100.0%
Higher Cost of Energy Efficient Equipment	62 55.9%	17 53.1%
Access to Financing or Capital for Energy Improvements	22 19.8%	8 25.0%
Time or logistics of application	5 4.5%	2 6.2%
Lack of Knowledge of Energy Efficient Options	3 2.7%	1 3.1%
Time or logistics of installation	3 2.7%	1 3.1%
Uncertainty about quality of energy efficienct products	3 2.7%	1 3.1%
Rebate amount too low	1 0.9%	3 9.4%
Uncertainty About the Savings From Energy Efficiency Improvements	2 1.8%	1 3.1%
Equipment Doesn't Qualify	2 1.8%	1 3.1%
Lack of Interest in Energy Efficient Equipment	1 0.9%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw4m1_rec2 Page 48
(Continued)
Duke Trade Ally Tables

What do you view as the main barriers that prevent your customers from installing energy efficient equipment?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Other	16 14.4%	3 9.4%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw5am1_re2 Page 49

Duke Trade Ally Tables

What do you view as the main barriers that prevent your customers from participating in the <PROGRAM1>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	110 100.0%	32 100.0%
Higher cost of energy efficient equipment	15 13.6%	6 18.8%
Access to financing or capital for energy improvements	3 2.7%	3 9.4%
Lack of knowledge of energy efficient options	2 1.8%	1 3.1%
Uncertainty about the savings from energy efficiency improvements	2 1.8%	-
Paperwork/Application process	9 8.2%	2 6.2%
Lack of awareness of the Smart $aver program	3 2.7%	-
Selection of equipment available through the Smart $aver program	2 1.8%	1 3.1%
Incentive levels	3 2.7%	3 9.4%
Time to Participate	4 3.6%	2 6.2%
Problems with vendors	-	1 3.1%
Not Duke Energy customers	2 1.8%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw5am1_re2 Page 50
(Continued)
Duke Trade Ally Tables

What do you view as the main barriers that prevent your customers from participating in the <PROGRAM1>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
No barriers to participation	59 53.6% B	11 34.4%
Other	10 9.1%	6 18.8%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qaw5bm1_re1 Page 51

Duke Trade Ally Tables

What could Duke Energy do to reduce these barriers to customer participation in the <program>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	52 100.0%	22 100.0%
Loosen Equipment Requirements	1 1.9%	-
Increase Incentives	12 23.1% b	2 9.1%
Simplify Application Process	5 9.6%	3 13.6%
Reduce Application Timeline	2 3.8%	-
Program is Performing Well, No Suggestion	6 11.5%	1 4.5%
Improve and Increase Program Marketing/ Communications	2 3.8%	7 31.8% A
Include More Product Categories	4 7.7%	2 9.1%
Offer training	1 1.9%	-
Other	23 44.2%	8 36.4%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr1 Page 52

Duke Trade Ally Tables

Have you participated in any training provided by Duke Energy’s <program>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Yes	48 43.2%	14 43.8%
No	63 56.8%	18 56.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr2m1_rec1 Page 53

Duke Trade Ally Tables

Which of the following trainings have you participated in?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	48 100.0%	14 100.0%
Program Training	26 54.2%	11 78.6% a
Sales Training	13 27.1%	2 14.3%
Online Application Portal Training	23 47.9%	7 50.0%
Other, Please Specify	9 18.8%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3a_1 Page 54

Duke Trade Ally Tables

When did you receive the program training from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	26 100.0%	11 100.0%
2014	8 30.8%	5 45.5%
2015	7 26.9%	1 9.1%
2016	8 30.8%	4 36.4%
Don't Know	3 11.5%	1 9.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3b_1 Page 55

Duke Trade Ally Tables

How useful was the program training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	26 100.0%	11 100.0%
Net 0-4	2 7.7%	-
1	2 7.7%	-
Net 5-7	12 46.2%	8 72.7%
5	4 15.4%	5 45.5% a
6	2 7.7%	1 9.1%
7	6 23.1%	2 18.2%
Net 8-10	12 46.2%	3 27.3%
8	5 19.2%	-
9	1 3.8%	1 9.1%
10 - Extremely useful	6 23.1%	2 18.2%
Mean	7.1	6.7

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3c_1m1 Page 56

Duke Trade Ally Tables

What would have made the program training more useful?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	2 100.0%	-
Other	2 100.0%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3d_1m1_1 Page 57

Duke Trade Ally Tables

What was the most useful about the program training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	20 100.0%	6 100.0%
Online Portal Explanation and Examples	1 5.0%	-
Application Questions Answered	1 5.0%	-
Increased Program-Related Knowledge Generally	5 25.0%	1 16.7%
Increased Knowledge of Program-Eligible Measures	1 5.0%	-
Increased Knowledge of Incentives	2 10.0%	2 33.3%
One-on-one Instruction	-	2 33.3%
Updates on changes to the program	4 20.0%	-
Program marketing strategies	4 20.0%	-
Program materials	1 5.0%	1 16.7%
Other	2 10.0%	1 16.7%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3a_2 Page 58

Duke Trade Ally Tables

When did you receive the sales training from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	13 100.0%	2 100.0%
2014	2 15.4%	1 50.0%
2015	7 53.8%	1 50.0%
2016	3 23.1%	-
Don't Know	1 7.7%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3b_2 Page 59

Duke Trade Ally Tables

How useful was the sales training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	13 100.0%	2 100.0%
Net 0-4	1 7.7%	-
1	1 7.7%	-
Net 5-7	4 30.8%	1 50.0%
5	2 15.4%	1 50.0%
7	2 15.4%	-
Net 8-10	8 61.5%	1 50.0%
8	4 30.8%	-
9	1 7.7%	-
10 - Extremely useful	3 23.1%	1 50.0%
Mean	7.4	7.5

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3c_2m1 Page 60

Duke Trade Ally Tables

What would have made the sales training more useful?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	1 100.0%	-
Other	1 100.0%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3d_2m1_1 Page 61

Duke Trade Ally Tables

What was the most useful about the sales training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	10 100.0%	1 100.0%
Rebate Calculation	1 10.0%	-
Online Portal Explanation and Examples	1 10.0%	-
Increased Program-Related Knowledge Generally	4 40.0%	-
Increased Knowledge of Program-Eligible Measures	1 10.0%	-
Increased Knowledge of Incentives	2 20.0%	-
Program marketing strategies	3 30.0%	1 100.0%
Other	1 10.0%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3a_3 Page 62

Duke Trade Ally Tables

When did you receive the online application portal training from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	23 100.0%	8 100.0%
2014	1 4.3%	1 12.5%
2015	5 21.7%	1 12.5%
2016	11 47.8%	3 37.5%
2017	2 8.7%	1 12.5%
Don't Know	4 17.4%	2 25.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3b_3 Page 63

Duke Trade Ally Tables

How useful was the online application portal training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	23 100.0%	8 100.0%
Net 0-4	2 8.7%	1 12.5%
0 - Not at all useful	1 4.3%	-
3	1 4.3%	1 12.5%
Net 5-7	6 26.1%	3 37.5%
5	1 4.3%	1 12.5%
6	4 17.4%	1 12.5%
7	1 4.3%	1 12.5%
Net 8-10	15 65.2%	4 50.0%
8	9 39.1%	-
9	2 8.7%	1 12.5%
10 - Extremely useful	4 17.4%	3 37.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3b_3 Page 64
(Continued)
Duke Trade Ally Tables

How useful was the online application portal training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Mean	7.3	7.5

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3c_3m1_r Page 65

Duke Trade Ally Tables

What would have made the online application portal training more useful?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	2 100.0%	1 100.0%
Other	2 100.0%	1 100.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3d_3m1_1 Page 66

Duke Trade Ally Tables

What was the most useful about the online application portal training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	20 100.0%	6 100.0%
Online Portal Explanation and Examples	3 15.0%	-
Question and Answer Opportunity	1 5.0%	-
Application Questions Answered	3 15.0%	2 33.3%
Increased Program-Related Knowledge Generally	8 40.0%	-
Other	6 30.0%	4 66.7% a

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3a_4 Page 67

Duke Trade Ally Tables

When did you receive the [TRAINING TYPE] from Duke Energy?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	9 100.0%	-
2014	2 22.2%	-
2015	1 11.1%	-
2016	5 55.6%	-
Don't Know	1 11.1%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3b_4 Page 68

Duke Trade Ally Tables

How useful was the [TRAINING TYPE]?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	9 100.0%	-
Net 8-10	9 100.0%	-
8	4 44.4%	-
10 - Extremely useful	5 55.6%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr3d_4m1_1 Page 69

Duke Trade Ally Tables

What was the most useful about the [TRAINING TYPE]?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	9 100.0%	-
Online Portal Explanation and Examples	1 11.1%	-
Question and Answer Opportunity	2 22.2%	-
Application Questions Answered	1 11.1%	-
Increased Program-Related Knowledge Generally	1 11.1%	-
One-on-one Instruction	2 22.2%	-
Other	4 44.4%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr4m1_rec Page 70

Duke Trade Ally Tables

Why have you not participated in a <program> training?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	63 100.0%	18 100.0%
Was Not Aware	33 52.4%	11 61.1%
Did Not Have Time	11 17.5% b	1 5.6%
Training Wasn't Needed	8 12.7%	2 11.1%
Location	3 4.8%	2 11.1%
Duke Energy Representative Answers Questions	2 3.2%	-
Other	8 12.7%	2 11.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qtr5a Page 71

Duke Trade Ally Tables

Is there any other type of training that Duke Energy could provide that would help you promote the <program>?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	48 100.0%	14 100.0%
Yes	11 22.9%	4 28.6%
No	37 77.1%	10 71.4%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qtr5bm1_rec Page 72

Duke Trade Ally Tables

What type of training would be helpful to you?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	11 100.0%	4 100.0%
End User Training	4 36.4%	-
Custom Program Training	2 18.2%	-
Marketing/Sales	1 9.1%	1 25.0%
Prescriptive	-	1 25.0%
Other	4 36.4%	2 50.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QOP1 Page 73

Duke Trade Ally Tables

Are you aware that Duke Energy has an online portal where trade allies can submit applications for energy efficiency projects, track the status of their applications, and access program information?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Yes	84 75.7%	23 71.9%
No	27 24.3%	9 28.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QOP2 Page 74

Duke Trade Ally Tables

Have you ever used the online portal?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	84 100.0%	24 100.0%
Yes	60 71.4%	14 58.3%
No	24 28.6%	10 41.7%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QOP3M1_1 Page 75

Duke Trade Ally Tables

How have you used the online portal? Have you used it to… Please select all that apply.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	60 100.0%	13 100.0%
Submit applications	55 91.7%	11 84.6%
Track the status of applications	42 70.0%	8 61.5%
Access program materials	26 43.3%	5 38.5%
Other, please specify:	1 1.7%	1 7.7%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QOP4 Page 76

Duke Trade Ally Tables

Approximately, what percentage of applications for the [PROGRAM1] do you submit through the online portal?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	55 100.0%	11 100.0%
0	3 5.5%	1 9.1%
10	1 1.8%	-
20	1 1.8%	1 9.1%
50	1 1.8%	1 9.1%
75	4 7.3%	-
90	1 1.8%	1 9.1%
95	1 1.8%	-
98	1 1.8%	-
100	36 65.5% b	4 36.4%
Don't know	6 10.9%	3 27.3%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qop5m1_rec1 Page 77

Duke Trade Ally Tables

Table: qop5m1_rec

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Prefer to use paper application	2 1.8%	2 6.2%
Customer filled out application and submitted themselves	2 1.8%	-
Submitted application by email	1 0.9%	1 3.1%
Haven't needed to	2 1.8%	1 3.1%
Don't know how to use the portal	2 1.8%	2 6.2%
Someone else at my company submits the applications	2 1.8%	-
Supplier completes and submits applications	1 0.9%	2 6.2%
Other	12 10.8%	2 6.2%
0	111 100.0%	32 100.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_a Page 78

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The application process...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	104 100.0%	31 100.0%
Net 0-4	13 12.5%	5 16.1%
1	2 1.9%	-
2	1 1.0%	2 6.5%
3	5 4.8%	2 6.5%
4	5 4.8%	1 3.2%
Net 5-7	31 29.8%	12 38.7%
5	13 12.5%	4 12.9%
6	7 6.7%	2 6.5%
7	11 10.6%	6 19.4%
Net 8-10	60 57.7%	14 45.2%
8	18 17.3%	4 12.9%
9	23 22.1% B	2 6.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_a Page 79
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The application process...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
10 - Extremely Satisfied	19 18.3%	8 25.8%
Mean	7.3	7.0

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_b Page 80

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The measures that are eligible for incentives through the <program>...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	105 100.0%	31 100.0%
Net 0-4	17 16.2%	4 12.9%
0 - Extremely Dissatisfied	1 1.0%	-
2	4 3.8%	-
3	7 6.7%	2 6.5%
4	5 4.8%	2 6.5%
Net 5-7	34 32.4%	9 29.0%
5	8 7.6%	2 6.5%
6	5 4.8%	2 6.5%
7	21 20.0%	5 16.1%
Net 8-10	54 51.4%	18 58.1%
8	16 15.2%	5 16.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qsat1_b Page 81
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The measures that are eligible for incentives through the <program>...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	19 18.1%	5 16.1%
10 - Extremely Satisfied	19 18.1%	8 25.8%
Mean	7.2	7.6

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_c Page 82

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The incentive levels...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	107 100.0%	32 100.0%
Net 0-4	15 14.0%	3 9.4%
0 - Extremely Dissatisfied	2 1.9%	-
1	1 0.9%	-
2	2 1.9%	-
3	8 7.5%	1 3.1%
4	2 1.9%	2 6.2%
Net 5-7	44 41.1%	12 37.5%
5	9 8.4%	6 18.8%
6	16 15.0%	2 6.2%
7	19 17.8%	4 12.5%
Net 8-10	48 44.9%	17 53.1%
8	15 14.0%	6 18.8%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_c Page 83
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The incentive levels...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	16 15.0%	6 18.8%
10 - Extremely Satisfied	17 15.9%	5 15.6%
Mean	7.0	7.3

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_d Page 84

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The <program> Trade Ally Online Portal...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	84 100.0%	22 100.0%
Net 0-4	11 13.1%	3 13.6%
0 - Extremely Dissatisfied	-	2 9.1%
1	2 2.4%	-
3	5 6.0%	1 4.5%
4	4 4.8%	-
Net 5-7	32 38.1%	10 45.5%
5	17 20.2%	5 22.7%
6	8 9.5%	3 13.6%
7	7 8.3%	2 9.1%
Net 8-10	41 48.8%	9 40.9%
8	11 13.1%	3 13.6%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_d Page 85
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The <program> Trade Ally Online Portal...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	15 17.9%	2 9.1%
10 - Extremely Satisfied	15 17.9%	4 18.2%
Mean	7.0	6.5

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_e Page 86

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? Your interactions with <program> staff...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	100 100.0%	32 100.0%
Net 0-4	8 8.0%	3 9.4%
0 - Extremely Dissatisfied	1 1.0%	-
2	-	1 3.1%
3	3 3.0%	2 6.2%
4	4 4.0%	-
Net 5-7	19 19.0%	7 21.9%
5	6 6.0%	1 3.1%
6	3 3.0%	3 9.4%
7	10 10.0%	3 9.4%
Net 8-10	73 73.0%	22 68.8%
8	9 9.0%	10 31.2% A

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_e Page 87
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? Your interactions with <program> staff...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
9	22 22.0% b	3 9.4%
10 - Extremely Satisfied	42 42.0%	9 28.1%
Mean	8.3	7.8

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qsat1_f Page 88

Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The <program> overall...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	107 100.0%	32 100.0%
Net 0-4	5 4.7%	2 6.2%
1	1 0.9%	-
3	1 0.9%	1 3.1%
4	3 2.8%	1 3.1%
Net 5-7	34 31.8%	13 40.6%
5	12 11.2%	2 6.2%
6	8 7.5%	4 12.5%
7	14 13.1%	7 21.9%
Net 8-10	68 63.6%	17 53.1%
8	22 20.6%	6 18.8%
9	27 25.2% b	4 12.5%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat1_f Page 89
(Continued)
Duke Trade Ally Tables

How would you rate your satisfaction with the following components of the <program>? The <program> overall...

	Jurisdiction	
	DEC	DEP
	(A)	(B)
10 - Extremely Satisfied	19 17.8%	7 21.9%
Mean	7.8	7.6

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2am1_re Page 90

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the application process. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	47 100.0%	17 100.0%
Too complicated / cumbersome	11 23.4%	4 23.5%
Specific issues with setup	5 10.6%	3 17.6%
Processing time	5 10.6%	2 11.8%
Dissatisfied with rebates / incentives	4 8.5%	3 17.6%
Application length/Too much effort required	5 10.6%	-
Would like training / more information	4 8.5%	1 5.9%
Unfamiliar with online option	2 4.3%	2 11.8%
Generally satisfied	2 4.3%	1 5.9%
Not streamlined	2 4.3%	-
Don't see a need to use it	1 2.1%	-
No reason	2 4.3%	-
Other	2 4.3%	1 5.9%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2am1_re Page 91
(Continued)
Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the application process. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Refusal	2 4.3%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2bm1_re Page 92

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the measures eligible for incentives. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	53 100.0%	13 100.0%
Some measures are not eligible, when they should	19 35.8%	3 23.1%
Measure incentives are insufficient	7 13.2%	1 7.7%
Easier process	4 7.5%	2 15.4%
Reduction in eligible measures	4 7.5%	1 7.7%
Unfamiliar / Need training or help	3 5.7%	2 15.4%
Other	3 5.7%	1 7.7%
No reason	6 11.3%	2 15.4%
Don't know	6 11.3%	1 7.7%
Refusal	1 1.9%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2cm1_re Page 93

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the incentive levels. Which measures do you think should have different incentive levels?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	60	15
	100.0%	100.0%
Lighting	28	6
	46.7%	40.0%
Other	23	7
	38.3%	46.7%
No reason	3	2
	5.0%	13.3%
Don't know	4	-
	6.7%	
Refusal	2	-
	3.3%	

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2dm1_re Page 94

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the <PROGRAM2> Trade Ally Online Portal. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	43 100.0%	13 100.0%
Used infrequently	12 27.9%	3 23.1%
It is cumbersome/Not user friendly	10 23.3%	2 15.4%
Specific IT issues	4 9.3%	-
It is good, no issues	3 7.0%	1 7.7%
Unaware of portal	2 4.7%	1 7.7%
Data re-entry required	3 7.0%	-
Would like more information / training	2 4.7%	1 7.7%
Can't go back and make edits	-	1 7.7%
Other	4 9.3%	3 23.1%
No reason	1 2.3%	1 7.7%
Don't Know	2 4.7%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Appendix G. Trade Ally Online Survey Cross-Tabulations

Table qsat2e_rec_ Page 95

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with your interactions with <PROGRAM2> staff. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	29 100.0%	10 100.0%
Limited interaction	7 24.1%	1 10.0%
Generally dissatisfied / needed more	5 17.2%	2 20.0%
Generally satisfied	6 20.7%	-
Difficult to contact	2 6.9%	4 40.0% A
Better communication	3 10.3%	2 20.0%
Directed to online portal	1 3.4%	-
No reason	2 6.9%	-
Don't Know	2 6.9%	-
Refusal	1 3.4%	1 10.0%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qsat2fm1_re Page 96

Duke Trade Ally Tables

Your response suggests that you are not fully satisfied with the <PROGRAM1> overall. Why did you give this rating?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	39 100.0%	15 100.0%
General improvements	8 20.5%	4 26.7%
Application Too Lengthy/ Complicated	7 17.9%	2 13.3%
Increase rebates and incentives	8 20.5%	-
Generally satisfied	2 5.1%	4 26.7% a
Processing time	2 5.1%	2 13.3%
Would like more information / training	4 10.3%	-
Other	3 7.7%	2 13.3%
No reason	3 7.7%	1 6.7%
Don't Know	1 2.6%	-
Refusal	1 2.6%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF1 Page 97

Duke Trade Ally Tables

Approximately how many TOTAL COMMERCIAL OR INDUSTRIAL PROJECTS does your company implement in a typical year in Duke Energy's <jurisdiction> service territory? If unsure, please provide your best estimate.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
1	2 1.8%	-
2	5 4.5%	4 12.5%
3	1 0.9%	-
5	4 3.6%	1 3.1%
6	-	1 3.1%
10	4 3.6%	-
12	3 2.7%	-
15	8 7.2%	1 3.1%
20	6 5.4%	3 9.4%
24	-	1 3.1%
25	2 1.8%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF1 Page 98
(Continued)
Duke Trade Ally Tables

Approximately how many TOTAL COMMERCIAL OR INDUSTRIAL PROJECTS does your company implement in a typical year in Duke Energy's <jurisdiction> service territory? If unsure, please provide your best estimate.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
30	2 1.8%	1 3.1%
40	1 0.9%	-
50	11 9.9%	3 9.4%
60	1 0.9%	1 3.1%
65	1 0.9%	-
70	1 0.9%	-
75	4 3.6%	1 3.1%
80	1 0.9%	-
100	10 9.0%	-
110	1 0.9%	-
120	1 0.9%	-
125	1 0.9%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF1 Page 99
(Continued)
Duke Trade Ally Tables

Approximately how many TOTAL COMMERCIAL OR INDUSTRIAL PROJECTS does your company implement in a typical year in Duke Energy's <jurisdiction> service territory? If unsure, please provide your best estimate.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
140	1 0.9%	-
150	2 1.8%	3 9.4%
200	2 1.8%	1 3.1%
250	1 0.9%	-
300	2 1.8%	-
400	3 2.7%	-
500	1 0.9%	-
1000	2 1.8%	-
5000	-	1 3.1%
Don't know	27 24.3%	10 31.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF2 Page 100

Duke Trade Ally Tables

How many employees does your company have?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
1	9 8.1%	4 12.5%
2	6 5.4%	-
3	7 6.3%	-
4	10 9.0%	4 12.5%
5	3 2.7%	4 12.5%
6	5 4.5%	2 6.2%
7	3 2.7%	-
8	-	1 3.1%
9	3 2.7%	2 6.2%
10	5 4.5%	-
11	-	1 3.1%
13	1 0.9%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF2 Page 101
(Continued)
Duke Trade Ally Tables

How many employees does your company have?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
14	1 0.9%	-
15	6 5.4%	-
18	2 1.8%	-
20	7 6.3%	-
21	-	1 3.1%
24	1 0.9%	-
25	4 3.6%	1 3.1%
26	1 0.9%	-
28	1 0.9%	-
34	-	1 3.1%
40	1 0.9%	-
45	1 0.9%	-
50	3 2.7%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF2 Page 102
(Continued)
Duke Trade Ally Tables

How many employees does your company have?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
55	1 0.9%	-
58	1 0.9%	-
65	1 0.9%	-
70	1 0.9%	-
75	1 0.9%	-
76	1 0.9%	-
85	-	1 3.1%
100	1 0.9%	2 6.2%
122	1 0.9%	-
155	1 0.9%	-
200	1 0.9%	-
220	1 0.9%	-
300	3 2.7%	-

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF2 Page 103
(Continued)
Duke Trade Ally Tables

How many employees does your company have?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
400	-	1 3.1%
425	-	1 3.1%
450	-	1 3.1%
500	2 1.8%	1 3.1%
750	1 0.9%	-
800	1 0.9%	-
8000	1 0.9%	-
9000	-	1 3.1%
Don't know	12 10.8%	3 9.4%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table QF3 Page 104

Duke Trade Ally Tables

Would you consider your company to be local, regional, national, or international in size?

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
Local	37 33.3%	15 46.9%
Regional	44 39.6% B	5 15.6%
National	21 18.9%	10 31.2%
International	9 8.1%	2 6.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qf4m1_rec_1 Page 105

Duke Trade Ally Tables

What are the key business sectors your company serves? Please select all that apply.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Total	111 100.0%	32 100.0%
K-12 School	45 40.5% B	6 18.8%
College/University	42 37.8%	12 37.5%
Grocery	31 27.9%	8 25.0%
Medical	46 41.4%	12 37.5%
Hotel/Motel	45 40.5%	15 46.9%
Light Industry	82 73.9% B	15 46.9%
Heavy Industry	49 44.1%	10 31.2%
Office	74 66.7%	23 71.9%
Restaurant	44 39.6%	14 43.8%
Retail/Service	59 53.2%	18 56.2%
Government	25 22.5%	9 28.1%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.
Lowercase letters indicate significance at the 90% level.

Table qf4m1_rec_1 Page 106
(Continued)
Duke Trade Ally Tables

What are the key business sectors your company serves? Please select all that apply.

	Jurisdiction	
	DEC	DEP
	(A)	(B)
Convenience Store	2 1.8%	-
Gas Station	2 1.8%	-
Warehouse	1 0.9%	-
Residential/Condominiums/ Multifamily	3 2.7%	2 6.2%
Other (Specify)	2 1.8%	2 6.2%

Comparison Groups: AB
T-Test for Means, Z-Test for Percentages
Uppercase letters indicate significance at the 95% level.

Lowercase letters indicate significance at the 90% level.

Appendix H. Impact Calculation Tables

Deemed Savings Review

The Word document containing the deemed savings review memorandum is provided as a separate file.

Gross Impact Analysis

The Excel spreadsheet containing the gross impact analysis is provided as a separate file.

For more information, please contact:

Antje Flanders
Vice President

617 492 1400 tel
617 497 7944 fax
aflanders@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Progress & Duke Energy Carolinas

Energy Efficient Lighting & Retail LED Programs

Evaluation Report – Final

April 6, 2018

Contributors

Tami Buhr
Vice President, Opinion Dynamics

Kessie Avseikova
Director, Opinion Dynamics

Katherine Randazzo
Senior Director, Opinion Dynamics

Kai Zhou
Managing Consultant, Opinion Dynamics

Dan Chen
Senior Consultant, Opinion Dynamics

Evan Tincknell
Consultant, Opinion Dynamics

Opinion Dynamics

Table of Contents

Opinion Dynamics

Table of Tables

Opinion Dynamics

Opinion Dynamics

Table of Figures

1. Evaluation Summary

This report provides results of a comprehensive process and impact evaluation of two distinct programs: the Duke Energy Progress (DEP) Energy Efficient Lighting (EEL) program and the Duke Energy Carolinas (DEC) Retail LED program. The program periods under evaluation are January 1, 2016 through March 12, 2017 for the DEP EEL program and March 21, 2016 through March 12, 2017 for the DEC Retail LED program. We refer to these periods as PY2016–2017 throughout the remainder of this evaluation report.

1.1 Program Summary

1.1.1 The DEP EEL Program

DEP launched the EEL program in January 2010, with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. DEP partners with retailers and manufacturers across North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR® fixtures, with a wide range of products across these technologies. Participating retailers include a variety of channel types, including Big Box, Do-It-Yourself (DIY), Club, and Discount stores.

DEP manages the EEL program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the EEL program on behalf of DEP since 2010.

The program period under evaluation includes bulb sales invoiced from January 1, 2016 through March 12, 2017. Over this period, DEP discounted more than 3.6 million lighting products, achieving 140,215 MWh in ex ante energy savings, 23.0 MW in ex ante summer peak demand savings, and 7.1 MW in ex ante winter peak demand savings. Table 1-1 provides a summary of DEP EEL program sales and savings achievements.

Table 1-1. DEP EEL Program Sales and Savings Summary

Metric	Performance
Bulbs	3,627,458
Ex ante energy savings (MWh)	140,215
Ex ante summer peak demand savings (MW)	23.0
Ex ante winter peak demand savings (MW)	7.1

Source: Opinion Dynamics analysis of program tracking data.

1.1.2 DEC Retail LED Program

DEC launched the Retail LED program in March 2016 with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. DEC partners with retailers and manufacturers across North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, along with ENERGY STAR LED fixtures. Participating retailers include a variety of channel types, including Big Box, DIY, Club, and Discount stores.

DEC manages the Retail LED program and is responsible for overseeing program design, marketing, and operations. Ecova implements the program on DEC's behalf.

The program period under evaluation includes bulb sales from March 21, 2016 through March 12, 2017. Over this period, DEC discounted more than 1.3 million lighting products, achieving 52,602 MWh in claimed/ex ante energy savings, 8.8 MW in ex ante summer peak demand savings, and 2.6 MW in ex ante winter peak demand savings. Table 1-2 provides a summary of DEC Retail LED program sales and savings achievements.

Table 1-2. DEC Retail LED Program Sales and Savings Summary

Metric	Performance
Bulbs	1,385,056
Ex ante energy savings (MWh)	52,602
Ex ante summer peak demand savings (MW)	8.8
Ex ante winter peak demand savings (MW)	2.6

Source: Opinion Dynamics analysis of program tracking data.

1.2 Evaluation Objectives and High-Level Findings

1.2.1 Evaluation Objectives

The 2017 evaluation of both the DEP EEL and DEC Retail LED programs included process, impact, and market assessment components and addressed several major research objectives:

- Assess program performance and estimate gross and net energy (kWh) and summer and winter peak demand (kW) savings associated with program activity
- Assess program implementation processes and marketing strategies and identify opportunities for improvement
- Better understand the quickly shifting lighting market and customer lighting use

To achieve these research objectives, the evaluation team completed a range of data collection and analytic activities, including interviews with program staff, a review of deemed savings, program tracking data analysis, a residential lighting logger study, retailer shelf audits, interviews with manufacturer and retailer staff, geographic information system (GIS) analysis to estimate leakage, sales data modeling, and an impact analysis. Table 1-3 provides an overview of the evaluation activities, the scope of each, the research area that each activity supported, and an overview of the activity's purpose.

Table 1-3. Overview of Evaluation Activities

#	Evaluation Activity	Scope: DEP EEL Program	Scope: DEC Retail LED Program	Impact	Process	Market	Purpose
1	Program staff interviews	n=2			X		• Provide insight into program design and delivery
2	Deemed savings review	All data provided		X			• Review completeness, accuracy, and consistency of data and ex ante savings assumptions
3	Materials review	All materials provided			X		• Provide insight into program design and delivery
4	Program tracking data analysis	All data provided		X	X	X	• Calculate gross energy and demand savings • Understand program footprint, measure mix, retailer mix, and incentive levels
5	Residential lighting logger study	n=107		X	X	X	• Estimate hours of use (HOU), coincidence factors (CFs), and in-service rates (ISRs) for LEDs installed in customer homes • Assess lighting composition and use among residential customers with LEDs
6	Retailer shelf audits	n=15	n=15	X	X	X	• Assess shelf space distribution for general service and reflector products • Estimate baseline wattage adjustments • Provide program marketing insight
7	Retailer and manufacturer interviews	n=21	n=21	X	X	X	• Estimate net-to-gross ratio (NTGR) • Provide insight into program delivery and the current and future lighting market
8	Sales data modeling	All data provided		X			• Estimate NTGR
9	Leakage analysis	All data provided		X			• Estimate leakage rate

Source: Opinion Dynamics analysis.

1.2.2 DEP EEL Program High-Level Findings and Recommendations

The DEP EEL program realized 89% of the gross energy savings, 95% of the gross summer peak demand savings, and 113% of the gross winter peak demand savings. Table 1-4 provides a summary of the program's gross impacts by savings type and sector. As can be seen in the table, the program achieved 125,001,897 kWh in ex post energy savings, 21,962 kW in summer peak demand savings, and 8,066 kW in winter peak demand savings.

Table 1-4. DEP EEL Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	109,576,023	97,829,373	89%
	Commercial savings	30,639,454	27,172,524	89%
	Total	**140,215,477**	**125,001,897**	**89%**
Summer peak demand savings (kW)	Residential savings	15,796	15,503	98%
	Commercial savings	7,215	6,458	90%
	Total	**23,011**	**21,962**	**95%**
Winter peak demand savings (kW)	Residential savings	5,246	6,412	122%
	Commercial savings	1,880	1,654	88%
	Total	**7,126**	**8,066**	**113%**

Source: Opinion Dynamics analysis of program tracking data.

Opinion Dynamics used sales data modeling and interviews with program participating retailers and manufacturers to estimate program NTGR. The analysis resulted in the program-level NTGR of 0.40. Applying this NTGR to the ex post gross savings resulted in net energy savings of 50,001 MWh, net summer peak demand savings of 8.8 MW, and net winter peak demand savings of 3.2 MW.

Table 1-5. DEP EEL Program Ex Post Net Savings

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	140,215	125,002	0.40	50,001	89%
Summer peak demand savings (MW)	23.0	22.0	0.40	8.8	95%
Winter peak demand savings (MW)	7.1	8.1	0.40	3.2	113%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 744 unique products across 289 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[1] divide the adjusted number of program bulbs by the total number of residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use. The program continued efforts to reach underserved customer segments and sockets by maintaining a relatively high share of sales through the Dollar/Discount channel (which attracts lower-income shoppers) and increased its focus on specialty products (standard bulb sales decreased by 8% between PY2015 and PY2016–2017).

[1] Assuming a 5-year expected useful life (EUL) for a CFL.

The transformation of the lighting market in the DEP jurisdiction continued at an accelerated pace. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves in the DEP jurisdiction, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, the shelf space dedicated to LEDs grew from 38% to 57%.

Additionally, LED prices have decreased dramatically over time. More specifically, based on the shelf audit research we conducted in 2014 and 2016 in DEP, standard LED prices dropped from $14.65 per bulb to $4.68, which represents a 68% drop in price. Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. These decreasing prices made LEDs more affordable and accessible to the broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs ineligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated by the energy-efficient lighting penetration in the DEP jurisdiction: nearly 9 in 10 DEP customers (88%) reported having CFLs or LEDs in their homes and 42% reported having LEDs in their homes.

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are scheduled to take effect in 2020 with the second phase of the Energy Independence and Security Act (EISA) of 2007, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEP EEL program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase the program's focus on underserved customer segments. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting of specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage specialty products, and by adjusting program marketing and messaging to focus on underserved sockets and increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion.

1.2.3 DEC Retail LED Program High-Level Findings and Recommendations

The DEC Retail LED program realized 110% of the gross energy savings, 121% of the gross summer peak demand savings, and 155% of the gross winter peak demand savings. Table 1-6 provides a summary of the program's gross impacts by savings type and sector. As can be seen in the table, the program achieved 57,846,855 kWh in energy savings, 10,676 kW in summer peak demand savings, and 4,045 in winter peak demand savings.

Table 1-6. DEC Retail LED Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	41,630,988	45,761,993	110%
	Commercial savings	10,971,300	12,084,862	110%
	Total	52,602,288	57,846,855	110%
Summer peak demand savings (kW)	Residential savings	6,002	7,543	126%
	Commercial savings	2,843	3,132	110%
	Total	8,845	10,676	121%
Winter peak demand savings (kW)	Residential savings	1,993	3,359	169%
	Commercial savings	624	686	110%
	Total	2,617	4,045	155%

Source: Opinion Dynamics analysis of program tracking data.

Opinion Dynamics used sales data modeling and interviews with program participating retailers and manufacturers to estimate program NTGR. The analysis resulted in the program-level NTGR of 0.41. Applying this NTGR to the ex post gross savings resulted in net energy savings of 23,717 MWh, net summer peak demand savings of 4.4 MW, and net winter peak demand savings of 1.7 MW.

Table 1-7. DEC Retail LED Program Ex Post Net Savings

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	52,602	57,847	0.41	23,717	110%
Summer peak demand savings (MW)	8.8	10.7	0.41	4.4	121%
Winter peak demand savings (MW)	2.6	4.0	0.41	1.7	155%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 384 unique products across 300 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

The program made efforts to reach underserved customer segments and sockets by targeting Dollar/Discount retailers (which attract lower-income shoppers), and focusing on specialty products. In PY2016–2017, 44% of program participating storefronts were Dollar/Discount, and they accounted for 10% of program sales.

Shelf audits conducted over time in the neighboring DEP jurisdiction show that LED prices have decreased dramatically over time. More specifically, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68 in 2016, which represents a 68% drop in price.[2] Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. Average LED prices in the DEC jurisdiction, based on the results of the 2016 shelf audits, mimic DEP's, with the per-bulb price for standard LEDs averaging $4.87 and the per-bulb price for reflector LEDs averaging $7.01. These decreasing prices made LEDs more affordable and accessible to a broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs ineligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated in the energy-efficient lighting penetration in the DEC jurisdiction: based on the data collected as part of the Residential Lighting Logger study, more than 9 in 10 DEC customers (92%) reported having CFLs or LEDs in their homes and 33% reported having LEDs in their homes.[3]

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty product[4]s, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are scheduled to take effect in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEC Retail LED program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase focus on underserved customer segments. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and, if possible, increase targeting of specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage specialty products, and by adjusting program marketing and messaging to focus on underserved sockets and increase messaging relevance (such as specialty sockets in dining rooms).

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[2] Note that this analysis is based on the light bulbs of all wattages, including those not discounted through the DEC Retail LED program.

[3] Note that these results include LED penetration across lighting products of all wattages, and not just the wattages discounted through the program.

[4] Specialty products include lighting products designed for specialty applications, such as three-way, candelabra, globe, etc.

- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion

2. Program Descriptions

This section provides an overview of the design, implementation, and performance of the Duke Energy Progress (DEP) Energy Efficient Lighting (EEL) program and the Duke Energy Carolinas (DEC) Retail LED program. We discuss each program separately. The program periods under evaluation are January 1, 2016 through March 12, 2017 for the DEP EEL program and March 21, 2016 through March 12, 2017 for the DEC Retail LED program. We refer to these periods as PY2016–2017 throughout the remainder of this evaluation report.

2.1 The DEP EEL Program

2.1.1 Program Design

DEP launched the EEL program in January 2010, with the goal of reducing energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. The program addresses two key barriers to the purchase of efficient lighting: (1) the higher prices of CFLs and LEDs compared to incandescent and halogen bulbs and (2) customer awareness and knowledge of the benefits of efficient lighting. DEP partners with retailers and manufacturers across its service territory in North and South Carolina to provide price markdowns on customer purchases of efficient lighting products. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR® fixtures, with a wide range of products across these technologies. Participating retailers represent a variety of retail channels, including Big Box, Do-It-Yourself (DIY), Club, and Discount stores.

2.1.2 Program Implementation

DEP manages the EEL program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the EEL program on behalf of DEP since 2010. Ecova is responsible for communicating directly with participating manufacturers and retailers, obtaining and processing program sales data, training retailer staff, and promoting program products through in-store demonstration events and point-of-purchase (POP) marketing materials.

2.1.3 Program Performance

In PY2016–2017, DEP discounted more than 3.6 million lighting products through the EEL program, achieving 140,215 MWh in claimed/ex ante energy savings, 23.0 MW in ex ante summer peak demand savings, and 7.1 MW in ex ante winter peak demand savings. Table 2-1 provides a summary of PY2016–17 achieved sales and ex ante savings.

Table 2-1. DEP EEL Program Sales and Savings Summary

Metric	Performance
Bulbs	3,627,458
Ex ante energy savings (MWh)	140,215
Ex ante summer peak demand savings (MW)	23.0
Ex ante winter peak demand savings (MW)	7.1

Source: Opinion Dynamics analysis of program tracking data.

Table 2-2 provides a summary of the product mix discounted through the program during PY2016–2017. For the first time in its history, the program sold more LEDs than CFLs (67% vs. 33%). Standard bulbs accounted for more than two-thirds of all bulbs sold (71%). Close to a third (31%) of all sales and 95% of CFL sales were standard CFL products, while 40% of all sales and 60% of all LEDs sales were standard LED products.

Table 2-2. DEP EEL Program Ex Ante Savings by Product Type

	Reported Bulbs		Ex Ante Energy Savings (kWh)		Ex Ante Summer Peak Demand Savings (kW)		Ex Ante Winter Peak Demand Savings (kW)	
Measure Type	**Bulbs**	**% of Total Sales**	**kWh Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**
LEDs	2,435,583	67%	91,221,854	65%	15,342	67%	4,539	64%
LED Standard	*1,434,774*	*40%*	*52,590,526*	*38%*	*8,847*	*38%*	*2,617*	*37%*
LED Specialty	*301,077*	*8%*	*8,873,879*	*6%*	*1,493*	*6%*	*442*	*6%*
LED Reflector	*502,385*	*14%*	*23,290,579*	*17%*	*3,918*	*17%*	*1,159*	*16%*
LED Fixture	*197,347*	*5%*	*6,466,871*	*5%*	*1,084*	*5%*	*321*	*5%*
CFLs	1,191,875	33%	48,993,623	35%	7,669	33%	2,588	36%
CFL Standard	*1,133,010*	*31%*	*45,586,662*	*33%*	*7,136*	*31%*	*2,408*	*34%*
CFL Specialty	*1,572*	*0%*	*55,333*	*0%*	*9*	*0%*	*3*	*0%*
CFL Reflector	*7,684*	*0%*	*295,166*	*0%*	*46*	*0%*	*16*	*0%*
CFL Fixture	*49,609*	*1%*	*3,056,461*	*2%*	*478*	*2%*	*161*	*2%*
Total	3,627,458	100%	140,215,477	100%	23,011	100%	7,126	100%

Source: Opinion Dynamics analysis of program tracking data.

2.2 DEC Retail LED Program

2.2.1 Program Design

DEC launched the Retail LED program in March 2016 with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. The program addresses two key barriers to the purchase of efficient lighting: (1) the higher prices of LEDs compared to less energy-efficient alternatives, such as incandescents and halogens, and (2) customer awareness and knowledge of the benefits of efficient lighting. DEC partners with retailers and manufacturers across its service territory in North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, along with ENERGY STAR fixtures, with a wide range of products across these technologies. The program product mix did not include 60-watt and 75-watt equivalents, as those products are discounted through DEC's Free LED program. Participating retailers represent several retail channels, including Big Box, DIY, Club, and Discount stores.

2.2.2 Program Implementation

DEC manages the Retail LED program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the Retail LED program on behalf of DEC since the program's inception in early 2016. Ecova is responsible for communicating directly with participating manufacturers and retailers, obtaining and processing program sales data, training retailer staff, and promoting program products through in-store demonstration events and POP marketing materials.

2.2.3 Program Performance

In PY2016–2017, DEC discounted more than 1.3 million lighting products, achieving 52,602 MWh in claimed/ex ante energy savings, 8.8 MW in ex ante summer peak demand savings, and 2.6 MW in ex ante winter peak demand savings. Table 2-3 provides a summary of PY2016–2017 sales and savings achievements.

Table 2-3. DEC Retail LED Program Sales and Savings Summary

Metric	Performance
Bulbs	1,385,056
Ex ante energy savings (MWh)	52,602
Ex ante summer peak demand savings (MW)	8.8
Ex ante winter peak demand savings (MW)	2.6

Source: Opinion Dynamics analysis of program tracking data.

Table 2-4 provides a summary of the product mix discounted through the DEC Retail LED program during the current evaluation period. Reflector bulbs accounted for 40% of bulbs sold, making up the largest share of program sales during the period. Standard LEDs comprised 24% of all sales, specialty LEDs 21%, and LED fixtures 16%.

Table 2-4. DEC Retail LED Program Ex Ante Savings by Product Type

Measure Type	Reported Bulbs		Ex Ante Energy Savings (kWh)		Ex Ante Summer Peak Demand Savings (kW)		Ex Ante Winter Peak Demand Savings (kW)	
	Bulbs	**% of Total Sales**	**kWh Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**
LED Standard	325,547	24%	11,932,672	23%	2,007	23%	594	23%
LED Specialty	290,875	21%	8,573,616	16%	1,442	16%	427	16%
LED Reflector	548,207	40%	24,872,820	47%	4,184	47%	1,238	47%
LED Fixture	220,427	16%	7,223,180	14%	1,210	14%	359	14%
Total	1,385,056	100%	52,602,288	100%	8,845	100%	2,617	100%

Source: Opinion Dynamics analysis of program tracking data.

3. Key Research Objectives

Opinion Dynamics' evaluation of the DEP EEL and DEC Retail LED programs included process, impact, and market assessment components. For each program, the key evaluation objectives were identical and consisted of the following:

- Assess program performance and estimate net energy (kWh) and summer and winter peak demand (kW) savings associated with program activity
- Assess program implementation processes and marketing strategies and identify opportunities for improvement
- Understand customer awareness, preferences, purchasing behaviors, and lighting market dynamics

We designed our evaluation tasks based on the following impact-related research objectives:

- Estimate program ex post gross energy and demand savings
- Estimate program ex post net energy and demand savings
- Develop updated leakage rate reflecting the share of program-discounted bulbs sold to other utilities' customers
- Develop updated residential LED in-service rates (ISRs), hours of use (HOU), summer peak coincidence factor (summer CF), and winter peak coincidence factor (winter CF)

Through our evaluation, we examined the following process-related questions:

- How effective are the program implementation and data tracking practices?
- How effective are the program marketing, outreach, and educational tactics?
- Are retailers and manufacturers satisfied with the programs?
- What are the strengths, weaknesses, and opportunities for program improvement?
- How, if at all, have retailer stocking and sales practices changed?
- What lighting technologies do customers have in their homes?
- How does energy-efficient lighting penetration vary by customer type?
- How does lighting usage vary by customer type and room type?
- What are current and future trends in the lighting market, including retailer stocking practices and customer preferences and purchasing decisions?

4. Overview of Evaluation Activities

To answer the research questions listed in the previous section, Opinion Dynamics performed a range of data collection and analytical activities. The activities were identical for both the DEP EEL and DEC Retail LED programs. Table 4-1 provides a summary of evaluation activities and the areas of inquiry each helped address. Following the table, we provide details on each activity's scope, sampling approach, and timing as applicable.

Table 4-1. Overview of Evaluation Activities

#	Evaluation Activity	Scope: DEP EEL Program	Scope: DEC Retail LED Program	Impact	Process	Market	Purpose
1	Program staff interviews	n=2			X		• Provide insight into program design and delivery
2	Deemed savings review	All data provided		X			• Review completeness, accuracy, and consistency of data and ex ante savings assumptions
3	Materials review	All materials provided			X		• Provide insight into program design and delivery
4	Program tracking data analysis	All data provided		X	X	X	• Calculate gross energy and demand savings • Understand program footprint, measure mix, retailer mix, and incentive levels
5	Residential lighting logger study	n=107		X	X	X	• Estimate HOU, CFs, and ISRs for LEDs installed in customer homes • Assess lighting composition and use among residential customers with LEDs
6	Retailer shelf audits	n=15	n=15	X	X	X	• Assess shelf space distribution for general service and reflector products • Estimate baseline wattage adjustments • Provide program marketing insight
7	Retailer and manufacturer interviews	n=21	n=21	X	X	X	• Estimate net-to-gross ratio (NTGR) • Provide insight into program delivery and the current and future lighting market
8	Sales data modeling	All data provided		X			• Estimate NTGR
9	Leakage analysis	All data provided		X			• Estimate leakage rate

Source: Opinion Dynamics analysis.

4.1 Program Staff Interviews

Opinion Dynamics completed two interviews with program staff at Duke Energy. We completed one interview in July 2016 and another in May 2017. Each interview covered both the DEP EEL and DEC Retail LED programs. For each program, the interviews explored, among other topics, program performance; changes in program design and implementation; participating retailer, product, and incentive mix; data-tracking and communication processes; and outlooks for future program planning.

4.2 Deemed Savings Review

In support of the impact evaluation, for each program, Opinion Dynamics completed a review of the energy savings assumptions used to estimate energy and peak demand savings. As part of this process, we also reviewed preliminary program sales data extracts and offered feedback to program staff regarding data quality and completeness. The objectives of the review were to identify and review the deemed savings values used for ex ante impacts and to check program sales data for any gaps, omissions, inconsistencies, or errors.

4.3 Materials Review

Opinion Dynamics conducted a review of program materials and data for each program, including marketing plans and materials, program planning documents, weekly field reports, and past evaluation reports and studies.

4.4 Program Tracking Data Analysis

Opinion Dynamics reviewed and assessed the sales data extracts for each program. Analyses included:

- Identifying any data gaps, omissions, inconsistencies, or errors, and correcting them as needed
- Summarizing program design and performance based on product mix, retailer mix, and incentive levels
- Analyzing sales trends over time, by geography and by retailer (specifically for the DEP EEL program)

4.5 Residential Lighting Logger Study

Opinion Dynamics completed a lighting logger study among DEP and DEC residential customers who had LED bulbs installed. The key goal of the study was to estimate HOU and CFs for LEDs. As part of the study, we also developed updated estimates of LED ISRs and collected valuable data on lighting penetration and saturation levels in each jurisdiction, which allowed us to assess and characterize lighting usage in customer homes in DEP and DEC jurisdictions.

4.5.1 Sample Design and Fielding

For purposes of this study, eligible customers were defined as DEP and DEC residential customers who have at least one LED installed in conditioned spaces. Because the data on the presence of LEDs are not readily available, data collection for the study consisted of two distinct activities:

- **Recruitment survey:** To identify and recruit eligible residential customers for the study

- **On-site visits:** To collect data on lighting products in use and to deploy and retrieve lighting logger equipment

We drew the sample for this study from the population of DEP and DEC residential customers provided by Duke Energy. We cleaned the customer data to remove duplicate records, customer records with no contact information, and customer records with a "do not contact" designator. We stratified the sample by jurisdiction and geographic region. We drew the sample in proportion to the share of customers in each jurisdiction and geographic region, with the goal of ensuring adequate representation of the customers from each jurisdiction and robust geographic coverage.

Identifying and recruiting customers with LEDs installed can be costly when administered over the phone, because it requires calling and screening a large number of ineligible customers. To achieve maximum efficiencies in the recruitment process, we recruited customers online as well as over the phone. We sent email invitations to participate to customers for whom we had email addresses, and called customers for whom we only had telephone numbers. To further increase the efficiency of the recruitment process, we oversampled customers with email addresses and administered a larger share of recruitment online. Online recruitment is less disruptive to customers than recruitment over the phone, much less costly, can be administered faster, and offers the valuable benefit of supplementing survey questions with visual aids (e.g., pictures of LED bulbs and socket types) for easier recognition and more-accurate self-reported data.

As part of the recruitment process, we screened customers for the presence of LEDs. During recruitment, we collected valuable data on LED and CFL penetration for all customers we spoke with, as well as customers' sociodemographic and household characteristics. This data allowed us to develop a robust post-stratification approach and to inform the process analysis.

We followed up with eligible customers to schedule a time for a site visit. As part of each site visit, we conducted a lighting inventory, sampled fixtures for logging, and placed lighting loggers. We kept the loggers in place for approximately 6 months. After 6 months, we scheduled return visits, during which we removed lighting loggers and collected updated information on key variables of interest. Customers who qualified and agreed to participate in the lighting logger study received a $50 gift card upon completion of the logger deployment site visit and another $50 gift card upon completion of the logger retrieval visit.

Table 4-2 provides a summary of the sampling and recruitment process. As can be seen in the table, from the sample of 5,866 of DEP and DEC customers, we identified 526 eligible customers, recruited 323 customers, and completed site visits with 107 of those customers. We retrieved loggers from all 107 homes where we deployed them.

Table 4-2. Summary of Sampling and Recruitment

Sampling Step	DEP	DEC	Total
Population	1,395,369	1,739,789	3,135,158
Sample frame	1,113,646	1,367,567	2,481,213
Sample drawn	1,757	4,109	5,866
Eligible customers	201	325	526
Recruited customers	131	192	323
Completed deployment site visits	46	61	107
Completed logger retrieval*	46	61	107

Source: Opinion Dynamics analysis.
* This includes homes where customers sent loggers back to us in prepaid packages with a brief self-administered survey. A total of 11 homes sent loggers back to us in prepaid packages.

We completed recruitment and deployment site visits between March and June 2016, and retrieval visits between October and December 2016. Table 4-3 provides the final survey dispositions for the study.

Table 4-3. Lighting Logger Recruitment Disposition Summary

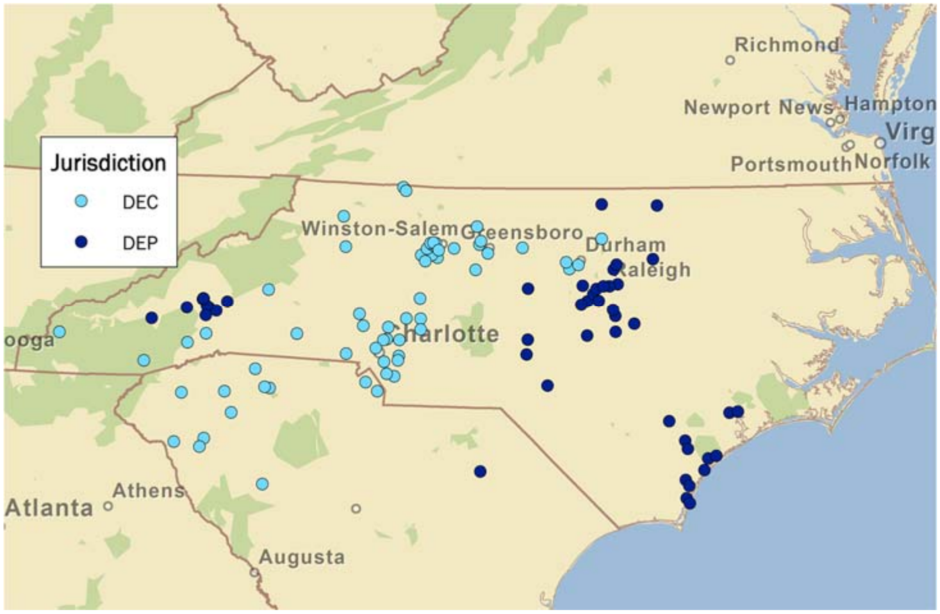
Disposition	Customers
Completed logger visit (I)	**107**
Eligible non-interviews (N)	**216**
Incomplete data	126
Recruited but site visit not completed	90
Survey ineligible household (X1)	**2,026**
Ineligible (no LEDs)	1,962
Does not live at address	55
Not a Duke Energy customer	9
Not eligible (X2)	**664**
Business number	65
Computer tone	18
Customer indicated called already	2
Disconnected phone/wrong email/phone number	579
Household with undetermined survey eligibility (U1)	**9,518**
Answering machine	863
Callback	243
Closed out of survey before completion	224
Did not open the online survey	7,034
Do not call list	31
Refusal	524
Alternative phone number	1
Language problems	57
Mid-interview terminate – do not call back	25
Not available	431
Recruited but unable to contact	85
Undetermined if eligible household (U2)	**411**
Busy tone	31
No answer	365
Privacy line/blocked number	15
Total customers in sample	*12,942*

Source: Opinion Dynamics analysis of the survey disposition data.

We calculated response rates using the Response Rate 3 (RR3) methodology specified by American Association of Public Opinion Research (AAPOR). The response rate for the lighting logger study was 6%.

Figure 4-1 illustrates the location of the 107 households that participated in the lighting logger study. As can be seen in the figure, the sample of homes adequately covered the DEP and DEC jurisdictions.

Figure 4-1. Distribution of Site Visits across DEP and DEC Jurisdictions



Source: Opinion Dynamics analysis of the site visit data.

4.5.2 Logger Deployment and Retrieval

As part of this study, we conducted an inventory of lighting products in all screw- or pin-based sockets (both medium screw-based and small screw-based sockets) located in both conditioned and unconditioned spaces (including outside).[5] We deployed loggers only on inside switches that control sockets with LEDs.

For logger deployment purposes, during the site visits, technicians classified rooms into seven following distinct room types[6]:

- Kitchen
- Living room
- Bedroom
- Bathroom
- Dining room
- Basement
- Other

For each room, technicians collected information on the total number of switches, switch controls, total number of light sockets controlled by each switch, lighting technology (CFL, LED, incandescent, halogen, empty socket), and bulb shape (twist, reflector, globe) in each socket. As part of the site visit, we also interviewed

[5] We excluded linear lighting from the inventory.

[6] Note that the list of room types for lighting inventory is more detailed and includes 16 unique room types.

homeowners and collected detailed data on their sociodemographic and household characteristics and lighting preferences.

To capture lighting usage, we used DENT loggers. We deployed up to seven loggers per home, one in each distinct room type. For homes with fewer than seven rooms with LEDs, we deployed more than one logger per room (but no more than three loggers per room) to increase the overall precision, as well as to use them as a backup loggers in case the need arose. Within each room and room type, we randomly selected the light switch to log in cases the room had multiple switches controlling LEDs. We placed lighting loggers only on switches that controlled at least one LED installed in a conditioned space. For each logger, we recorded the switch it was placed on and the count of light bulbs, by technology, it controlled. We also recorded a detailed description of the logger placement to aid in subsequent retrieval visits (e.g., light above master bathroom mirror).

To accurately capture lighting usage, we placed lighting loggers as close to the light source as possible, without compromising the aesthetics of the lighting. We recorded any instances when lighting loggers could not be placed on the desired fixture and the reasons why (e.g., accessibility, homeowner objections). In these cases, we selected alternative light fixtures for logger placement.

As part of the logger deployment process, we calibrated each logger's sensitivity setting to make sure it only captured lighting from the dedicated fixture and did not accidentally capture ambient sources of lighting, such as daylight.

Upon completion of the study, we removed the loggers using standard procedures for logger testing prior to removal, including state of light testing, and battery check prior to retrieval. We also conducted a closing interview with the homeowner about any changes in lighting usage over the course of the logging period.

4.5.3 Logger Data Preparation and Cleaning

We deployed a total of 314 loggers across 107 households. We were unable to retrieve a total of 7 loggers. To prepare the logger data for analysis, we performed a series of data-cleaning steps to ensure proper and reasonable logging. Those steps included:

- Identification and removal of corrupted/failed loggers: Initial review of the logger files identified loggers that were corrupted or failed to log the data properly. Corrupted/failed loggers consisted of those that: (1) did not contain any logs falling within the valid logging time frame (indicative of issues with logger clock calibration); (2) did not collect any data (indicative of the loggers not working properly); (3) contained logged data in stark contrast to self-reported socket usage, namely, loggers with no "on" time or very sporadically low "on" periods, while the homeowner reported the fixtures being always on or on most of the time. We identified 44 loggers that were corrupted/failed and therefore needed to be removed from further analysis.
- Logger date "trimming": This step was necessary to ensure that extraneous observations (i.e., logs) associated with logger placement, testing, and calibration were not a part of the analysis. Logger data were "trimmed" to remove all logs recorded "on" before the logger installation date, as well as on or after the logger retrieval day. To determine and validate deployment and retrieval dates, we used data recorded by the field staff as part of the deployment and retrieval process. For each logger, we trimmed the start date to be the first full day of logging and the end date to be the last full day of logging. For loggers received in the mail and therefore missing a clear indicator of the logging end period,[7] we carefully reviewed each individual logger's log patterns to determine an appropriate end date.

[7] Those loggers were removed and mailed to us by residents; thus, the retrieval process did not follow standard retrieval procedures.

Comparing the selected end date to the ship date of the package validated this assumption. We did not drop any loggers as a result of this step.

- Identification of loggers with short logging periods: Once "trimmed," we calculated logging periods for each logger. Some loggers may have failed or been removed by the residents during the early part of the logging period and therefore only contained logging data for a small fraction of the period. To increase the reliability of the HOU estimates, loggers logging for less than 1 month were excluded from the analysis. We identified one logger with a short logging period that needed to be removed from the analysis.
- Analysis of unexpected/suspicious usage patterns: To ensure proper operation of the loggers throughout the logging period, we performed an extensive analysis of logger usage patterns and flagged loggers with unusual or unexpected patterns for further review and validation. We explored a variety of patterns, including long "on" periods, long "off" periods and usage gaps, no "on" periods, and high variance in usage and usage changes over time. We did not identify any loggers with unexpected patterns and therefore did not drop any loggers from our analysis as a result of this step.
- Analysis of logger flickering: We thoroughly explored logger flickering and its impact on the HOU estimates. Logger flickering is caused by an external stimulus, such as sunlight or moisture interference. Flickering commonly manifests itself in short "flicks" or "on" and "off" periods. Flickering is generally difficult to identify and correct for because it is hard to determine whether the short-interval "on/off" periods are false positives or false negatives. We explored the impact logger flickering could have on average daily HOU by calculating, for each logger, the total number of logs that each logger recorded and normalizing the total number of logs to the days that the logger was in the field, thus arriving at an average number of logs per day. A high count of logs per day is usually indicative of loggers flickering. We then estimated the impact that potential logger flickering could have on the HOU estimates by summing for each logger every 1–10 second "on/off" period[8] and dividing them by the total number of days that the logger was deployed. The resulting number presents an upper bound of the impact that flickering has on the HOU estimates. The results of the analysis revealed that the impacts of the flickering issue on the estimation of the average daily HOU are negligible. As such, we did not make any adjustments to the logger data.

In the end, we deployed 314 loggers, of which 262 were used for the analysis (83%). Table 4-4 provides a summary of logger attrition.

Table 4-4. Logger Attrition Summary

Cut or Drop Decision	Loggers Affected		Sites Affected	
	#	%	#	%
Total deployed	314	100%	107	100%
Unusable loggers	52	17%	42	39%
Unable to retrieve	7	2%	5	5%
Corrupted/failed loggers	44	14%	36	34%
Less than 30 days of logging	1	<1%	1	1%
Total used in analysis	262	83%	107	100%

Source: Opinion Dynamics analysis of the logger data.

[8] 1–10 second "on" and "off" periods were determined as the most common "flicker" periods. This is a very conservative range because the 10-second "on/off" pattern is a very conceivable usage pattern for people to exhibit.

4.5.4 Post-Stratification

Lighting metering studies are involved and require time and effort on behalf of the customer. Certain customer types may be less likely to participate in such a study (e.g., those with higher incomes or those employed full-time). If the customers that are under- or overrepresented in our sample have different lighting usage patterns, the study results, namely HOU and CFs, will suffer from non-response error and will not be representative of the broader population.

As part of our analysis, Opinion Dynamics explored the presence of non-response bias in the site visit sample by comparing the study's site visit participants to the broader population on a range of observable characteristics associated with the lighting usage. Those include home type, homeownership status, age, income, education, household size, and employment status.

Only customers with LEDs were eligible for the lighting logger study, and the data on the sociodemographic and household characteristics of that population segment do not exist. To assess non-response bias, therefore, we made two comparisons:

- **Recruitment survey respondents to the general population of DEP and DEC customers.** As part of the recruitment survey, we collected sociodemographic and household information from both qualifying and non-qualifying customers. We compared the composition of the customers who responded to the recruitment survey to a broader population of DEP and DEC customers. We used the U.S. Census Bureau's 2010–2015 American Community Survey (ACS) data to obtain information on DEP and DEC customers. This comparison allowed us to assess the presence of the non-response bias in our recruitment effort. Aside from DEP customers being slightly underrepresented, the sample was well aligned with the population across a range of sociodemographic and household characteristics.
- **Sample of site visits to the eligible population of customers.** We compared the sociodemographic and household characteristics of the households that participated in the logger study with those of all customers eligible for the study, as determined through the recruitment survey. This comparison allowed us to assess whether customers who agreed to participate in the study were different from those who qualified but chose not to participate. We found that our site visit sample was skewed in terms of homeownership and home type, with renters and residents of multifamily properties being underrepresented. We also found that DEP customers were slightly underrepresented. As expected, HOU and other key variables of interest differed considerably across those groups.

Based on this analysis, we developed and applied post-stratification weights based on homeownership and jurisdiction to align the sample with the population. We did not weight the data by home type because home type is highly correlated with homeownership, and weighting the data by the latter automatically aligned the sample by the former. Table 4-5 summarizes the post-stratification weights that we applied.

Table 4-5. Lighting Logger Study Post-Stratification Weights

Jurisdiction	Homeownership	n	Weight
DEP	Own	41	1.0383
DEP	Rent	5	1.5645
DEC	Own	49	0.8439
DEC	Rent	12	1.2715

Source: Opinion Dynamics analysis of the site visit and logger data.

4.5.5 Hours of Use Annualization Process

Lighting logger studies that do not log usage during the entire year must employ an annualization process to adjust for changes in daylight hours that likely affect HOU. While this study did not cover the whole year, loggers were in place for most of the year, capturing data on usage during the spring, summer, and part of the fall. Such a considerable fielding period is likely to result in observed HOU estimates mimicking the annual values. In this case, using observed estimates will be appropriate, and even preferable, given the modeling uncertainty that the annualization process might introduce.

Before defaulting to the observed HOU estimates, however, we annualized the lighting usage data using an individual ordinary least squares (OLS) regression model. The model specification is provided in Equation 4-1.

Equation 4-1. Hours of Use Model Specification

$$Hd = \alpha + \beta sin(\theta d) + \varepsilon d$$

Where:

Hd = HOU on day d, starting with d=1 on January 1.

α = The intercept representing HOU when sin(θd)=0. Since average sin(θd) for the year is equal to zero by design, evaluating the model at the average declination angle leaves only the constant to estimate HOU; therefore, the intercept term is equal to average annualized HOU for each bulb.

β = Sine coefficient, or the difference between the HOU on the solstice and days with the average annual declination angle.

$Sin(\theta d)$ = Sine of the solar declination angle or day d converted to follow the change in the HOU and adjusted to fit the −1 to +1 interval with an average of zero for the year (for ease of analysis). The solar declination angle represents the latitude at which the sun is directly overhead at midday. We used the following formula to calculate the sine of the solar declination angle for each day of the year:

$$\sin(-\pi*2*(284+d)/365)$$

εd = Residual error

We fit sinusoid regression models separately for weekends and weekdays for each individual logger and then combined the results in proportion to the percent of weekends versus weekdays in a year. We analyzed each regression model for goodness of fit to determine if the individual bulb was sufficiently daylight-sensitive to justify regression-based annualization and to determine if the sinusoid model could provide a reliable estimate (i.e., the sinusoid model accurately represented trends in lighting use over time). Specifically, we looked at:

- Significance of the sine coefficient t-statistic. Loggers with a t-statistic lower than 1.282 or higher than −1.282 were flagged as "poor fit" (meaning that the solar declination angle is not significantly different from 0 at a 90% confidence level).
- Magnitude of the sine coefficient. Models that resulted in extremely high sine coefficients (absolute magnitude of seven or more) were flagged as "poor fit."[9]

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[9] In many of those cases, use changed dramatically during different periods of the study, and it was not possible to determine typical use. For example, lights may have stayed continuously on for a portion of the study, and then used intermittently.

- The value of the intercept. Models with the negative intercept were flagged as "poor fit."

If any of the parameters described above were true, we replaced the modeled HOU with non-annualized observed daily average HOU. As part of this exercise, we replaced 76% of modeled results with observed HOU estimates.

4.5.6 Coincidence Factor Estimation

CFs represent the fraction of time during the peak period that the light is on. We used the following definitions of peak periods in the CF calculations:

- Summer peak period: non-holiday weekday, during the months of June–August, between the hours of 3pm and 5pm
- Winter peak period: non-holiday weekday, during the months of December–February, between the hours of 7am and 9am

Because loggers were in the field for the entire duration of the summer peak period, annualization of the lighting usage was not necessary. Therefore, we relied on the observed usage data to estimate summer peak CFs. We calculated the summer peak CF by summing, for each logger, the time the light was on during the summer peak period and dividing the result by 2 (3pm–5pm).

Conversely, we did not log lighting usage during the winter peak period. To determine winter peak CFs, we annualized lighting usage. We performed similar goodness of fit calculations as with the HOU annualization described in the section above. We calculated the winter peak CF by summing, for each logger, the time the light was on during the winter peak period and dividing the result by 2 (7am–9am).

4.5.7 Hours of Use and Coincidence Factor Aggregation Process

Consistent with the three-stage cluster or multi-stage sampling approach to deploying loggers, wherein we first select households, then rooms, then switches to place loggers on, we aggregated the individual logger results first to the room level within each household, then to the room level across households, and finally across room levels to the overall household-level estimate. To arrive at the room-level HOU and CF estimates within a household, we aggregated the results from the individual loggers, weighting down loggers that were installed in the same room type in a single household so that room-level estimates' contribution to the overall estimate is consistent across households. This weighting process ensured that a household where multiple loggers were installed within the same room type did not contribute to the room-level estimate more heavily than a household where only one logger was installed in a given room type. We then developed across-household room-level estimates by weighting individual estimates by the number of light bulbs logged as part of the process. Finally, we weighted room-level estimates by the share of LEDs in each room type to arrive at the overall HOU and CF estimates.

4.5.8 In-Service Rate Calculation

We calculated ISRs for LEDs by summing all of the LEDs in storage and dividing the result by the sum of LEDs installed inside and outside of customers' homes, as well as in storage. We developed ISRs for each household and then weighted the results to the overall ISR for each jurisdiction by the share of LEDs in each household. This ensured that homes with more LEDs contributed more heavily to the program ISR. We also applied homeownership weights as described in the section above to ensure representativeness of the results.

Table 4-7 summarizes achieved relative precision across all metrics.

Table 4-6. Precision and Margins of Error at 90% Confidence

Metric of Interest	Relative Precision (at 90% Confidence)
DEP ISR	4%
DEC ISR	5%

Source: Opinion Dynamics analysis of the site visit data.

4.5.9 Targeted Confidence and Precision

The evaluation targeted 10% precision at the 90% confidence level (90/10) for the HOU estimates across the DEP and DEC jurisdictions combined. Opinion Dynamics achieved the desired precision for HOU estimates. Precision around the CF estimates is slightly worse than 90/10. With ISR estimates, we were able to meet 90/10 at the jurisdiction level. Table 4-7 summarizes achieved relative precision across all metrics.

Table 4-7. Precision and Margins of Error at 90% Confidence

Metric of Interest	Relative Precision (at 90% Confidence)
HOU	9%
Summer CF	12%
Winter CF	12%

Source: Opinion Dynamics analysis of the logger data.

4.6 Retailer Shelf Audits

Opinion Dynamics completed retail shelf audits across a range of retail channels in DEP and DEC jurisdictions in September 2016. We completed shelf audits at both participating and non-participating retailers. We selected a purposeful sample of retailers and storefronts to provide good geographic and retailer channel coverage, while capturing a meaningful percentage of program bulb sales. Table 4-8 summarizes the shelf audit sample by retail channel and jurisdiction. As can be seen in the table, we completed 15 retailer shelf audits per jurisdiction. Of the 15 DEP retailers, 12 were participating in the DEP EEL program and 3 were not. Of the 15 DEC retailers, 10 were participating in the program and 5 were not. The 12 participating retailers that we visited in the DEP jurisdiction accounted for 21% of program sales, and the 10 participating retailers that we visited in the DEC jurisdiction accounted for 25% of program sales.

Table 4-8. Shelf Audit Data Collection Overview

Retail Channel	DEP			DEC		
	Participating Retailers	% of Program Sales	Non-Participating Retailers	Participating Retailers	% of Program Sales	Non-Participating Retailers
Big Box	1	1%	1	2	<1%	1
DIY	3	5%	2	4	4%	2
Club	4	13%	0	4	21%	2
Discount*	1	<1%	0	0	<1%	0
Hardware	3	2%	0	0	<1%	0
Total	12	21%	3	10	25%	5

Source: Opinion Dynamics analysis of the shelf audit data.
* Discount channel includes Dollar Tree, Goodwill, and Habitat ReStore stores.

As part of each shelf audit, the evaluation team recorded the number and price ranges of different lighting products in key wattage categories. We recorded data separately for general service products and reflector products. The evaluation team also recorded the presence of program-sponsored POP marketing and promotional materials. We used results from the study to adjust baseline wattage assumptions and to provide insight into the shelf space devoted to different lighting products.

As described above, the selection of retailers for shelf audits made use of a purposeful sampling approach. As a non-probability sampling method, the concept of sampling error does not apply, so there is no estimate of precision for the resulting estimates.[10]

4.7 Retailer and Manufacturer Interviews

Opinion Dynamics completed a total of 33 interviews with store-level retailer staff and manufacturer contacts. The sample frame for retailer interviews included all participating retailer locations. We drew a purposeful sample with consideration of geographic and retail channel coverage, and attempted to maximize representation of total program sales.

The sample frame for manufacturers and corporate-level retailers was supplied to us by the program manager and included a total of 15 contacts from 14 companies. We reached out to nearly all manufacturer contacts, with a purposeful focus on the retailers and manufacturers representing the most program sales. All the manufacturers we contacted sold products discounted by both programs during the evaluation period.

Table 4-9 provides a summary of the retailer and manufacturer interviews by jurisdiction and stakeholder type. The table also provides the percent of sales accounted for by each group of interviewed respondents.

[10] There may be other sources of uncertainty, such as measurement error, that are associated with these interviews and all the NTGR methods. It is not possible to quantify these errors like we can sampling error. We discuss these other research limitations throughout this report.

Table 4-9. Retailer and Manufacturer Interview Data Collection Overview

Interview Type	DEP			DEC		
	Planned Interviews	Completed Interviews	% of Bulb Sales	Planned Interviews	Completed Interviews	% of Bulb Sales
Store-level retailer staff	10	10	20%	10	12	28%
Manufacturer contacts*	7	11	84%	7	9	84%
Total	17	21	83%	17	21	90%

Source: Opinion Dynamics analysis of retailer and manufacturer interview data.
* We spoke to 11 manufacturer contacts, 9 of whom provided feedback for both programs and 2 of whom participated in only the DEP EEL program.

As described above, retailer and manufacturer interviews made use of a purposeful sampling approach. As a non-probability sampling method, the concept of sampling error does not apply, so there is no estimate of precision for the resulting estimates, including NTGR.[11]

4.8 Sales Data Modeling

The goal of the sales data modeling was to develop a NTGR estimate. As part of this research activity, we estimated, for each program, lighting price elasticities using regression modeling of PY2016–2017 program sales and pricing data. We calculated a NTGR estimate from the price elasticities. A detailed description of the sales data modeling methodology can be found in Section 6.1 of this report.

Sales data modeling uses sales data from the entire period under evaluation rather than a sample of the program sales records. Because no sampling was used, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

4.9 Leakage Analysis

Leakage occurs when non-Duke Energy customers purchase program-discounted products and install them in homes or businesses located outside of a utility's service territory. The program leakage rate reflects the percentage of program bulbs purchased by non-Duke Energy electric customers. Duke Energy cannot claim savings from those products, and the savings associated with them need to be subtracted from the overall program impacts.

DEP and DEC share a border. With both jurisdictions running upstream lighting programs, program bulbs are "leaking" from one jurisdiction into the other. As part of the leakage analysis, it is therefore important to estimate not only leakage "out" (percent of program bulbs purchased by non-utility customers) but also leakage "in" (percent of other program's bulbs purchased by utility customers). The final leakage rate, as a result, is the net of the two leakage estimates (see Equation 4-2 below).

Equation 4-2. Leakage Rate Formula

$$Leakage\ Rate = Leakage\ Out - Leakage\ In$$

[11] There may be other sources of uncertainty, such as measurement error, that are associated with these interviews and all the NTGR methods. It is not possible to quantify these errors like we can sampling error. We discuss these other research limitations throughout this report.

The key factor affecting leakage for an upstream residential lighting program is the location of the participating stores in relation to the DEP and DEC jurisdiction borders. Opinion Dynamics relied on geographic information system (GIS) analysis to estimate both leakage "out" and "in" rates for each jurisdiction. We leveraged three data sources to perform the analysis:

- Participating store location and bulb sales data
- U.S. Census 2015 ACS data at the census block group level
- Customer data

To calculate leakage rates, we performed the following steps:

- Mapped respective store locations participating in the DEP EEL and DEC Retail LED programs.
- Defined a store's territory as the area lying within a certain radius from participating stores. We customized radius designators depending on whether the stores were located in urban or rural areas. We relied on the U.S. Census definitions of urban area, urbanized cluster, and rural area,[12] and assigned a 5-mile radius to the stores located in urban areas, a 7-mile radius to the stores located in urbanized clusters, and a 10-mile radius to the stores located in rural areas. The customized radius assignments assume that customers will need to travel further in rural compared to urban areas to have access to the types of retailers that participate in the program.
- Calculated the number of households living within each participating store's territory by summing the total number of households across all census block groups lying within the store-assigned radius (5, 7, or 10 miles). In cases where a portion of a census block group fell within the designated radius, we apportioned the population of shoppers based on the percentage of land mass falling within the designated radius of the store.
- Calculated the total number of the DEP and DEC customers, respectively, living within each participating store's territory by mapping DEP and DEC customer data to the census block groups lying within each store's designated radius and summing the customers across the census block groups. Similar to calculating the total number of households within a store's territory, in cases where a part of a census block group fell within a designated radius, we apportioned the population of DEP and DEC customers based on the percentage of land mass falling within that radius.
- Calculated leakage "out" for each participating store by dividing the total number of DEP and DEC customers, respectively, by the total population falling within each store's territory and subtracting it from 1 (see Equation 4-3 below). We calculated a program-level leakage "out" by weighting the individual store rates by the program sales volume, so stores that sold more bulbs through the program had more weight.

Equation 4-3. Leakage Out Formula

$$Leakage\ Out\ (DEP) = 1 - \left(\frac{DEP\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEP\ Participating\ Stores}\right)$$

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[12] The U.S. Census defines urban area as an area with the population of 50,000 or more, an urbanized cluster as an area with population between 2,500 and 50,000, and a rural area as areas that are not urban areas or urbanized clusters. It should be noted that a store's territory and the shopping patterns are likely to be influenced by a number of factors, including the type of store, the road network, and the population density of the area. It was not possible to consider all of these factors for this analysis.

$$Leakage\ Out\ (DEC) = 1 - \left(\frac{DEC\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEC\ Participating\ Stores}\right)$$

- Calculated leakage "in" for each participating store by diving the total number of the opposite jurisdiction's customers living within a store's territory by the total population within each store's territory. Similar to the leakage "out" calculation, we developed initial program-level leakage "in" by weighting the individual store rates by the program sales volume, so stores that sold more bulbs through the program had more weight.

Equation 4-4. Initial Leakage In Formula

$$Initial\ Leakage\ In\ (DEP) = \left(\frac{DEC\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEP\ Participating\ Stores}\right)$$

$$Initial\ Leakage\ In\ (DEC) = \left(\frac{DEP\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEC\ Participating\ Stores}\right)$$

We applied the resulting rates to the energy savings to estimate the total savings "leaking into" the DEP jurisdiction from the DEC Retail LED program and vice versa. We adjusted the savings to reflect the ISRs associated with the jurisdiction in which bulbs would being installed. We then divided the resulting leakage "in" savings by the program's overall ex post gross savings to arrive at the normalized final leakage "in" rate for each program.

Equation 4-5. Final Leakage In Formula

$$Leakage\ In\ (DEP) = \left(\frac{Leakage\ In\ Savings\ from\ DEC}{DEP\ Ex\ Post\ Gross\ Savings}\right)$$

$$Leakage\ In\ (DEC) = \left(\frac{Leakage\ In\ Savings\ from\ DEP}{DEC\ Ex\ Post\ Gross\ Savings}\right)$$

Leakage data analysis relied on sales data from the entire period under evaluation rather than a sample of the program sales records. Because no sampling was used, the concept of sampling error does not apply, so there is no estimate of precision for the resulting leakage rate estimates.

5. Gross Impact Evaluation

This section describes the methodology the evaluation team used to conduct the gross impact analysis and the results of the analysis. Due to the similarities in the savings assumptions and analytical approaches across the DEP EEL and DEC Retail LED programs, we present the methodology and the results of the gross impact evaluation together for the two programs.

The evaluation team completed the following activities as part of the gross impact analysis:

- Reviewed program tracking data and ex ante savings values for accuracy, completeness, and consistency
- Reviewed and compiled appropriate ex post assumptions based on recent Carolinas-specific research
- Conducted engineering analysis to develop estimates of ex post gross energy and demand savings

5.1 Methodology

Neither North Carolina nor South Carolina has a Technical Reference Manual (TRM) that provides a recommended savings estimation approach and savings assumptions. Therefore, all savings assumptions are based on the most recent available Carolinas-specific research.

Duke Energy changed its approach to estimating ex ante savings during the current evaluation period, relying on per-unit savings by product category and applying a single set of values across all products within each category. Per-unit values are based on results of the previous evaluation (DEP EEL PY2015), and categories are defined by bulb technology, shape, and subtype (e.g., general purpose CFLs, outdoor reflector LEDs, 3-way LEDs). We applied the per-unit savings specified by the program based on product categories recorded in the program tracking data.

We estimated gross savings using the recommended approach in the Uniform Methods Project (UMP) protocols. Per the UMP protocols, savings calculations account for baseline wattages, actual bulb wattages, ISR, lighting operation (HOU and CFs), and interactive effects. These equations and all recommended savings parameters are detailed below. We reviewed program sales data and corrected any inconsistencies in product categorization or bulb specifications prior to calculating gross savings.

5.1.1 Review of Program Tracking Data for Completeness and Consistency

Opinion Dynamics analyzed the program sales data for any gaps and inconsistencies. As part of the analysis, we performed the following steps:

- Checked the core data fields for missing values
- Checked the data for temporal gaps (due to missing invoices, transactions, etc.) by reviewing variation in monthly invoiced sales
- Verified consistency of product categorization for each product, cross-checked these categories with detailed measure descriptions, and corrected any inconsistent product categories based on available information from the ENERGY STAR or retailer websites

- Cross-checked wattages, lumen outputs, incandescent equivalent wattages, and detailed measure description data fields for consistency and accuracy and corrected inconsistent values
- Checked pack size and rebate information for outliers or unreasonable values

Opinion Dynamics identified and corrected slight inconsistencies in bulb categorizations, bulb wattage, and lumen assignments. None of those inconsistencies was widespread; each adjustment affected a fraction of a percent of total sales, and the effect on program savings was negligible.

5.1.2 Recommended Savings Assumptions

In this section, we provide an overview of the savings assumptions applied to estimate ex post gross savings for each program. We chose the savings assumptions with consideration of the following factors:

- Assumptions are based on Carolinas-specific research
- Assumptions are based on the most recent available research and analysis
- LED savings assumptions are specific to LEDs as much as possible

We relied on a standard equation to estimate program savings and estimated savings attributable to the residential vs. commercial installations separately. The equation incorporates baseline wattages, actual bulb wattages, ISR, lighting operation (HOU and CFs), and interactive effects. Equation 5-1 provides the formula that we used to estimate energy savings, while Equation 5-2 provides the formula for demand savings. These formulas are standard and are routinely used to estimate savings for lighting programs.

Equation 5-1. Annual Energy Savings

$$Res\ kWh_{saved} = NUMUNIT * ResShare\left[\left(\frac{\Delta W}{1{,}000}\right) * HOU_{Res} * ISR_{Res} * INT_{Res}\right]$$

$$Com\ kWh_{saved} = NUMUNIT * ComShare\left[\left(\frac{\Delta W}{1{,}000}\right) * HOU_{Com} * ISR_{Com} * INT_{Com}\right]$$

Equation 5-2. Annual Demand Savings

$$Res\ kW_{saved} = NUMUNIT * ResShare\left[\left(\frac{\Delta W}{1{,}000}\right) * CF_{Res} * ISR_{Res} * INT_{Res}\right]$$

$$Com\ kW_{saved} = NUMUNIT * ComShare\left[\left(\frac{\Delta W}{1{,}000}\right) * CF_{Com} * ISR_{Com} * INT_{Com}\right]$$

Where:

kWh_{saved} = First-year electric energy savings

kW_{saved} = Summer peak electric demand savings

$NUMUNIT$ = Number of bulbs

$ResShare$ = Percentage of light bulbs installed in residential applications (accounts for leakage)

$ComShare$ = Percentage of light bulbs installed in commercial applications (accounts for leakage)

ΔW = Delta watts = Baseline wattage minus efficient lighting product wattage

HOU = Annual operating hours

ISR = In-service rate

INT = Cooling and heating interactive effects

CF = Summer/winter peak coincidence factor

Res = Residential values

Com = Commercial values

Table 5-1 presents the sources of savings assumptions used to calculate program ex post gross energy and demand savings.

Table 5-1. Ex Post Savings Assumption Sources

Assumption	Source of Residential Assumptions	Source of Commercial Assumptions
Sales to residential/ commercial customers	2011 and 2012 Intercept Surveys	
Leakage rate	GIS analysis	
Baseline wattage	Incandescent equivalent adjusted for Energy Independence and Security Act (EISA) based on 2016 Retailer Shelf Audit and U.S. Department of Energy's (DOE) Energy Conservation Standards for Incandescent Reflector Lamps	
Replacement wattage	Actual product wattage	
HOU	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2012 DEP Residential Metering Study (CFLs)	2016 DEP Commercial Lighting Logger Study
First-year ISR and future installation rate trajectory	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2013 DEP General Population Survey (CFLs) 2014 DEP Storage Log Study (future installations)	2016 DEP Commercial Lighting Logger Study 2014 DEP Storage Log Study (future installations)
Interactive effects	2012 DOE2 Simulation Models	No interactive effects applied
CF (summer and winter)	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2012 DEP Residential Metering Study (CFLs)	2016 DEP Commercial Lighting Logger Study

Source: Opinion Dynamics analysis and prior evaluation reports.

Table 5-2 provides the savings assumptions used to calculate ex post gross savings. Following the table, we provide greater detail on each assumption.

Appendix M contains a detailed overview of the ex ante savings assumptions and their sources.

Table 5-2. Ex Post Savings Assumption Values

Assumption	DEP EEL Program		DEC Retail LED Program	
	Residential	**Commercial**	**Residential**	**Commercial**
Sales to residential/ commercial customers*	0.817	0.099	0.880	0.107
Leakage rate	0.084	0.084	0.013	0.013
Baseline wattage	Minimum efficiency baseline adjusted for applicable federal standards			
Replacement wattage	Actual product wattage			
HOU	2.922 (CFLs) 2.881 (LEDs)	6.930 (CFLs) 5.783 (LEDs)	2.881	5.783
First-year ISR	0.795 (CFLs) 0.943 (LEDs) 1.0 (fixtures)	0.879 (CFLs) 0.979 (LEDs) 1.0 (fixtures)	0.865 (LEDs) 1.0 (fixtures)	0.979 (LEDs) 1.0 (fixtures)
Interactive effects	0.94 (Energy) 1.27 (Summer peak) 0.50 (Winter peak)	1.0	0.94 (Energy) 1.27 (Summer peak) 0.50 (Winter peak)	1.0
Summer CF	0.1138 (CFLs) 0.1283 (LEDs)	0.4966 (CFLs) 0.5471 (LEDs)	0.1283	0.5471
Winter CF	0.0960 (CFLs) 0.1451 (LEDs)	0.1737 (CFLs) 0.1199 (LEDs)	0.1451	0.1199

Source: Opinion Dynamics analysis and prior evaluation reports.
* Together with the leakage rate, these values add up to 1.

Sales to Residential/Commercial Customers and Leakage Rate

Because the DEP EEL and DEC Retail LED programs rely on retail channels to reach customers, both residential and commercial customers end up purchasing and installing program-discounted lighting products. Due to longer operating hours, savings from the discounted lighting products installed in commercial settings are greater than residential savings. Furthermore, not all program bulbs are installed in homes where Duke Energy provides electric service (leakage). The nature of the upstream program design makes it difficult to limit the purchase of program-discounted products to Duke Energy customers only.

As part of the previous DEP EEL program evaluations (namely, 2011 and 2012 in-store intercept survey efforts), Navigant Consulting estimated the percentage of program sales to commercial versus residential customers (Table 5-3). We relied on these estimates to apportion program savings across residential and commercial customers for the current evaluation. We leveraged the results of the GIS analysis to estimate program leakage and adjusted program savings based on the results.

Table 5-3. Residential versus Commercial Installations

Metric	Percent of Sales
Share of sales to residential customers	89%
Share of sales to commercial customers	11%
Total	100%

Source: Navigant Consulting. EM&V Report for the 2013 Energy Efficient Lighting Program.

For leakage rates, we relied on the GIS analysis. As part of the analysis, we estimated both leakage in and leakage out, as well as leakage in for each program. Table 5-4 provides the results of the leakage rate analysis. As can be seen in the table, the overall leakage rate is 8.4% for the DEP EEL program and 1.3% for the DEC Retail LED program.

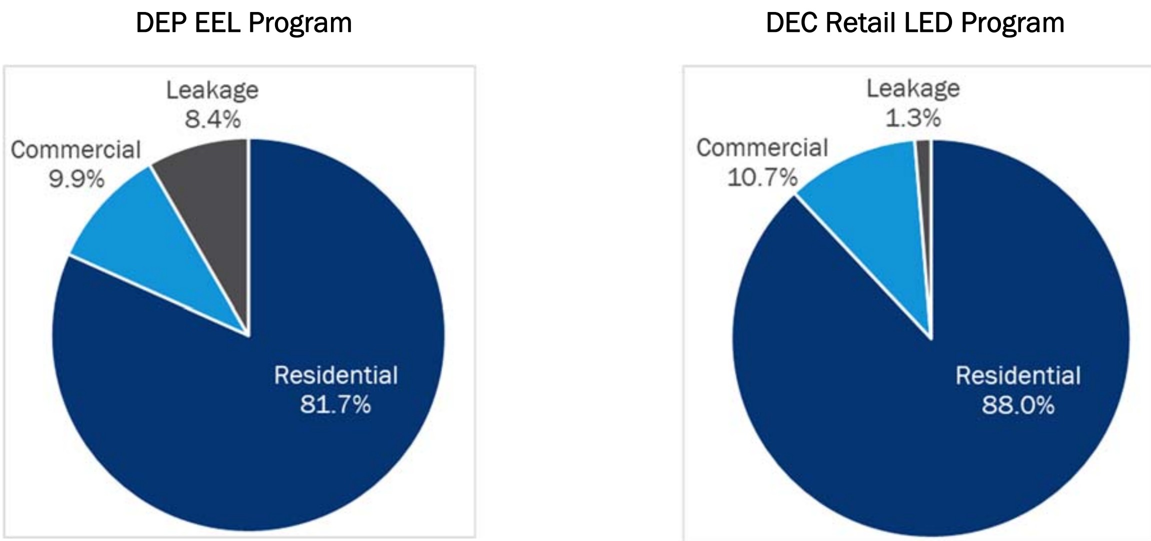
Table 5-4. Program Leakage Rates

Program	Leakage Out Rate	Leakage In Rate	Total Leakage Rate
DEP EEL	8.7%	0.3%	8.4%
DEC Retail LED	3.4%	2.1%	1.3%

Source: Opinion Dynamics GIS analysis.

Figure 5-1 provides the distribution of program sales for each program across sectors and outside of each program's respective jurisdiction.

Figure 5-1. Sales to Residential/Commercial Customers and Leakage Rate Assumptions



Source: Opinion Dynamics GIS analysis.

Baseline Wattages

We used the minimum efficiency baseline approach to determine baseline wattages for program-discounted products for both programs (in both residential and commercial settings). Minimum efficiency standards in the market vary by product type based on the federal standards. Below we detail the methods we used to calculate baseline wattages for each product type.

General Service Products

Incandescent products have historically been the lowest efficiency product on the market. The 2007 EISA gradually phased out general service incandescent products, replacing them with halogens and thus making them the new baseline. The EISA regulations affected 100-watt incandescent products in January 2012, 75-watt incandescent products in January 2013, and 60-watt and 40-watt incandescent products in January 2014. However, products did not immediately disappear from the market, as manufacturers and retailers were allowed to sell through their existing inventory of incandescents. Because some incandescent products may still have been available for purchase in 2016, assuming a halogen baseline may not reflect the actual market and be too punitive to program savings.

To assess incandescent product availability and determine if any upward adjustments to the baseline wattage are warranted, Opinion Dynamics relied on the shelf audit research.

Of the 15 stores in DEP jurisdiction, none carried 100-watt or 75-watt incandescents. One retailer (a participating hardware store) carried one 60-watt incandescent product. The incandescent product was one of twenty 60-watt equivalent products available to the customers at that store. Two stores (both participating hardware stores) carried 40-watt incandescent products. In both stores, incandescent products represented a small portion of 40-watt equivalent products (2 out of 14 products in one store, and 3 out of 22 products at the other). The three stores that carried incandescent products accounted for a small percent of program sales (10%).

Of the 15 stores that we visited in the DEC jurisdiction, none carried incandescent products, and all but Club stores carried halogen products.

Given that we did not find any incandescent products in the DEC jurisdiction and the very limited availability of these products in the DEP service territory, we used halogen baseline wattages to estimate savings for general service CFLs and LEDs discounted through both the DEP EEL and DEC Retail LED program (see Table 5-5).

Table 5-5. Recommended Baseline Wattages for General Service Products

Equivalent Incandescent Wattage	EISA Baseline Wattage
100-watt equivalents	72
75-watt equivalents	53
60-watt equivalents	43
40-watt equivalents	29

Source: Opinion Dynamics analysis.

Reflector Products

To determine baseline wattages for flood lights and reflector bulbs and fixtures, we relied on the approach established by the Navigant Consulting team during its PY2013 evaluation of the DEP EEL program. Baselines were assigned based on a combination of maximum allowable wattage and the available information for replacement bulbs regarding wattage and lumen output. We accounted for higher efficiency standards introduced by the DOE Energy Conservation Standards for some incandescent reflector lamps that went into effect in July 2012. We deemed this approach reasonable given the complexities associated with assigning baseline wattages to reflector products, which include a non-linear lumen-to-watt ratio, a variety of bulb shapes and sizes of varying efficacies, and the discrepancy between maximum allowable wattages and product availability on store shelves.

Table 5-6. Baseline Wattage Assumptions for Reflector and Flood Light Products

Bulb Type	Lumen Range		Baseline Watts	Exemption Status
	Lower End	Upper End		
R, PAR, ER, BR, BPAR, or similar bulb shapes with medium screw bases with diameter > 2.5" (*see exceptions below)	600	739	50	
	740	849	50	
	850	999	55	
	1,000	1,300	65	
*ER30, BR30, BR40, ER40	400	449	40	Exempt
	450	499	45	Exempt
	500	1,419	65	Exempt
*R20	400	449	40	Exempt
	450	719	45	Exempt
*All reflector lamps below the lumen ranges specified above	200	299	30	
	300	399	40	

Source: Opinion Dynamics analysis and prior evaluation reports.

Specialty Products

Neither EISA nor DOE Energy Conservation standards for incandescent reflector lamps affect other specialty products, such as three-way bulbs, candelabra bulbs, and globe bulbs. As such, we used incandescent equivalent wattage as the baseline for these specialty products.

Replacement Wattage

For the replacement wattage, we used the actual bulb wattage associated with each discounted lighting product. We compared the listed wattage to lumen outputs and measure descriptions where possible to ensure that the most accurate wattage was applied.

Hours of Use and Coincidence Factors

A light metering study is the industry standard to estimate HOU and CFs. Depending on the technology and customer type, we relied on several metering studies for HOU and CF for the two programs.

On the residential side, HOU and CF assumptions for CFLs (for the DEP EEL program only) were drawn from the 2012 DEP Residential Metering study. Table 5-7 provides a summary of the HOU and CF values for CFLs.

Table 5-7. Residential HOU and CF Assumptions for CFLs

Statistic	CFL Value
HOU	2.922
Summer CF	0.1138
Winter CF	0.0960

Source: Prior evaluation reports.

Residential HOU and CF assumptions for LEDs for both programs are based on the results from the 2016 DEP-DEC Residential Lighting Logger study. As part of the study, we metered LED usage across a representative sample of 107 homes across DEP and DEC jurisdictions, including 46 homes in the DEP jurisdiction and 61 homes in the DEC jurisdiction. The study yielded updated LED- and Carolinas-specific residential HOU and CF estimates. Table 5-8 provides LED HOU and CF estimates from the study.

Table 5-8. Residential HOU and CF Assumptions for LEDs

Statistic	LED Value
HOU	2.881
Summer CF	0.1283
Winter CF	0.1451

Source: Opinion Dynamics lighting logger analysis.

Appendix N provides additional results from the study.

On the commercial side, we applied commercial HOU and CF estimates from the 2015–2016 DEP Commercial Lighting Logger study completed by Opinion Dynamics as part of the PY2015 DEP EEL program evaluation. As part of the study, Opinion Dynamics logged CFL and LED lighting in 79 commercial facilities across the DEP service territory over an 8-month period.[13] Table 5-9 provides recommended HOU and CF assumptions for commercial installation.

Table 5-9. Commercial HOU and CF Assumptions

Statistic	CFL	LED
HOU	6.930	5.783
Summer CF	0.4966	0.5471
Winter CF	0.1737	0.1199

Source: Opinion Dynamics lighting logger analysis.

First-Year In-Service Rate and Future Savings

First-year ISR varies by technology, customer type (residential vs. commercial), and jurisdiction. For residential CFL installations (for the DEP EEL program only), we relied on the results from the general population survey completed by Navigant Consulting as part of the DEP EEL PY2013 evaluation. For residential LED installations, we relied on results from the 2016 Residential Lighting Logger study completed as part of this evaluation. As

[13] Opinion Dynamics placed loggers in 88 facilities, but excluded logger data from 9 facilities during the data-cleaning process.

part of the study, we collected information on the number of LEDs installed and in storage. We estimated the first-year ISR by dividing the total number of LEDs installed by the total number of LEDs installed and in storage. We estimated independent ISRs for DEP and DEC. For commercial savings, we relied on the results of the 2015–2016 DEP Commercial Lighting Logger Study that Opinion Dynamics completed as part of the PY2015 DEP EEL program evaluation. As part of that study, we completed a full inventory of all medium screw-based sockets within each business facility, including bulbs that were in storage. The ISR for a given bulb type is defined as the number of installed bulbs divided by the total number of bulbs found within the facility. For lighting fixtures, we used a first-year ISR of 100% for both residential and commercial sectors and across both programs. It is highly unlikely that customers who purchase lighting fixtures do not install them right away. Table 5-10 summarizes the first-year ISRs that we used in the impact analysis.

Table 5-10. First-Year In-Service Rates

	DEP			DEC		
Year	**LEDs**	**CFLs**	**Fixtures**	**LEDs**	**CFLs**	**Fixtures**
Residential	94.3%	79.5%	100.0%	86.5%	N/A	100.0%
Commercial	97.9%	87.9%	100.0%	97.9%	N/A	100.0%

Source: Opinion Dynamics lighting logger analysis and prior evaluation reports.

Although the first-year ISR is less than 100% for both CFLs and LEDs, research studies across the country have found that customers eventually install nearly all bulbs received through a program. The two main approaches to claiming savings from these later installations are: (1) staggering the savings over time and claiming some in later program years and (2) claiming the savings from the expected installation in the program year the product was sold but discounting the saving by a societal or utility discount rate. While the "staggered" approach allows program administrators to more accurately capture the timing of the realized savings, the "discounted savings" approach allows for the simplicity of claiming all costs and benefits during the program year and eliminates the need to keep track of and claim savings from future installations.

Opinion Dynamics used the discounted savings approach to claim savings from future installations.

To allocate installations over time, we relied on the installation trajectory from the lighting storage log study conducted by Navigant Consulting as part of the PY2013 DEP EEL program evaluation. The study estimates that participants install 97% of bulbs within 4 years of purchase. Table 5-11 presents the approach to developing installation rates over the 4 years following purchase, based on the study.

Table 5-11. Installation Rate Trajectory Formulas

Year	Installation Rate Trajectory	Incremental Installation Trajectory
Year 1	First-Year ISR	First-Year ISR
Year 2	((1 – First-Year ISR) * 41%) + First-Year ISR	(1 – First-Year ISR) * 41%
Year 3	((1 – First-Year ISR) * 69%) + First-Year ISR	(1 – First-Year ISR) * 28%
Year 4	97%	97% – ((1 – First-Year ISR) * 69%) + First-Year ISR

Source: Uniform Methods Project (UMP) Lighting Evaluation Protocols.

To claim savings from future installations of PY2015 sales, we discounted all future savings by the utility-specified discount rate using the net present value (NPV) formula (Equation 5-3). Program staff provided discount rates for each utility.

Equation 5-3. Net Present Value Formula

$$NPV = \frac{R_t}{(1+i)^t}$$

Where:

R = savings

t = number of years in the future savings take place

i = discount rate

Table 5-12 provides NPV-adjusted ISRs by program, sector, and bulb type.

Table 5-12. Final NPV-Adjusted In-Service Rates

	DEP			DEC		
Year	**LEDs**	**CFLs**	**Fixtures**	**LEDs**	**CFLs**	**Fixtures**
Residential	95.8%	95.2%	100.0%	95.9%	N/A	100.0%
Commercial	97.9%	96.1%	100.0%	97.9%	N/A	100.0%

Source: Opinion Dynamics analysis.

Interactive Effects

CFLs and LEDs emit less heat than incandescents, resulting in increased heating loads as more energy is needed to supplement heat emitted by incandescent light bulbs. Efficient bulbs also decrease cooling loads as less energy is needed to compensate for heat given off by incandescents. Application of interactive effects accounts for the changes in heating and cooling loads in the estimation of savings.

Consistent with the most recent evaluation, we used residential HVAC system interaction factors of 0.94 for energy savings, 1.27 for summer peak demand savings, and 0.50 for winter peak demand savings. These interactive effects estimates are based on the simulation analysis performed as part of the 2012 DEP EEL program evaluation by Navigant. Our review of the estimates determined that these factors were reasonable, relatively recent, and based on Carolinas-specific research.

Due to differences in technologies, interactive effects caused by CFLs and LEDs are likely different. The difference in these effects is unclear, especially as it pertains to the DEP and DEC jurisdictions. We are unaware of any existing modeling or simulation efforts to estimate LED-specific interactive effects. In our professional judgment, the difference between CFL and LED interactive effects is likely to have only a marginal impact on energy and peak demand savings. Given the small anticipated change in energy and peak demand savings estimates due to LED-specific interactive effects and the relatively high cost of conducting the modeling and simulation needed to estimate those interactive effects, Opinion Dynamics used previously established interactive effect estimates for CFLs from the study cited above.

For both DEP EEL and DEC Retail LED programs, we set commercial interactive effects to 1.0. In the absence of a reliable interactive effects estimate and a projected small impact of the lighting products on heat loss or gain given the nature of commercial-scale HVAC systems in place in commercial settings; not applying interactive effects is both reasonable and appropriate.

5.2 Gross Impact Results

This section presents the results of the gross impact analysis for the DEP EEL and DEC Retail LED programs.

5.2.1 Review of Program Tracking Data and Ex Ante Savings

As a first step in the gross impact analysis, the evaluation team analyzed the program sales data for any gaps, inconsistencies, and inaccuracies. We found that data fields were generally clean and fully populated, with very minor exceptions, and we did not identify any observable gaps between invoice dates and found the data to be complete and reasonable. Opinion Dynamics identified and corrected slight inconsistencies in bulb categorizations, bulb wattage, and lumen assignments. None of those inconsistencies was considerable nor resulted in a significant difference in savings.

As mentioned in the earlier section of this report, Duke Energy changed its approach to estimating ex ante savings during the current evaluation period. Duke Energy relied on per-bulb savings by product category, using categories defined by bulb technology, shape, and application (e.g., general purpose CFLs, outdoor reflector LEDs, 3-way LEDs), and applying a single set of values across all products within a category based on evaluation-recommended savings from the PY2015 DEP EEL program evaluation. We compared these ex ante per-bulb savings values to those provided by PY2015 DEP EEL program evaluation and found that all values matched perfectly. Table 5-13 provides the ex ante per-bulb savings values associated with each product category that program staff used to generate ex ante savings for both the DEP EEL and DEC Retail LED programs.

Table 5-13. Applied Ex Ante Per-Bulb Savings

Product Category	Residential Per-Bulb Savings			Commercial Per-Bulb Savings		
	Energy (kWh)	**Summer Peak (kW)**	**Winter Peak (kW)**	**Energy (kWh)**	**Summer Peak (kW)**	**Winter Peak (kW)**
Reflector track lighting LED	28.88	4.16	1.38	62.94	16.31	3.58
Reflector recessed LED	37.95	5.47	1.82	82.70	21.43	4.70
Reflector outdoor LED	50.88	7.33	2.44	110.87	28.73	6.30
Globe LED	22.32	3.22	1.07	48.64	12.61	2.77
General purpose LED	32.50	4.69	1.56	70.83	18.35	4.03
Fixture LED	29.26	4.22	1.40	61.61	15.97	3.50
Candelabra LED	25.86	3.73	1.24	56.35	14.60	3.20
3-way LED	71.77	10.35	3.44	156.40	40.53	8.89
Reflector recessed CFL	32.89	4.74	1.57	83.83	16.47	5.77
Globe CFL	29.25	4.22	1.40	74.54	14.65	5.13
General purpose CFL	34.45	4.97	1.65	87.81	17.25	6.04
Fixture CFL	52.88	7.62	2.53	133.43	26.22	9.18
Candelabra CFL	30.33	4.37	1.45	77.31	15.19	5.32

Source: Opinion Dynamics analysis of program tracking data.

5.2.2 DEP EEL Program Ex Post Gross Savings

Review of product category fields in the program tracking data extract revealed inconsistent bulb categorization for six unique products (identified by unique model number), which resulted in miscategorization of a small number of total bulb sales (0.1%). As such, total ex ante energy savings would have been very slightly higher (<0.1%) if the program had used the corrected product categories. One unique product was also recorded with inconsistent pack sizes. Correcting the discrepant pack size increased total bulb sales by 0.2% and would have increased ex ante savings by the same percentage.

Following program tracking data review, we calculated ex post gross energy and peak demand savings achieved by the DEP EEL program during PY2016–2017.

The program achieved 125,002 MWh in ex post gross energy savings, 22.0 MW in ex post gross summer peak demand savings, and 8.1 MW in ex post gross winter peak demand savings. The respective gross realization rates are 89% for energy savings, 95% for summer peak demand savings, and 113% for winter peak demand savings.Table 5-14 presents the results of the analysis.

Table 5-14. DEP EEL Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	109,576,023	97,829,373	89%
	Commercial savings	30,639,454	27,172,524	89%
	Total	140,215,477	125,001,897	89%
Summer peak demand savings (kW)	Residential savings	15,796	15,503	98%
	Commercial savings	7,215	6,458	90%
	Total	23,011	21,962	95%
Winter peak demand savings (kW)	Residential savings	5,246	6,412	122%
	Commercial savings	1,880	1,654	88%
	Total	7,126	8,066	113%

Source: Opinion Dynamics analysis of program tracking data.

5.2.3 DEC Retail LED Program Ex Post Gross Savings

Review of product category fields revealed inconsistent bulb categorization for 13 unique products (identified by unique model number), which resulted in miscategorization of a small number of total bulb sales (1.6%). As such, total ex ante energy savings would have been slightly higher (0.5%) if the program had used the corrected product categories.

Following program tracking data review, we calculated ex post gross energy and peak demand savings achieved by the DEC Retail LED program during PY2016–2017.

The program achieved 57,847 MWh in ex post gross energy savings, 10.7 MW in ex post gross summer peak demand savings, and 4.0 MW in ex post gross in winter peak demand savings. The respective gross realization rates are 110% for energy savings, 121% for summer peak demand savings, and 155% for winter peak demand savings. Table 5-15 presents the results of the analysis.

Table 5-15. DEC Retail LED Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	41,630,988	45,761,993	110%
	Commercial savings	10,971,300	12,084,862	110%
	Total	52,602,288	57,846,855	110%
Summer peak demand savings (kW)	Residential savings	6,002	7,543	126%
	Commercial savings	2,843	3,132	110%
	Total	8,845	10,676	121%
Winter peak demand savings (kW)	Residential savings	1,993	3,359	169%
	Commercial savings	624	686	110%
	Total	2,617	4,045	155%

Source: Opinion Dynamics analysis of program tracking data.

5.3 References

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6. Net-to-Gross Analysis

This section describes our approach for estimating the NTGR for each program and presents the resulting NTGRs and program net impacts.

6.1 Methodology

The NTGR represents the portion of the gross energy savings associated with a program-supported measure or behavior change that would not have been realized in the absence of the program. In other words, the NTGR represents the share of gross savings that are attributable to the program. The NTGR consists of free-ridership (FR) and spillover (SO) and is calculated as $(1 - FR + SO)$. FR is the proportion of the program-achieved verified gross savings that would have been realized absent the program. SO is additional energy-saving actions that are influenced by program interventions but did not receive program support. Sales data modeling only produces an estimate of FR.

The assessment of NTGR for upstream residential lighting programs is especially challenging for the following reasons:

- Because customers purchase discounted bulbs in a retail setting where they do not need to provide contact information, there is no list of participants with whom we can conduct a follow-up self-report NTGR survey (i.e., customers who purchased discounted bulbs through the program). Because light bulbs are a low-cost commodity product, most customers do not put extensive thought into or have reliable recall of their purchase decision. Customers may not even be aware that they purchased discounted bulbs. Therefore, we cannot conduct a general population survey in which we ask customers about their past light bulb purchases and the influence of program discounts on those purchases.
- Although we have detailed data regarding sales for the bulbs associated with the program, we lack any information about sales of other bulbs sold at the same retailers (including less-efficient and non-discounted products). Thus, while we can successfully model the relationship between bulb price and sales for the products associated with the program, we cannot take into consideration how other factors (e.g., discounts of non-program bulbs) may have affected our results.
- Program interventions may affect manufacturer distribution and retailer stocking practices, resulting in shelf space changes. Those changes are not visible to participants and therefore call for research with a range of market actors and, ultimately, triangulation of NTGR estimates from multiple sources.

To understand customers' counterfactual behaviors and to develop the most accurate possible estimates of the programs' NTGRs, Opinion Dynamics relied on two distinct methods:

- Sales data modeling
- Retailer and manufacturer interviews

Our assessment of NTGRs for the two programs was identical in approach. Below we discussed the methodology associated with each NTGR approach.

6.1.1 Sales Data Modeling

The sales data modeling approach to estimating NTGRs is based on the simple economic principle that a change in price causes a change in product sales. This assumption is the foundation of upstream program theory, so measuring the effect of program discounts on bulb sales serves as a good indicator of a program's net impact. The sales data modeling method models this relationship between product price and sales volume using the program sales data. The model produces price elasticity curves, allowing for predictions of sales at various prices, namely, program-discounted and non-discounted price levels.

For the modeling effort to succeed, there must be sufficient price variation for identical products during the evaluation period. The program implementer supported this analysis by facilitating price variation via changes in program discounts throughout the year across the two programs. As the first step in our analysis, we reviewed the data to confirm sufficient variation in product pricing. Our analysis confirmed sufficient price variation to support data modeling. In fact, price variation achieved in PY2016–2017 for the DEP EEL program exceeded that observed in the previous program years, namely, PY2014 and PY2015.

The program tracking data for both programs contained transaction-level sales summaries. Depending on the retailer and manufacturer, transaction periods ranged from 1 week to 1 month, though the majority were weekly. To ensure time series consistency and to maximize the potential for capturing the effect of in-store events on bulb sales, we normalized transaction periods to a weekly level. In instances where transactions were available only at the monthly level, the sales were split evenly across weeks of the month.

To reach our final price elasticity estimates, we fit a series of theoretically driven models predicting sales volume from product price. These models all fell into two categories: (1) models that included bulb characteristics (e.g., lumens) and interactions between bulb characteristics and (2) models that included unique product identifiers. For each model, we examined several diagnostics to assess the model's performance in terms of efficiency, omitted variables, and heteroscedasticity of residuals.[14] We also considered model fit indices, favoring models with larger R-squared values[15] and lower Akaike's Information Criterion (AIC) values[16] relative to other models based on comparable bulb quantities or sales transactions.

The simplest model, which used only unique product identifiers (inherently representative of all bulb characteristics), emerged as the best performing for both the DEP EEL and DEC Retail LED programs. Although the methodology and model design were the same for both programs, we present separate results for each.

Equation 6-1 contains the final sales data model specification. As is common in this type of analysis, we used the log of both price and sales quantity, which greatly improves the distributions of those variables, and allows for the interpretation of the price coefficient as the percent increase in sales given a one percent decrease in price, simplifying the process of analyzing price elasticity and NTGR.

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[14] Heteroscedasticity is a statistical term that describes errors in prediction that vary in size across different values of a predictor. One of the assumptions of the OLS regression is that the errors are homoscedastic (that the variance around the regression line is the same for all values of a predictor variable), so when they are heteroscedastic, an assumption of the method is violated.

[15] R-squared value is a summary statistic for many regression techniques. It shows the proportion of the total variance in the outcome variable that is correctly predicted by the model's predictor variables.

[16] AIC is a summary statistic that is based on how well the outcome variable is predicted given the number of predictor variables in the regression model. The AIC value has no inherent meaning except in comparison to the values on the same statistic produced by alternative models under consideration. Modelers seek to minimize the AIC value, along with other ways of judging the models.

Equation 6-1. Final Sales Data Model Specification

$$ln(Q_m) = \alpha + \beta_1 ln(P_m) + \sum_{\mu} (\beta_\mu model\ dummy_m)$$

Where:

m = model

ln = natural log

Q = quantity of bulbs sold

P = price per bulb[17]

model dummy = a vector of dummy variables equaling 1 for each unique model number, and 0 for all others

β_1 = coefficient representing average price elasticity

β_μ = a vector of coefficients representing each unique model number (*m*)

α = constant

Using the modeled results, the evaluation team estimated sales at non-discounted prices using Equation 6-2. We used MSRP data supplied as part of the program sales data extract for estimates of non-discounted prices.

Equation 6-2. Estimating Sales at Non-Discounted Prices

$$\widehat{Sales}_{wo} = Sales_w * \left(\frac{Price_{wo}}{Price_w}\right)^{PC}$$

Where:

$\widehat{Sales}_{wo}$ = Estimated sales without discount (MSRP)

$Sales_w$ = Sales with discount (actual sales)

$Price_{wo}$ = Price without discount (MSRP)

$Price_w$ = Price with discount (actual price)

PC = Price coefficient

We excluded bulbs sold through the Dollar/Discount retailer channel from the sales data modeling based on feedback from retailer and manufacturer staff due to lack of price variation. We developed NTGRs by comparing the predicted sales at non-discounted prices to the actual sales at program-discounted prices using Equation 6-3 below.

Equation 6-3. Sales Data Modeling NTGR Estimation Formula

$$NTGR = \frac{\widehat{Sales}_{wo} - Sales_w}{Sales_w} = \frac{NetSales}{DiscountedSales}$$

17 We received two discounted prices in the data set, one that reflects program discounts and one that reflects other retailer or manufacturer discounts. We included the other retailer or manufacturer discounts in all projections.

Where:

$NTGR$ = NTGR (excluding any SO)

$\widehat{Sales}_{wo}$= Estimated sales without discount (MSRP)

$Sales_w$= Sales with discount

6.1.2 Retailer and Manufacturer Interviews

Opinion Dynamics completed a total of 33 interviews across a range of participating manufacturers and retailers in DEP and DEC jurisdictions to support the NTGR assessment. Of the 33 interviews, 21 informed the NTGR assessment for the DEP EEL program and 21 for the DEC Retail LED program. The interviews yielded feedback from retailers and manufacturers that accounted for 83% of DEP EEL program sales and 90% of DEC Retail LED program sales. We asked each interviewee to estimate the percentage by which the sales of efficient bulbs would be different in the absence of the program for each bulb category (i.e., standard and specialty; CFLs and LEDs). Respondents who said that sales of energy-efficient products would have decreased received a follow-up question asking to estimate the percent that would have shifted to other energy-efficient products (e.g., a percentage of LEDs that would have been CFLs or percent of ENERGY STAR LEDs that would have been non-ENERGY STAR LEDs), to account for the efficient product substitution effect. The percentage of energy-efficient bulb sales expected to move to non-energy-efficient products in the program's absence represents the NTGR for the respondent.

To the degree possible, we asked the NTGR questions for each major program-discounted product type, namely, standard and specialty LEDs, standard and specialty CFLs (only for DEP EEL program), and fixtures. As part of the interview guide, we embedded a range of validation questions to check responses for consistency. We asked respondents to provide their rationale for the reported percent change in sales in the absence of the program. Other questions included exploratory questions asking retailers to rank the importance of the program rebates as compared to the other factors, such as EISA, the need to stay ahead of the competition in terms of technological advancements, and manufacturing practices.

As part of the NTGR analysis, we estimated a NTGR for each respondent we interviewed, which we aggregated to the retail chain level and sales-weighted to the program level. As part of the analysis and aggregation process, a single manufacturer could contribute to the NTGRs across several retail channels, as long as that manufacturer was supplying its product to those retail channels.

6.2 NTGR Results

This section contains NTGR results for each program.

6.2.1 DEP EEL Program NTGR Results

Below we first present the NTGR results from sales data modeling and retailer and manufacturer interviews separately, then provide an overview of the triangulation approach, and finally present the final program-level NTGR for the DEP EEL program.

Sales Data Modeling

Using the results from the sales data model, Opinion Dynamics estimated total sales at program-discounted and non-discounted prices separately for CFLs and LEDs. For LEDs, price variation within product categories was sufficient to model outputs separately for each product category (standard LEDs, specialty LEDs, reflector LEDs, and LED fixtures). Because 95% of program-discounted CFLs were standard bulbs, this breakout was not possible or practical for CFLs. We averaged product-level NTGRs to an overall sales data modeling-based NTGR, weighting the contribution of each estimate in proportion to product sales in the program. Because sales records across the entire evaluation period were used and there was no sampling needed, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

According to the results of the sales data modeling, customers would have purchased slightly fewer LEDs and considerably fewer CFLs in the absence of program discounts. We found that 90% of all LED program sales would have occurred regardless of the program discounts, and slightly more than half of program CFL sales (54%) would have occurred in the absence of the program discounts. In other words, the NTGR is 0.10 for LEDs and 0.46 for CFLs. When weighted by program sales, this reflects a program-wide NTGR of 0.20. Within LEDs, fixtures and standard bulbs showed the lowest price elasticity and therefore NTGRs (0.03 and 0.06, respectively), while reflector and specialty bulbs were more price-elastic, resulting in higher NTGRs (0.14 and 0.20, respectively). Table 6-1 summarizes NTGR results from sales data modeling. Note that the 0.20 NTGR established through the sales data modeling methods excludes the Dollar/Discount retailer channel.

Table 6-1. DEP EEL Program NTGRs from Sales Data Modeling

Bulb Type	NTGR	% of Total Sales
All LEDs	0.10	67%
LED standard	*0.06*	*40%*
LED specialty	*0.20*	*8%*
LED reflector	*0.14*	*14%*
LED fixture	*0.03*	*5%*
All CFLs	0.46	33%
Total	0.20	100%

Source: Opinion Dynamics sales data modeling analysis.

We used the modeling results to estimate price elasticities for both CFLs and LEDs. The elasticity curves show minimal to moderate sensitivity to changes in price. CFLs exhibited greater sensitivity to price changes than LEDs. As can be seen in Figure 6-1, LED price elasticity is only 0.09 and CFL elasticity is 0.37. A price elasticity of 0.09 for LEDs means that for every 100% increase in price, there is a 9% decrease in sales. Similarly, a price elasticity of 0.37 for CFLs means that for every 100% increase in price there is a 37% decrease in sales.

Figure 6-1. Modeled Price Elasticity Based on DEP EEL Program Sales Data

Source: Opinion Dynamics sales data modeling analysis.

The higher NTGR for CFLs than LEDs likely reflects consumer preferences shifting away from CFLs as superior-quality LEDs continue to drop in price and grow in popularity. It requires a greater discount for customers to purchase CFLs because of their preference for LEDs.

Retailer and Manufacturer Interviews

Using the results from the retailer and manufacturer interviews, we estimated NTGRs by retailer channel. Dollar and Discount stores received the highest NTGR of 1.00, while NTGRs for other retail channels range from 0.32 for DIY and grocery stores to 0.38 for Big Box stores. The NTGR of 1.00 for the Dollar/Discount channel reflects feedback from corporate retailer and manufacturer contacts that availability of energy-efficient lighting products at these stores is solely dependent on the DEP EEL program. In the program's absence, energy-efficient lighting products would not be stocked at these locations. Customers who shop at these stores, in turn, are likely to be highly price sensitive and, in the absence of the energy-efficient products offered through the program, would have defaulted to the lowest-cost alternative present on the market, which is currently a halogen bulb. Table 6-2 provides NTGRs for each retail channel included in the DEP EEL program.

Table 6-2. DEP EEL Program NTGRs from Retailer and Manufacturer Interviews

Retailer Channel	NTGR	% of Program Sales
DIY	0.32	30%
Club	0.33	19%
Dollar/Discount	1.00	18%
Big Box	0.38	17%
Hardware	0.37	15%
Grocery	0.32	<1%
Other	0.34	<1%
Total	0.46	100%

Source: Retailer and manufacturer interviews.

Final NTGR Estimation

Opinion Dynamics combined the NTGRs derived through the two methods described above using the following triangulation approach to arrive at a final program-wide NTGR, summarized in Table 6-3:

- Given the complete dependence of lighting product availability on program operations within the Discount/Dollar retailer channel and the likely price sensitivity of the customers shopping at those stores, we assigned a NTGR of 1.00 to all sales made through this retail channel.
- We based the NTGRs for all other retail channels on an average of the bulb-weighted average derived from each of the two approaches. By averaging the NTGR of 0.20 from the sales data modeling analysis and 0.34 from retailer and manufacturer interviews,[18] we arrive at a NTGR of 0.27 for bulbs sold through all retail channels except Dollar and Discount stores.
- The bulb-weighted average of the Dollar/Discount NTGR estimate of 1.00 and the NTGR estimate for all other retail channels of 0.27 produces the final program-wide NTGR of 0.40.

Table 6-3. Final DEP EEL Program-Wide NTGR Triangulation

Retail Channel	NTGR Source	NTGR	% of Program Sales
Dollar/Discount	Retailer/manufacturer interviews	1.00	18%
All other channels	Combined	0.27	82%
	Sales data modeling*	*0.20*	
	Retailer/manufacturer interviews*	*0.34*	
Overall		0.40	100%

Source: Opinion Dynamics analysis.
* Excludes the Dollar/Discount channel.

6.2.2 DEC Retail LED Program NTGR Results

Below we first present the NTGR results from sales data modeling and retailer and manufacturer interviews separately, then provide an overview of the triangulation approach, and finally present the final program-level NTGR for the DEC Retail LED program.

Sales Data Modeling

Using the results from the sales data model, Opinion Dynamics estimated total sales at program-discounted and non-discounted prices separately for each LED product category (standard LEDs, specialty LEDs, reflector LEDs, and LED fixtures). To arrive at the program-wide NTGR, we weighted the bulb category-specific NTGR estimates by program sales. Because sales records across the entire evaluation period were used and there was no sampling needed, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

According to the results of the sales data modeling, customers would have purchased fewer LEDs in the absence of program discounts. We found that 73% of all LED program sales would have occurred regardless of the program discounts, i.e., a NTGR of 0.27. The NTGR is the highest for specialty LEDs (0.39) and lowest for standard LEDs and LED fixtures (0.21 and 0.16, respectively). Table 6-4 summarizes NTGR results from

[18] This NTGR excludes the Dollar/Discount retailer channel.

sales data modeling. Note that the 0.27 NTGR established through the sales data modeling methods excludes the Dollar/Discount retailer channel.

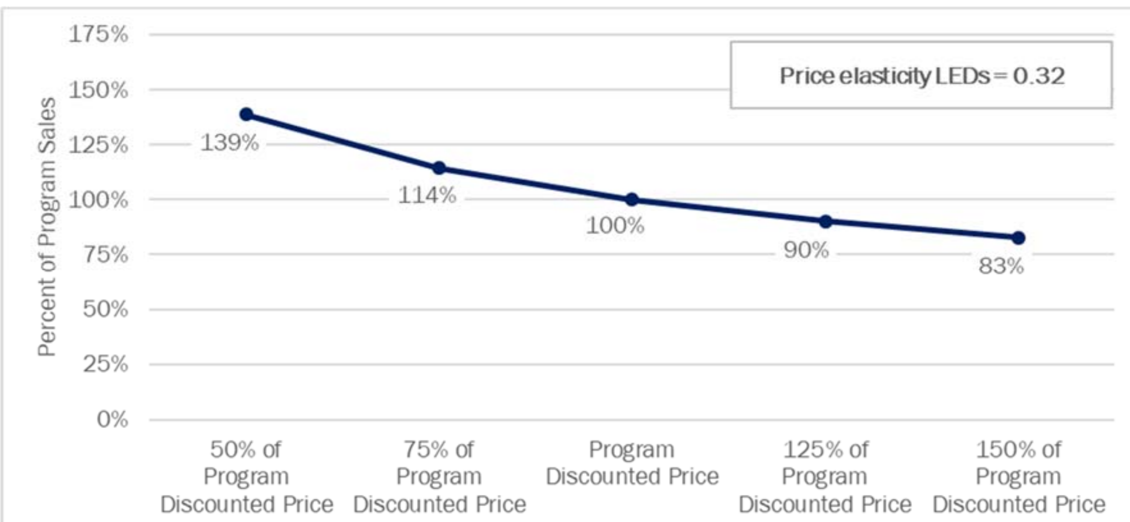
Table 6-4. DEC Retail LED Program NTGRs from Sales Data Modeling

Bulb Type	NTGR	% of Total Sales
LED standard	0.25	22%
LED specialty	0.39	21%
LED reflector	0.24	40%
LED fixture	0.23	16%
Total	0.27	100%

Source: Opinion Dynamics sales data modeling analysis.

We used the modeling results to estimate price elasticity for program bulbs. The elasticity curve shows moderate sensitivity to changes in price. As shown in Figure 6-2, LED price elasticity is 0.32, meaning that for every 100% increase in price, there is a 32% decrease in sales.

Figure 6-2. Modeled Price Elasticity Based on DEC Retail LED Program Sales Data



Source: Opinion Dynamics sales data modeling analysis.

Retailer and Manufacturer Interviews

Using the results from the retailer and manufacturer interviews, we estimated NTGRs by retail channel. The Dollar/Discount channel received a NTGR of 1.00, reflecting the feedback from corporate retailer and manufacturer contacts who said that availability of energy-efficient lighting products at these participating stores is solely dependent on the DEC Retail LED program. In the program's absence, energy-efficient lighting products would not be stocked at these locations. Customers who shop at these stores, in turn, are likely to be highly price sensitive and, in the absence of the energy-efficient products offered through the program, would have defaulted to the lowest-cost alternative present on the market, which is a halogen bulb. NTGRs for other retailer channels range from the low of 0.33 for Club stores to 0.51 for DIY stores. Table 6-2 provides NTGRs for each retail channel included in the DEC Retail LED program. As can be seen in the table, the overall NTGR for the program is 0.47.

Table 6-5. DEC Retail LED Program NTGRs from Retailer and Manufacturer Interviews

Retailer Channel	NTGR	% of Program Sales
Club	0.33	47%
DIY	0.51	36%
Dollar/Discount	1.00	10%
Big Box	0.46	7%
Total	0.47	100%

Source: Retailer and manufacturer interviews.

Final NTGR Estimation

Opinion Dynamics combined the NTGRs derived through the two methods described above using the following triangulation approach to arrive at a final program-wide NTGR, summarized in Table 6-6:

- Given the complete dependence of lighting product availability on program operations within the Discount/Dollar retail channel and the likely price sensitivity of the customers shopping at those stores, we assigned a NTGR of 1.00 to all sales made through this retail channel.
- We based the NTGRs for all other retail channels on an average of the bulb-weighted average derived from each of the two approaches. By averaging the NTGR of 0.27 from the sales data modeling analysis and 0.42 from retailer and manufacturer interviews,[19] we arrive at a NTGR of 0.34 for bulbs sold through all retail channels except Dollar and Discount stores.
- The bulb-weighted average of the Dollar/Discount NTGR estimate of 1.00 and the NTGR estimate for all other retail channels of 0.34 produces the final program-wide NTGR of 0.41.

Table 6-6. Final DEC Retail LED Program-Wide NTGR Triangulation

Retail Channel	NTGR Source	NTGR	% of Program Sales
Dollar/Discount	Retailer/manufacturer interviews	1.00	10%
All other channels	Combined	0.34	90%
	*Sales data modeling**	*0.27*	
	*Retailer/manufacturer interviews**	*0.42*	
Overall		0.41	100%

Source: Opinion Dynamics analysis.
* Excludes the Dollar/Discount channel.

[19] This NTGR excludes the Dollar/Discount retailer channel.

6.3 Net Impact Results

The sections below provide net impact results for each program.

6.3.1 DEP EEL Program

We applied the program-level NTGR to ex post gross energy and peak demand savings to arrive at ex post net savings (Table 6-8). Program net energy savings for the DEP EEL program in PY2016–2017 were 50,001 MWh, net summer peak demand savings were 8.8 MW, and net winter peak demand savings were 3.2 MW.

Table 6-7. DEP EEL Program Ex Post Net Savings Summary

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	140,215	125,002	0.40	50,001	89%
Summer peak demand savings (MW)	23.0	22.0	0.40	8.8	95%
Winter peak demand savings (MW)	7.1	8.1	0.40	3.2	113%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

6.3.2 DEC Retail LED Program

We applied the program-level NTGR to ex post gross energy and peak demand savings to arrive at ex post net savings (Table 6-8). Program net energy savings in PY2016–2017 were 23,717 MWh, net summer peak demand savings were 4.4 MW, and net winter peak demand savings were 1.7 MW.

Table 6-8. DEC Retail LED Program Ex Post Net Savings Summary

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	52,602	57,847	0.41	23,717	110%
Summer peak demand savings (MW)	8.8	10.7	0.41	4.4	121%
Winter peak demand savings (MW)	2.6	4.0	0.41	1.7	155%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

7. Process Evaluation and Market Assessment

Opinion Dynamics relied on the following data collection and analytic activities to support evaluation of program processes and characterization of the lighting market in the DEP and DEC service territories.

- Program staff interviews
- Materials review
- Program tracking data analysis
- Retailer and manufacturer interviews
- Retailer shelf audits
- Residential lighting logger study

Section 4 provided a detailed overview of each data collection method, as well as targeted and achieved confidence and precision levels.

As part of the process evaluation specifically, Opinion Dynamics examined the following key program performance indicators:

- Retailer satisfaction with the programs
- Presence of program marketing in participating stores
- Retailer satisfaction with program marketing and training
- Knowledge of the programs and their benefits among sales staff at participating retailers

7.1 Researchable Questions

Process evaluation activities aimed at answering the following researchable questions for each program:

- How effective are the program implementation and data-tracking practices?
- How effective are the program marketing, outreach, and educational tactics?
- Are retailers and manufacturers satisfied with the programs?
- What are the strengths, weaknesses, and opportunities for program improvement?
- How have retailer stocking and sales practices changed?
- What lighting technologies do customers have in their homes?
- How does energy-efficient lighting penetration vary by customer type?
- How does lighting usage vary by customer type and room type?
- What are current and future trends in the lighting market, including retailer stocking practices and customer preferences and purchasing decisions?

7.2 Key Findings

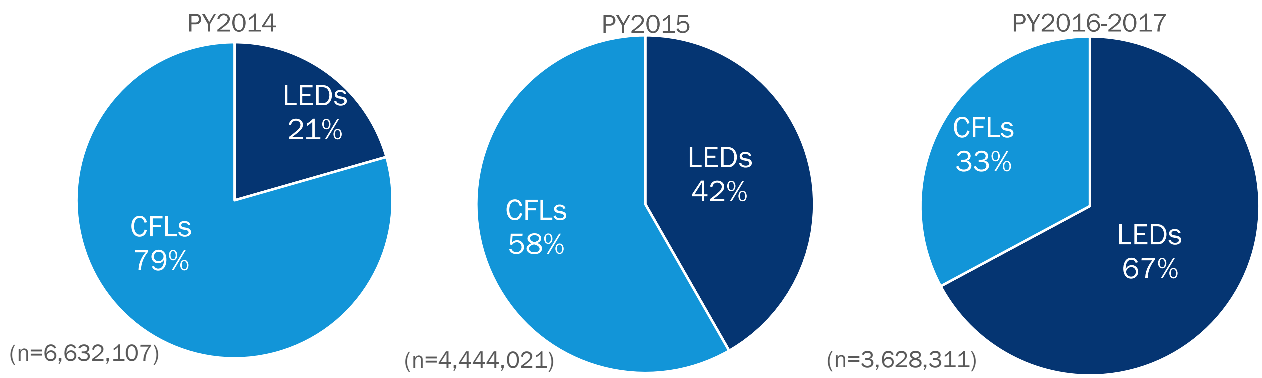
We present process findings results separately for the DEP EEL and DEC Retail LED programs. Sections below contain detailed key process and market findings.

7.2.1 DEP EEL Program

Program Participating Product Mix

The DEP EEL program sold 3,628,311 bulbs and fixtures in PY2016–2017, which included 2,436,436 LED bulbs and fixtures (67% of all sales) and 1,191,875 CFL bulbs and fixtures (33% of all sales). Overall program sales decreased by 18% compared to PY2015, when the program discounted 4,444,021 light bulbs and fixtures. Over time, the program has shifted its focus from CFLs to LEDs. In PY2016–2017, LED sales accounted for more than three times the portion of program sales that they did in PY2014 (67% compared to 21%), as shown in Figure 7-1.

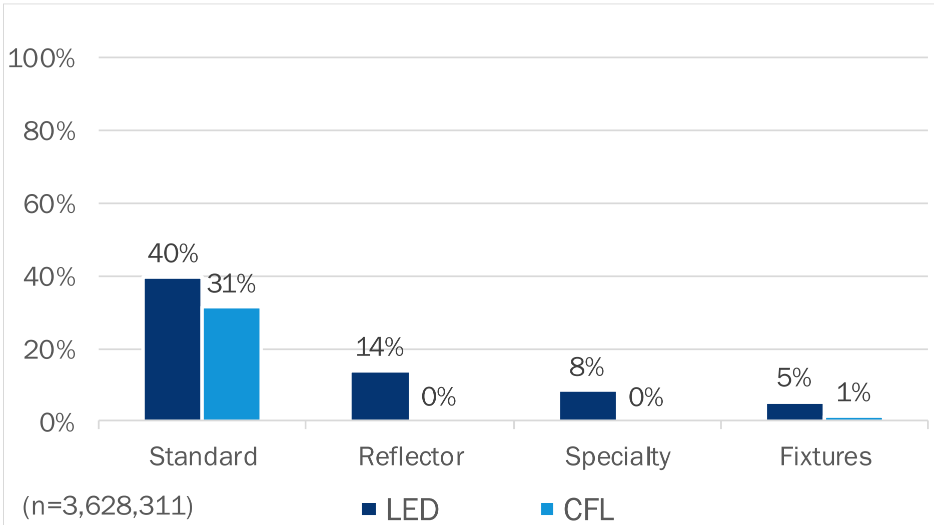
Figure 7-1. DEP EEL Program Changes in Bulb Technology Shares



Source: Opinion Dynamics analysis of program tracking data.

Standard products accounted for more than two-thirds of total bulb sales in PY2016–2017 (71%), followed by reflectors (14%) and specialty products (8%). Fixtures accounted for just 6% of all PY2016–2017 sales. CFLs were largely limited to the standard product category: 95% of PY2015–2016 CFL sales share were standard CFLs. LED products dominated specialty and reflector sales (Figure 7-2).

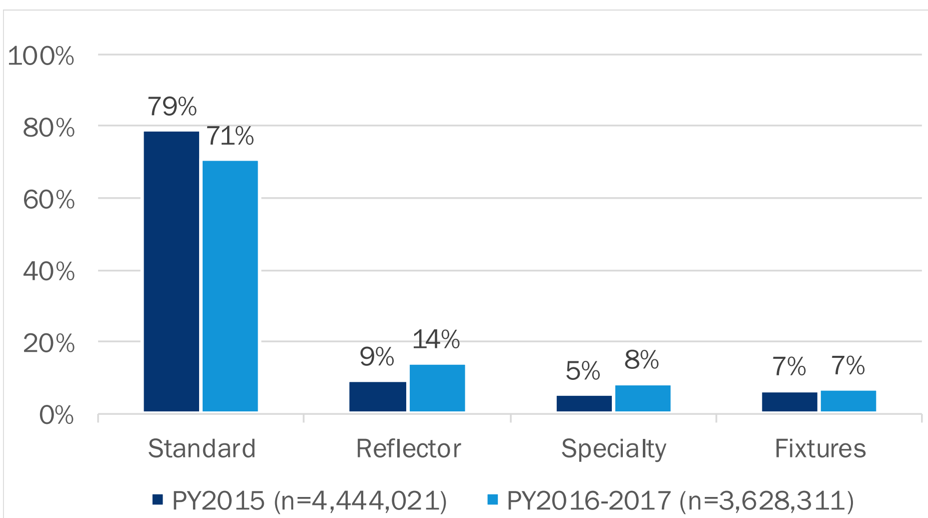
Figure 7-2. DEP EEL Program Technology Shares by Product Type



Source: Opinion Dynamics analysis of program tracking data.

Compared to PY2015, the share of specialty products increased slightly. As can be seen in Figure 7-3, program sales increased from 9% to 14% for reflector products and from 5% to 8% for specialty products and subsequently decreased from 79% to 71% for standard products.

Figure 7-3. DEP EEL Program Changes in Product Type Shares



Source: Opinion Dynamics analysis of program tracking data.

Over the course of PY2016–2017, the DEP EEL program discounted 744 unique products across a range of bulb types and wattages, which represents a 21% increase from PY2016, when the program managed 614 unique products. Such a large number of products can present implementation challenges in terms of managing the discounts and accurately tracking the sales data and calculating savings. Program staff effectively managed this large number of products, which is evidenced in clean and accurate program sales records (discussed in greater detail in Section 5.2 of this report) and high levels of retailer and manufacturer satisfaction described later in this section.

The DEP EEL program discounted a range of pack sizes over the course of PY2016–2017. Figure 7-4 provides a breakdown of program sales by pack size. As can be seen in the figure, standard CFLs were sold in larger packs, whereas LEDs of all types were sold predominantly in single packs. For standard CFLs, four-packs were most common, accounting for 62% of all packages sold. Conversely, 69% of LED packages were single packs. The reflector and specialty CFL product categories were dominated by two-packs, which comprised 59% of all packs sold in PY2016–2017. The number of large multipacks (six-pack and larger) decreased compared to PY2016, primarily due to a decrease in sales by club retailers, which tend to sell bulbs in large packages.

Figure 7-4. DEP EEL Program Sales by Package Type

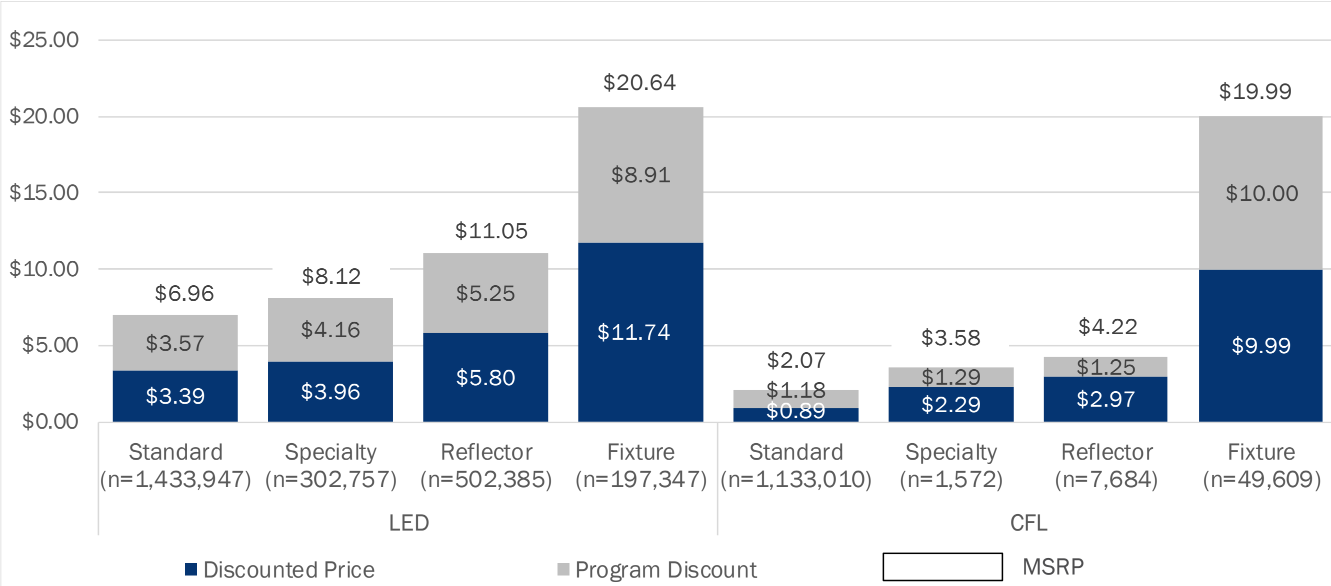
Distribution of Program Sales Across Pack Sizes by Technology

							Total
Standard CFLs (n=285,926)	14%	5%	2%	62%	8%	8%	100%
Standard LEDs (n=823,718)	69%	9%	2%	21%	0%	0%	100%
Reflector and Specialty CFLs (n=2,820)	0%	59%	12%	0%	29%	0%	100%
Reflector and Specialty LEDs (n=516,165)	69%	13%	12%	5%	1%	0%	100%

Source: Opinion Dynamics analysis of program tracking data.

Average program discounts ranged from $1.18 for standard CFLs to $10.00 for CFL fixtures. Depending on the product category, the average discount as a percentage of MSRP ranged from 30% for reflector CFLs to 57% for standard CFL products. The average program discount across all product categories was $3.48, which represents on average 50% of MSRP. Figure 7-5 provides a detailed overview of the program discounts by product type in PY2016–2017. As can be seen in the figure, discounts on LED products were higher than on CFL products as a result of the technology being generally more expensive. Average LED discounts ranged from $3.57 for standard LEDs to $8.91 for LED fixtures.

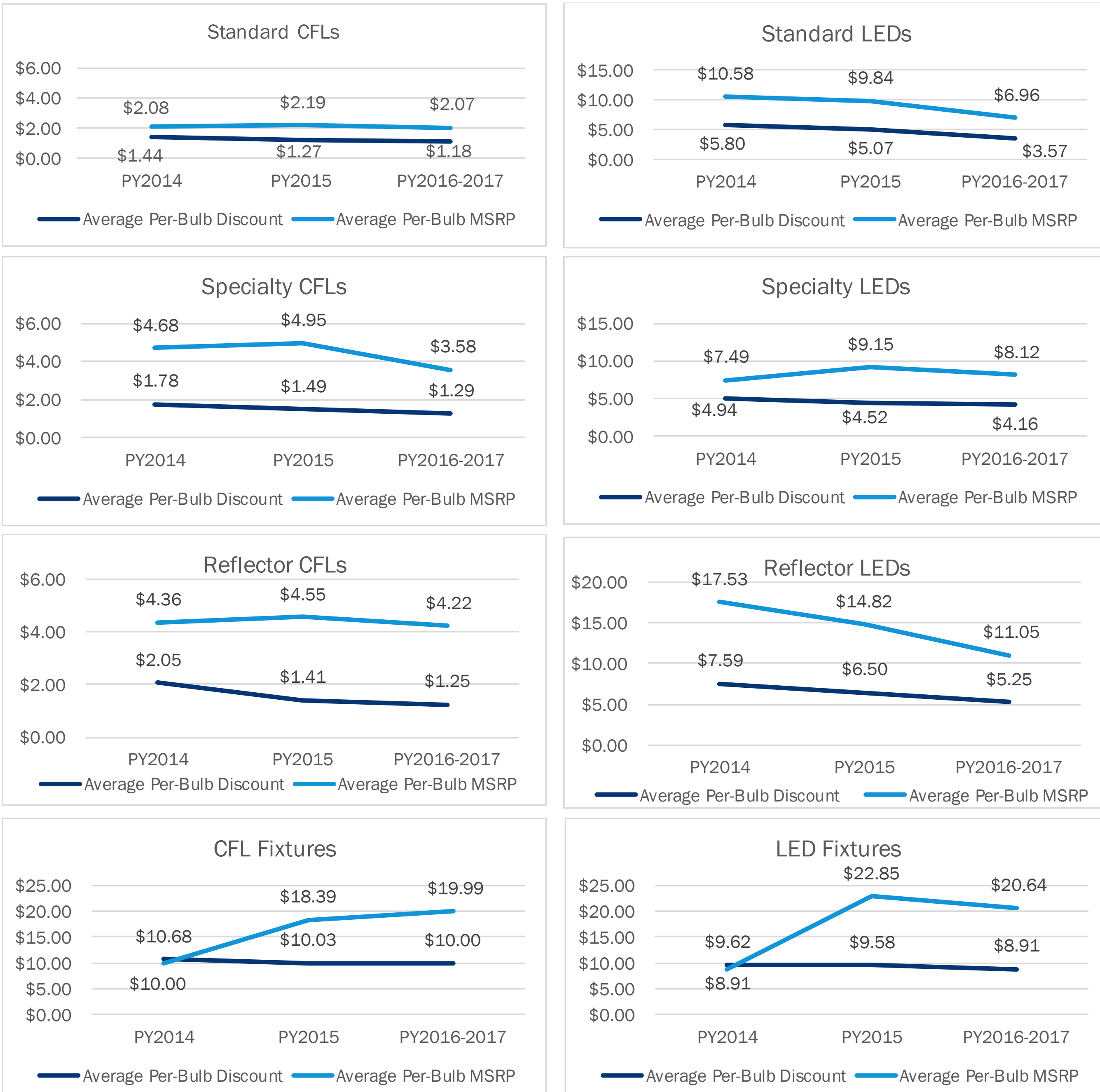
Figure 7-5. DEP EEL Program Pricing



Source: Opinion Dynamics analysis of program tracking data.

Compared to PY2014, MSRP for program-discounted products decreased across nearly all product categories. CFL fixtures is the only exception. Program discounts kept pace, indicating that program discounts were aligned with the changing retail pricing of the lighting products. Figure 7-6 shows changes in program-discounted prices and MSRP by product category over time. Program LED products decreased in price quite considerably over time, especially standard LEDs, where the MSRP dropped by 34% from $10.58 to $6.96, as well as reflector LEDs, where the MSRP dropped by 37% from $17.53 to $11.05.

Figure 7-6. DEP EEL Program Changes in Discounts and MSRP Over Time



Source: Opinion Dynamics analysis of program tracking data.

Program Retailer Mix

Similar to previous program years, the retailer mix in PY2016–2017 included a range of retailer channels. The program engaged 17 unique retailers across 289 storefronts in PY2016–2017. This represents a 7% increase from 269 storefronts in PY2015. Through the participating retailer mix, the program maintained good coverage of the DEP service territory, thus ensuring equitable customer access to program-discounted lighting products.

Table 7-1 shows a breakdown of participating storefronts and program sales across retailer channels, as well as changes in this breakdown over time. Club stores and DIY stores cumulatively captured nearly half of program sales (49%). Program sales decreased from 31% in PY2015 to 19% in PY2016–2017 for the Club retailer channel and doubled for the Hardware channel (from 7% to 15%). The program continued to discount a considerable share of sales (18%) through the Dollar/Discount channel. This focus on the Dollar/Discount channel and a shift to the Hardware channel illustrates the program's continued effort to target underserved customer segments, such as low-income customers.

Table 7-1. DEP EEL Program Changes in Participating Retailer Mix

	PY2015		PY2016–2017	
Retailer Channel	% of Storefronts (n=269)	% of Sales (n=4,444,021)	% of Storefronts (n=289)	% of Sales (n=3,628,311)
DIY	14%	26%	13%	30%
Club	4%	31%	4%	19%
Dollar/Discount	36%	18%	35%	18%
Big Box	21%	17%	14%	17%
Hardware	17%	7%	20%	15%
Grocery/Authentic	6%	<1%	11%	<1%
Other	1%	1%	1%	<1%
Total	100%	100%	100%	100%

Source: Opinion Dynamics analysis of program tracking data.

Program Marketing and Outreach

Over the course of PY2016–2017, the DEP EEL program relied on a range of marketing and outreach tactics:

- **In-store events and special promotions.** In conjunction with DEP marketing, Ecova performed a total of 246 in-store events and demonstrations in PY2016–2017 across 54 unique storefronts, with an average of 21 events per month. Ecova held the events at storefronts that were top-sellers for the program. The 54 unique storefronts where events were held accounted for a total of 48% of program sales in PY2016–2017. During these events, Ecova field staff promoted program products and discounts and educated customers about the benefits of energy-efficient lighting products.
- **Store visits and POP marketing material placement.** Over the course of the year, Ecova completed a total of 3,393 store visits, during which field staff checked for the presence and proper placement of program POP materials, updated materials as necessary, and checked for sufficient levels of inventory of program-discounted lighting products. The frequency of store visits varied by retailer based on sales volumes. This enabled team members to concentrate their visits on stores that had higher sales volumes and also tended to discount more products.

- **Community events.** Over the course of the program year, Ecova completed a total of 17 community events in which the program field representatives visited community centers to provide educational materials.
- **Direct mail, mass media, and other marketing.** Other sources of program marketing in PY2016–2017 included targeted bill inserts, direct mailers, email blasts, web promos, radio spots, and billboards.
- **POP marketing material presence.** Evaluators verified the presence of POP marketing materials as part of their visits to 12 participating retailers. POP marketing materials were present at all participating locations.

Program Implementation Processes and Program Satisfaction

Program implementation processes were smooth and consistent, resulting in high levels of retailer and manufacturer satisfaction. Program staff whom we interviewed as part of the evaluation did not identify any implementation issues or bottlenecks. The average satisfaction rating of participating manufacturers and retailers was 9.4 on a scale of 0 to 10, where 0 is “extremely dissatisfied” and 10 is “extremely satisfied.” The average satisfaction rating for the product mix included in the program was 8.9, and average satisfaction with the discount size was 9.4 on the same scale. In fact, corporate-level retailers and manufacturers praised the DEP EEL program for being above average compared to similar programs across the country in terms of both incentive amounts and product mix.

“They are a top utility program across the country.”

Corporate-level manufacturers were also highly satisfied with the program data-tracking and invoicing processes. The average satisfaction rating was 9.0. Several manufacturer contacts did point to challenges associated with formatting data for submission, but still expressed satisfaction with the support they received around these issues.

“The support we get from Ecova makes it much easier. They're great at communicating…as far as implementers, the best in the country.”

“We struggle with some upload issues, but we tend to get those resolved very quickly.”

"It might take an extra hour to format data to be able to upload, but it means that it’s accurate and easy to read and understand."

Most store-level retailer contacts expressed high levels of satisfaction with marketing materials and training provided by Ecova, but some suggested that sturdier or larger signage could be helpful, and they provided an average satisfaction ratings of 7.8 Those familiar with program representatives or demonstrations expressed praise for their effectiveness and professionalism.

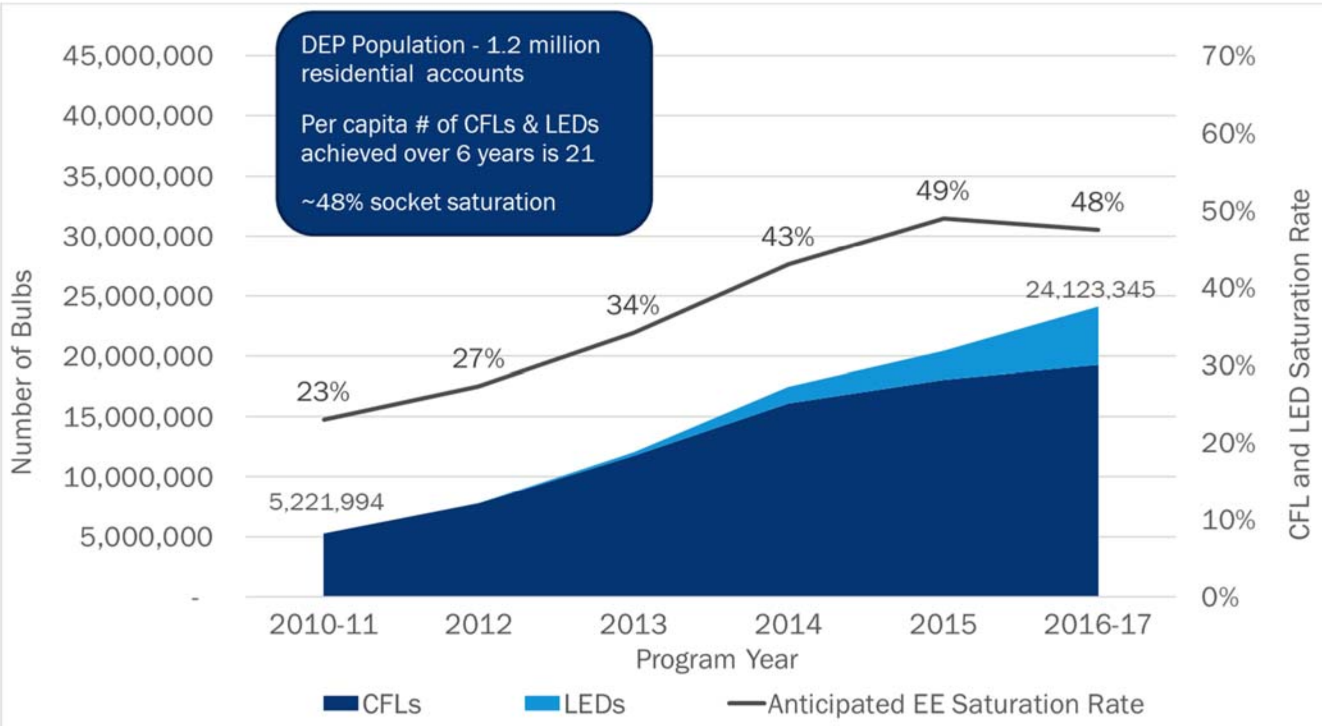
Program Impact in the DEP Service Territory and Market Trends

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[20] divide the adjusted number of program bulbs by the total number of

[20] Assuming a 5-year expected useful life (EUL) for a CFL.

residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use.

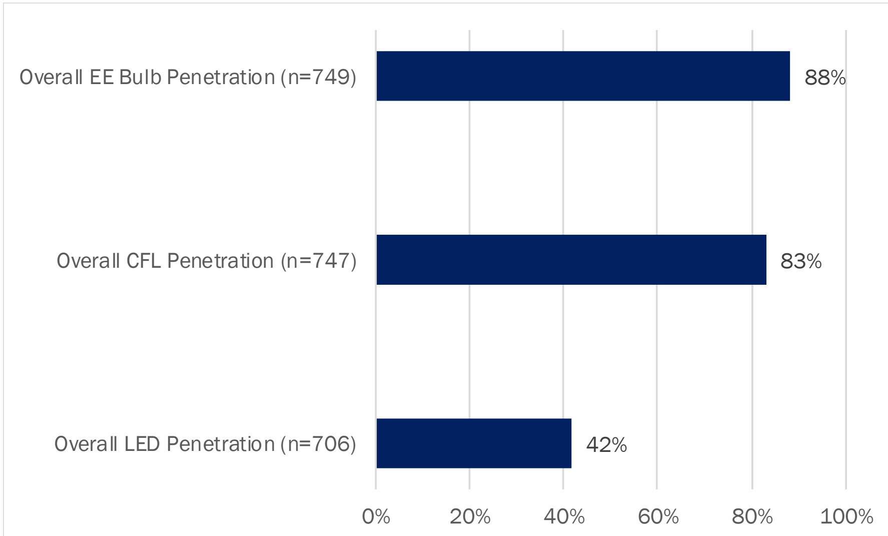
Figure 7-7. DEP EEL Program Impact on Efficient Bulb Saturation



Source: Opinion Dynamics analysis of program tracking data.
Note that 24,123,345 bulbs is not adjusted for CFL burnout, while the estimated saturation rate of 48% is adjusted for CFL burnout from the early program years.

Most customers in DEP jurisdiction have energy efficient products in their homes. As can be seen in Figure 7-8, nearly 9 in 10 customers reported having either CFLs or LEDs in their homes (88%), 83% reported having CFLs, and 42% reported having LEDs.

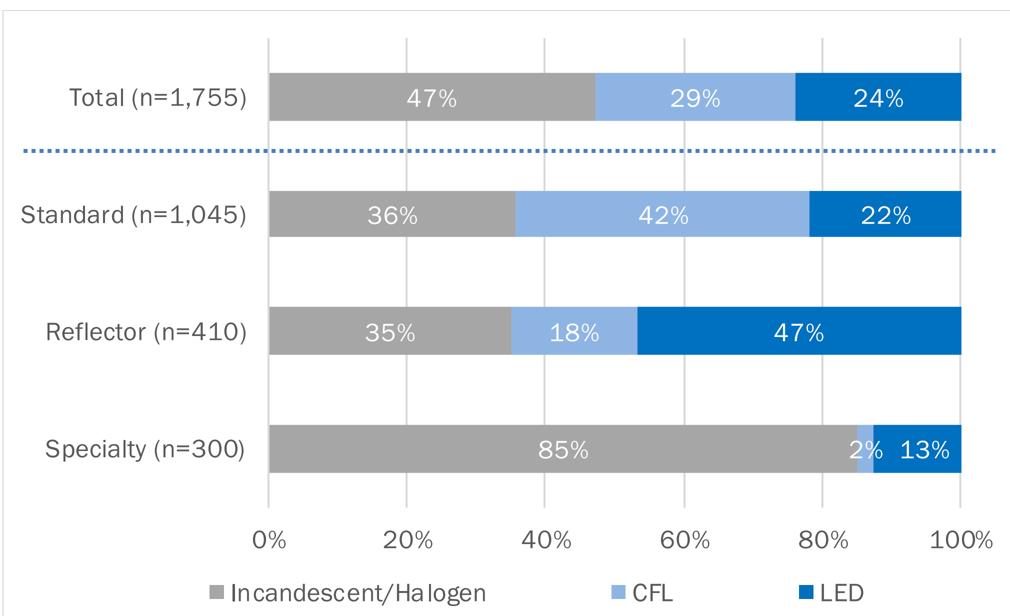
Figure 7-8. DEP EEL Program Energy-Efficient Product Penetration



Source: Opinion Dynamics analysis of site visit data.

As part of the lighting logger study, we collected detailed information on the lighting inventory in homes with LEDs. We found that even in homes with LEDs, a considerable number of sockets, especially specialty ones, contain less efficient bulbs. Figure 7-9 details the results. As can be seen in the figure, 24% of all sockets in homes with LEDs contain LEDs and 29% contain CFLs. LEDs are much more prominent among reflector products, accounting for 47% of all sockets, than in standard and specialty sockets, of which 22% and 13%, respectively, contain LEDs. Overall, 47% of all sockets and 83% of specialty sockets still have less-efficient light bulbs.

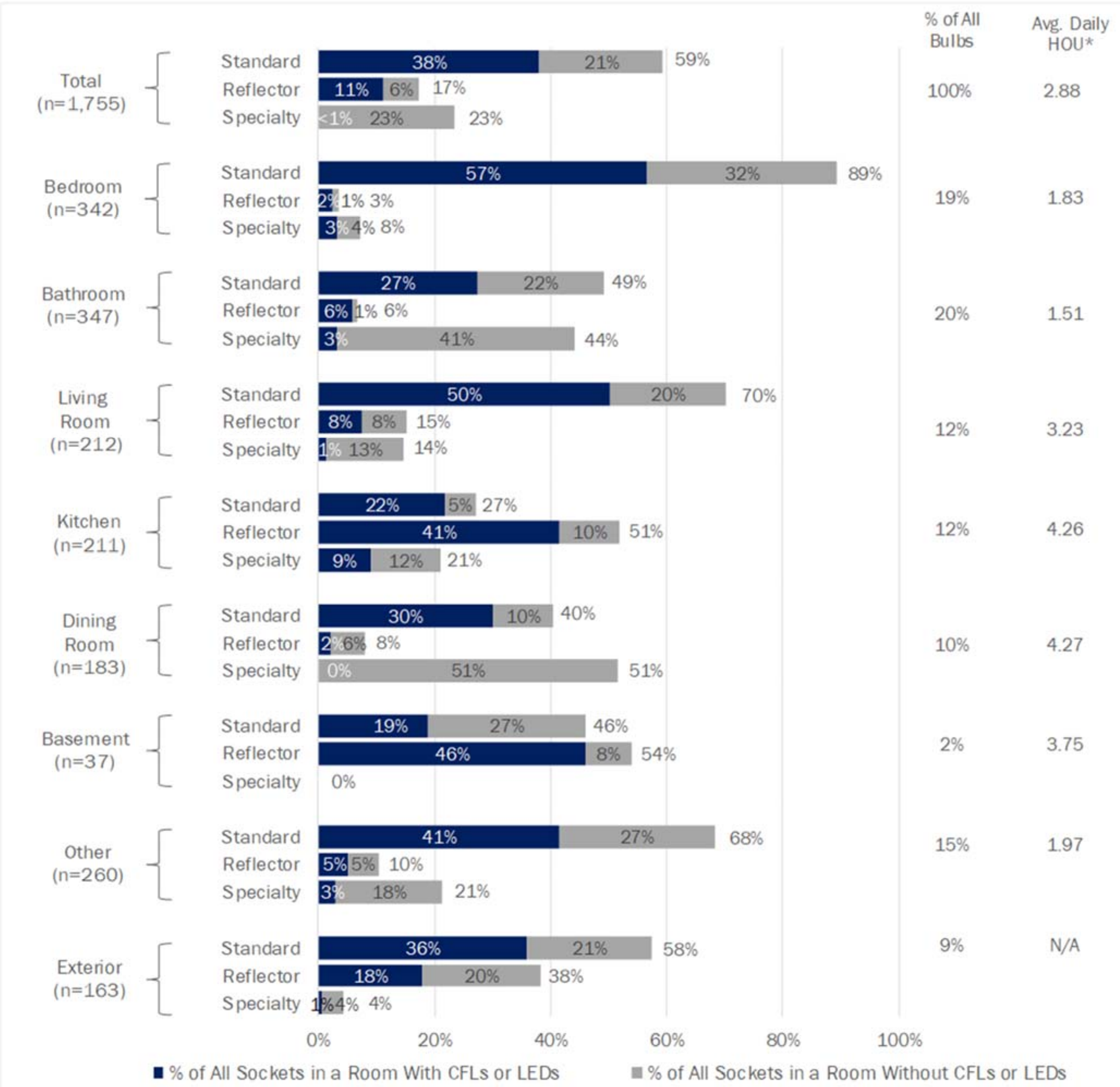
Figure 7-9. DEP EEL Program Bulb Mix in Homes with LEDs



Source: Opinion Dynamics analysis of site visit data.

An analysis of product mix by room in homes with LEDs shows pockets of opportunity. Figure 7-10 provides a breakdown of lighting products by technology and type in homes with LEDs. The figure also provides a percent distribution of all bulbs by room type, as well as average daily hours of use by room type. As can be seen in the figure, across room types, energy efficient bulbs are used more frequently in standard sockets than in specialty sockets. Energy-efficient product shares vary by room type, with kitchens having the highest share of energy-efficient products (72%) and dining rooms having the lowest (32%). More than half of light sockets in dining rooms (51%) are specialty sockets, and none of them have energy-efficient bulbs in them, which explains the low energy-efficient bulb share in this room type. Yet at the same time, dining rooms feature high average HOU (4.27 hours a day on average). Focusing program messaging on specialty products in dining rooms may help increase the marketing relevance and help the program reach these underserved sockets.

Figure 7-10. DEP EEL Program Product Mix by Room Type



Source: Opinion Dynamics analysis of site visit data.

* Average daily HOU values are for the DEP and DEC jurisdictions combined.
Note that percentages may not add up due to rounding.

A detailed analysis of the reported CFL and LED penetration among DEP customers, as well as an analysis of lighting composition in homes with LEDs, shows that there remain underserved customer segments. Table 7-2 provides a comparative analysis of the reported CFL and LED penetration rates among DEP customers, as well as the percent of sockets with LEDs among a subset of DEP customers with LEDs. As can be seen in the table, customers residing in multifamily and mobile homes, customers who rent their homes, older customers (ages

65+), customers with lower education levels, and customers with lower income levels (<$50,000) are less likely to have CFLs or LEDs in their homes. Furthermore, customers in these segments who have LEDs generally tend to have fewer LEDs. The program's continued focus on these underserved segments will ensure further transformation of the lighting market.

Table 7-2. DEP EEL Program CFL and LED Penetration by Customer Segment

Customer Segment	Energy-Efficient Light Bulb Penetration	CFL Penetration	LED Penetration	% of Sockets with LEDs*
Home Type				
Single-family	89%	84%	46%	24%
Multifamily	86%	82%	25%	26%
Mobile home	84%	75%	25%	7%
Homeownership				
Own	89%	84%	46%	24%
Rent	87%	82%	28%	26%
Age				
<35	90%	83%	31%	25%
35–64	91%	86%	45%	26%
65+	79%	73%	40%	15%
Education				
Less than college degree	85%	79%	35%	22%
College degree +	92%	87%	48%	25%
Income				
<$50,000	84%	77%	32%	27%
$50,000+	93%	88%	49%	22%

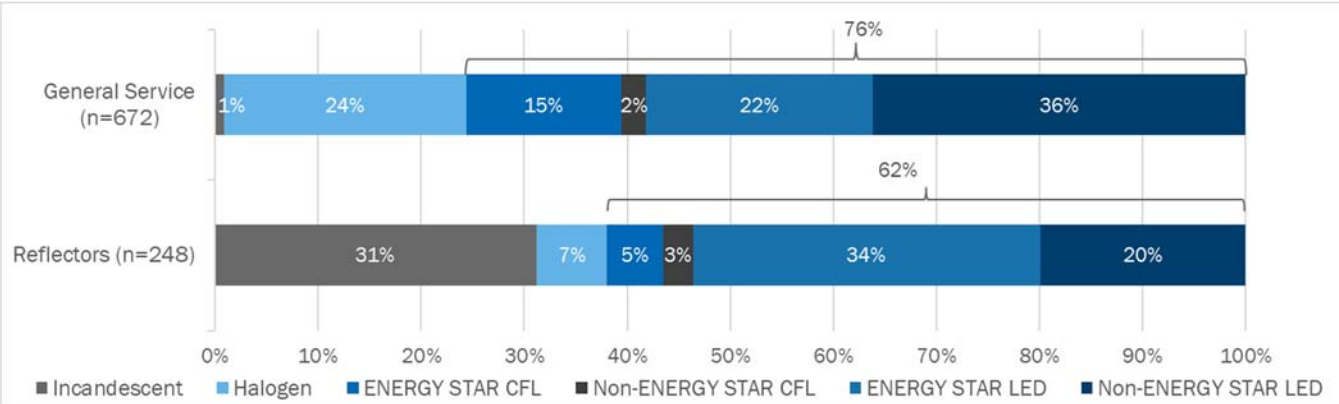
Source: Opinion Dynamics analysis of site visit data.

* Among customers who have LEDs.

shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Figure 7-11 provides a breakdown of the shelf space across lighting technologies. As can be seen in the figure, more than three-quarters of the general service products on the retailer shelves (76%) are CFLs and LEDs, and 58% are LEDs. Incandescent products are virtually not available and halogen products represent just under a quarter (24%) of all products. General service ENERGY STAR LEDs are more prominent than non-ENERGY STAR LEDs (36% vs. 22% of all general service products).

In the reflector product category, incandescent products are much more prominent than in the general service category, CFLs are a lot less prominent, and ENERGY STAR LEDs are more common than non-ENERGY STAR LEDs. Incandescent products account for almost a third of all products (31%), while CFLs and LEDs account for 62%, and LEDs account for 54%. ENERGY STAR LEDs account for a larger share of all reflector products than non-ENERGY STAR LEDs (34% vs. 20%). The reflector category may present a program opportunity due to a higher share of incandescent and halogen products.

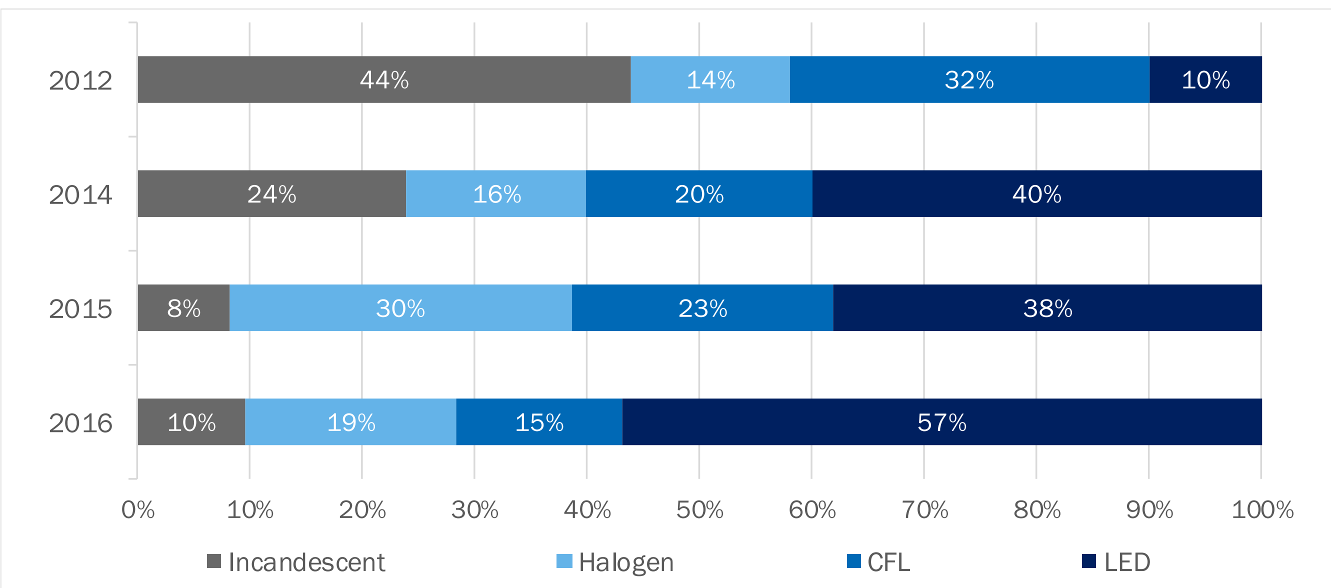
Figure 7-11. DEP EEL Program Shelf Composition of General Service and Reflector Products



Source: Opinion Dynamics analysis of shelf audit data.

The lighting products that retailers stock has changed rapidly, and the rate of change especially accelerated in the last year. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, the shelf space dedicated to LEDs grew from 38% to 57% (Figure 7-12).

Figure 7-12. DEP EEL Program Changes in the Lighting Shelf Space Composition Over Time



Source: Opinion Dynamics analysis of shelf audit data and prior evaluation reports.

The mix of bulb technologies varies by retailer channel, with Club stores carrying only CFLs and LEDs, in both the general service and reflector categories.[21] DIY and Big Box stores are the retailers with the highest percentage of halogen general service products (25% and 30%, respectively), while DIY and Hardware stores

[21] Note that the Dollar/Discount store that we visited as part of the shelf audit was a participating store and was carrying only program LEDs.

are the retailers with the highest percentage of reflector incandescent and halogen products (41%). Focusing program efforts on further shifting the shelf space away from incandescent and halogen products at these retailer channels, while further reducing program presence at the Club stores, could help increase program impact on the market.

Table 7-3. DEP EEL Program Lighting Shelf Space Composition by Retailer Channel

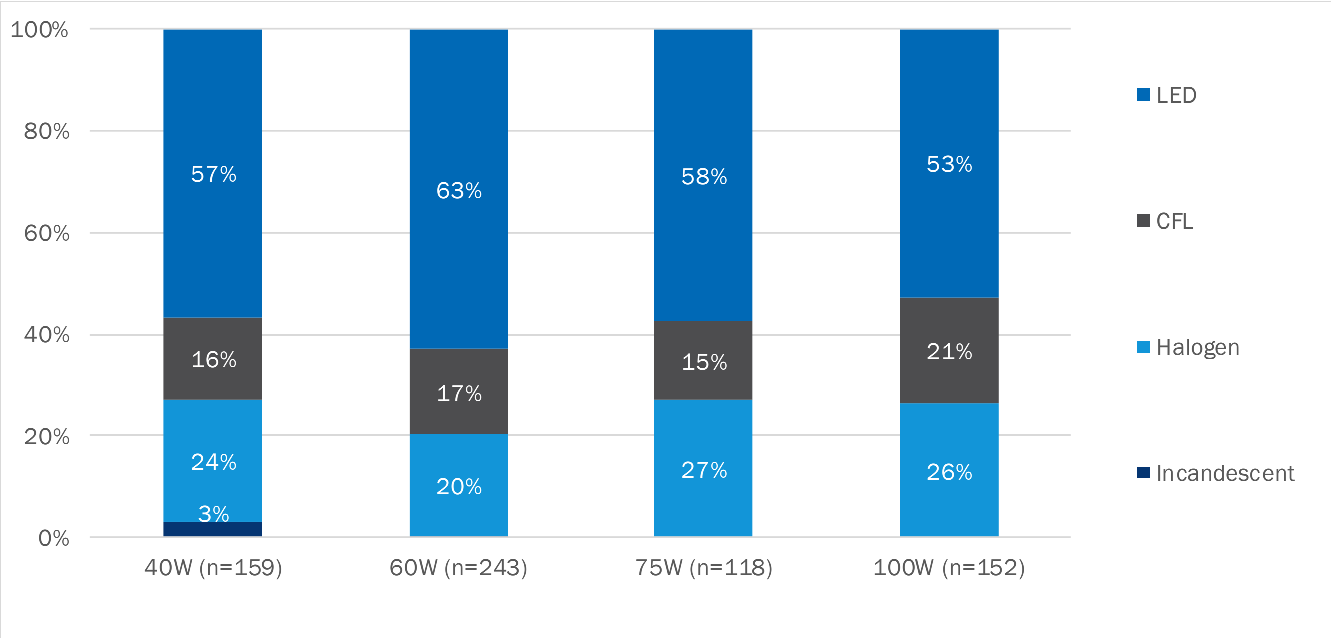
Retailer Channel	Big Box (2 stores)	Club (4 stores)	DIY (5 stores)	Dollar/ Discount (1 store)*	Hardware (3 stores)	Total (15 stores)
General Service Products						
Number of Products (n=)	*194*	*14*	*281*	*2*	*181*	*672*
Incandescent	0%	0%	0%	0%	3%	1%
Halogen	25%	0%	30%	0%	14%	24%
CFLs (Non-ENERGY STAR)	0%	0%	0%	0%	9%	2%
CFLs (ENERGY STAR)	0%	14%	16%	0%	29%	15%
LEDs (Non-ENERGY STAR)	59%	43%	31%	0%	20%	36%
LEDs (ENERGY STAR)	15%	43%	23%	100%	24%	22%
Total	100%	100%	100%	100%	100%	100%
Reflector Products						
Number of Products (n=)	*51*	*9*	*150*	*0*	*66*	*276*
Incandescent	33%	0%	29%	N/A	39%	31%
Halogen	0%	0%	12%	N/A	2%	7%
CFLs (Non-ENERGY STAR)	2%	0%	0%	N/A	11%	3%
CFLs (ENERGY STAR)	0%	22%	3%	N/A	12%	5%
LEDs (Non-ENERGY STAR)	22%	22%	23%	N/A	11%	20%
LEDs (ENERGY STAR)	43%	56%	33%	N/A	26%	34%
Total	100%	100%	100%	N/A	100%	100%

Source: Opinion Dynamics analysis of shelf audit data.

* Participating store.

An analysis of shelf space by most common bulb wattages shows that the share of energy-efficient products is relatively evenly distributed across standard bulb wattages. As can be seen in Figure 7-13, between 20% and 27% of products within a given wattage category are incandescent or halogen. LEDs, however, are slightly more prominent in the most popular 60-watt equivalent wattage.

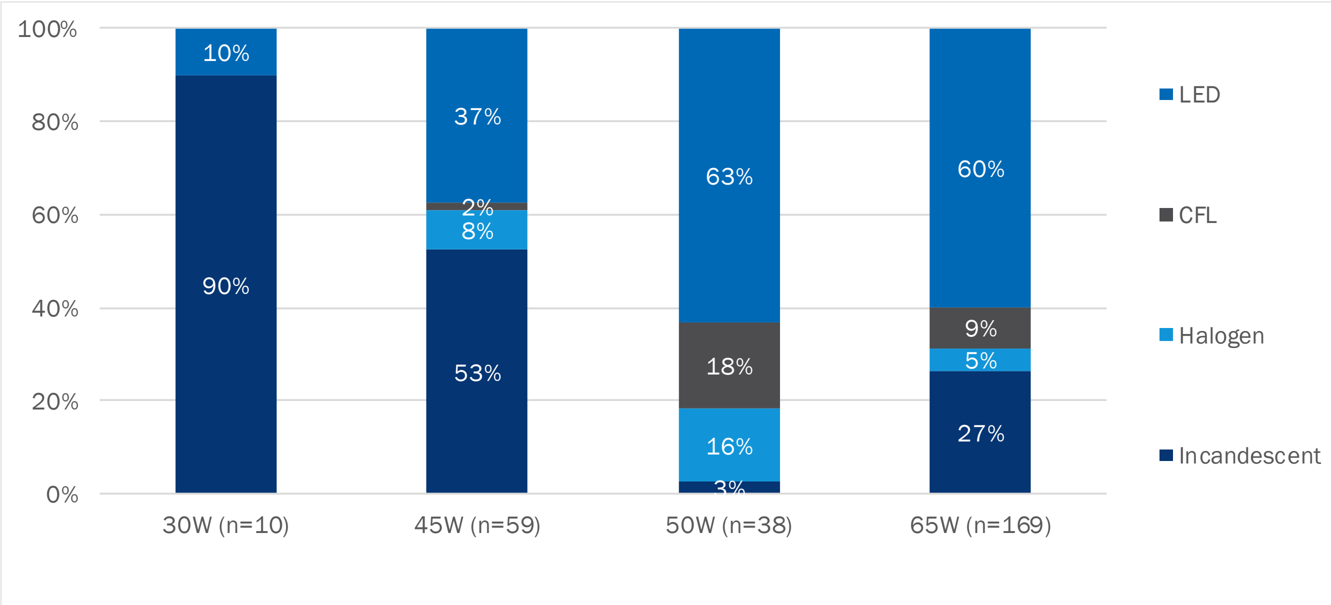
Figure 7-13. DEP EEL Program General Service Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

When it comes to reflectors, however, the technology mix varies considerably depending on the wattage. Lower-wattage reflectors (30-watt and 45-watt equivalents) are dominated by incandescents (90% and 53% of all products, respectively), while 50-watt and 65-watt equivalents are dominated by LEDs (63% and 60%, respectively). Across all stores, lower-wattage reflector products account for a quarter of all reflector products (25%), which represents a considerable share of products. Increasing the volume of lower-wattage reflector products discounted through the program may help further increase program impact on the lighting market transformation.

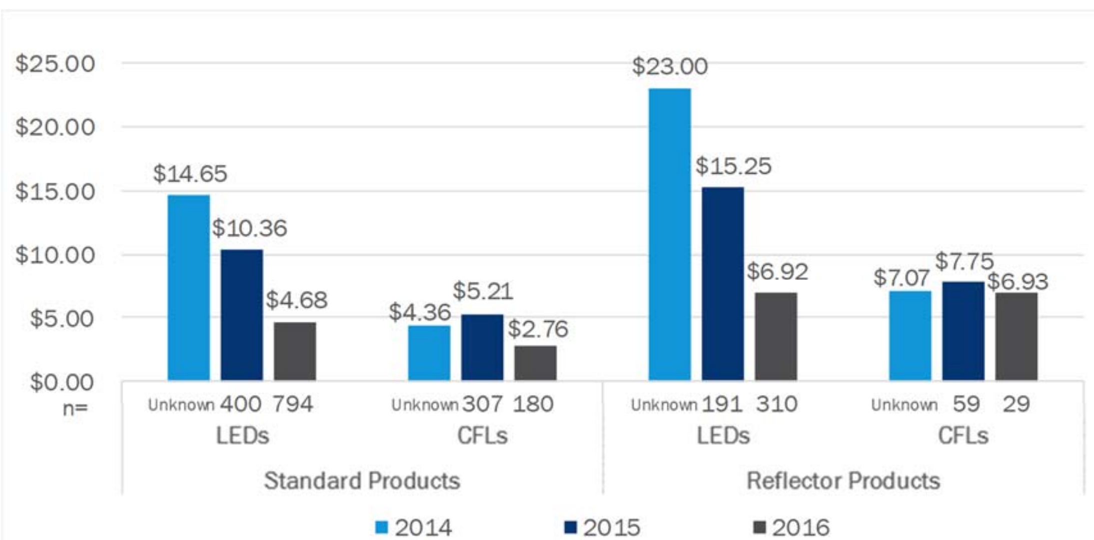
Figure 7-14. DEP EEL Program Reflector Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

In addition to becoming increasingly available on the store shelves, LEDs prices dropped considerably, making them more affordable. As part of the shelf audits, Opinion Dynamics collected data on product pricing for general service and reflector LEDs and CFLs. As can be seen in Figure 7-15, general service LED prices dropped from an average of $10.36 per bulb to $4.68 over the course of a year, and reflector LED prices dropped from an average of $15.25 per bulb to $6.92 over the course of a year. General service CFL prices also decreased, from an average of $5.21 per bulb to $2.76. Reflector CFL prices remained relatively stable over time.

Figure 7-15. DEP EEL Program Changes in Non-Discounted Light Bulb Prices Over Time



Source: Opinion Dynamics analysis of shelf audit data.

Despite the drops in price, CFLs and LEDs continue to be the most expensive product on the market, and halogens continue to be the least expensive lighting technology. As can be seen in Table 7-4, the average price is $1.98 for a general service halogen, $2.76 for a general service CFL, and $4.68 for a general service LED. The average price for a reflector incandescent is $4.69, for a reflector halogen is $6.24, and for a reflector CFL is $6.93. The average price for a reflector LED is $6.92. For the price-sensitive customer segments, such as lower-income residential customers, program incentives can help bring LEDs on par with halogen and incandescent pricing, thus making the technology an affordable alternative.

Table 7-4. DEP EEL Program General Service and Reflector Pricing

	Average Price (15 stores)	Min Price (15 stores)	Max Price (15 stores)
General Service Products (n=672)			
Incandescent	$0.92	$0.60	$1.25
Halogen	$1.98	$1.60	$2.36
CFLs	$2.76	$2.18	$3.33
LEDs	$4.68	$3.89	$5.48
Reflector Products (n=672)			
Incandescent	$4.69	$4.06	$5.31
Halogen	$6.24	$6.05	$6.44
CFLs	$6.93	$5.84	$8.02
LEDs	$6.92	$5.74	$8.10

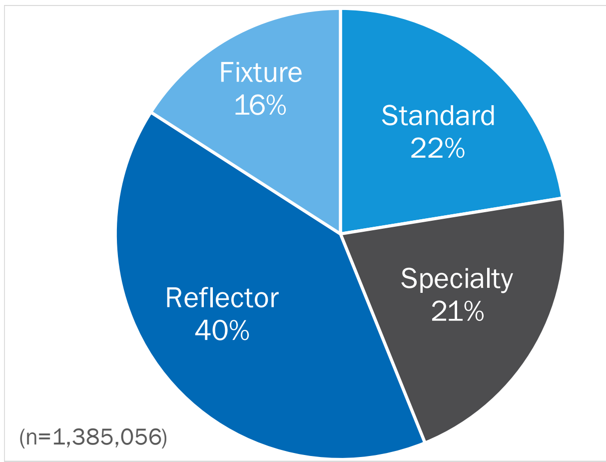
Source: Opinion Dynamics analysis of shelf audit data.

7.2.2 DEC Retail LED Program

Program Participating Product Mix

The DEC Retail LED program sold 1,385,056 LED bulbs and fixtures in PY2016–2017. As can be seen in Figure 7-16, reflector LEDs accounted for the largest share of the program sales (40%). Standard LEDs accounted for 22% of all sales, specialty LEDs for 21%, and LED fixtures for 16%.

Figure 7-16. DEC Retail LED Program Technology Shares by Product Type



Source: Opinion Dynamics analysis of program tracking data.

Over the course of PY2016–2017, the DEC Retail LED program discounted 384 unique products across a range of bulb types and wattages. Program staff effectively managed this number of products, which is evidenced in clean and accurate program sales records (discussed in greater detail in Section 5.2 of this report) and high levels of retailer and manufacturer satisfaction described later in this section.

The DEC Retail LED program discounted a range of pack sizes over the course of PY2016–2017. Figure 7-17 provides a breakdown of program sales by pack size. As can be seen in the figure, more than half of standard and specialty and reflector LEDs (59% and 57%, respectively) were sold in single packs, and 80% of LED fixtures were sold in single packs. A very small percent of reflector and specialty products (2%) were sold in six-packs, and none of the standard LEDs were sold in packages larger than four-bulb packs.

Figure 7-17. DEC Retail LED Program Sales by Package Type

Distribution of Program Sales Across Pack Sizes by Technology

						Total
Standard LEDs (n=159,896)	59%	8%	13%	20%	0%	100%
Reflector and specialty LEDs (n=453,825)	57%	15%	15%	11%	2%	100%
LED fixtures (n=186,563)	82%	18%	0%	0%	0%	100%

Source: Opinion Dynamics analysis of program tracking data.

Average program discounts ranged from $3.38 for specialty LEDs to $8.11 for fixtures. Depending on the product category, the average discount as a percentage of MSRP ranged from 45% for reflector LEDs to 55% for standard LEDs. The average program discount across all product categories was $4.49, which represents on average 46% of MSRP. Figure 7-18 provides an overview of the program discounts by product type in PY2016–2017. As can be seen in the figure, discounts for standard and specialty LEDs were generally on par, at $3.40 and $3.38, respectively. Discounts on LED fixtures were the highest, at $8.11.

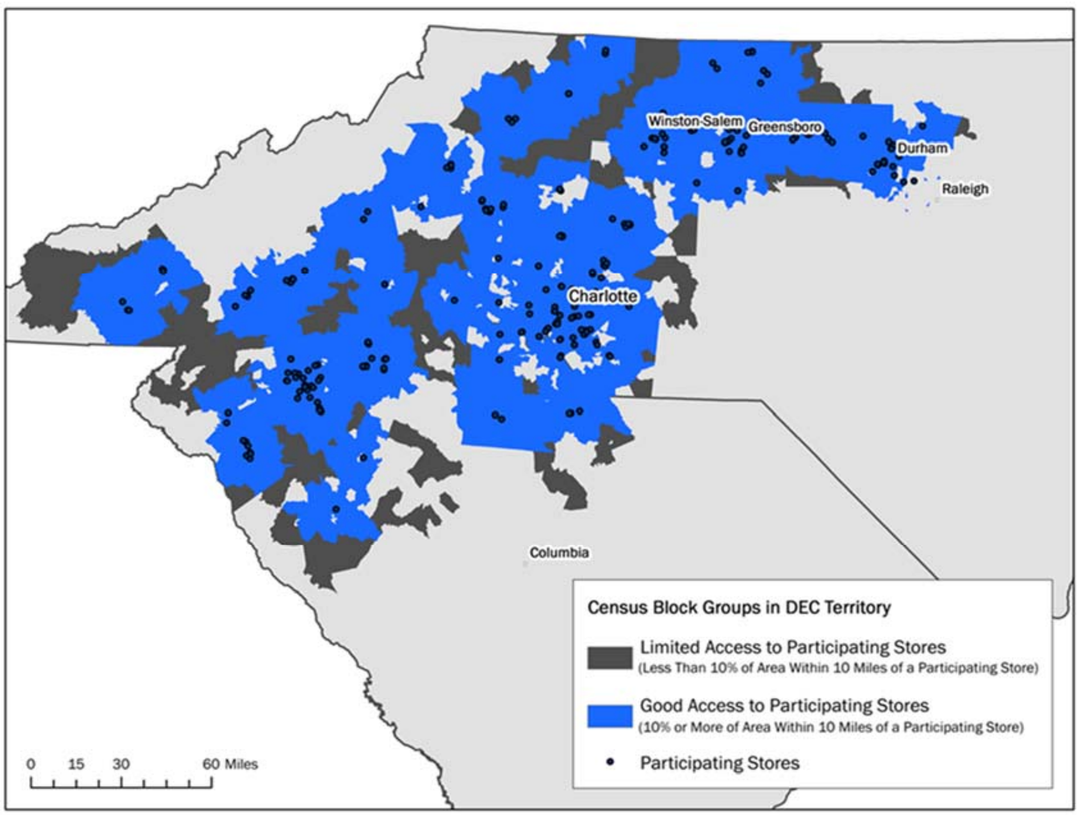
Figure 7-18. DEC Retail LED Program Pricing

Source: Opinion Dynamics analysis of program tracking data.

Program Retailer Mix

The retailer mix in PY2016–2017 included a range of retailer channels. The program engaged eight unique retailers across 300 storefronts in PY2016–2017. Through the participating retailer mix, the program maintained good coverage of the DEC jurisdiction, thus ensuring equitable customer access to program-discounted lighting products. Figure 7-19 displays the coverage of the DEC jurisdiction with participating retailers. Blue and dark gray areas on the map combined show the DEC jurisdiction boundaries. The areas of the map colored in blue show census block groups with good access to program participating storefronts, while areas in dark grey show census block group with limited access to program participating storefronts. As can be seen, most of the census block groups in the DEC jurisdiction have good access to program participating stores.

Figure 7-19. DEC Retail LED Program Participating Retailer Coverage of DEC Jurisdiction



Source: Opinion Dynamics GIS analysis.

Table 7-5 shows a breakdown of participating retailers, storefronts, and program sales across retailer channels. Club stores cumulatively captured close to half of program sales (47%), and DIY stores captured an additional 36% of sales. The program discounted 10% of products through the Dollar/Discount channel. A continued focus on the Dollar/Discount channel is important to reach underserved customer segments and also helps to maintain NTGRs.

Table 7-5. DEC Retail LED Program Participating Retailer Mix

Retail Channel	# of Retailers	% of Storefronts (n=300)	% of Sales (n=1,385,056)
Club	2	7%	47%
DIY	2	26%	36%
Dollar/Discount	3	44%	10%
Big Box	1	23%	7%
Total	8	100%	100%

Source: Opinion Dynamics analysis of program tracking data.

Program Marketing and Outreach

Over the course of PY2016–2017, the DEC Retail LED program relied on a range of marketing and outreach tactics:

- **In-store events and special promotions.** In conjunction with DEC marketing, Ecova performed a total of 236 in-store events and demonstrations in PY2016–2017 across 47 unique storefronts, with an average of 20 events per month. Ecova held the events at storefronts that were top-sellers for the program. The 47 unique storefronts where events were held accounted for a total of 62% of program sales in PY2016–2017. During these events, Ecova field staff promoted program products and discounts and educated customers about the benefits of energy-efficient lighting products.
- **Store visits and POP marketing material placement.** Over the course of the year, Ecova completed a total of 3,156 store visits, during which field staff checked for the presence and proper placement of program POP materials, updated materials as necessary, and checked for sufficient levels of inventory of program-discounted lighting products. The frequency of store visits varied by retailer based on sales volumes. This enabled team members to concentrate their visits on stores that had higher sales volumes and also tended to discount more products.
- **Community events.** Over the course of the program year, Ecova completed a total of 19 community events in which the program field representatives visited community centers to provide educational materials.
- **Direct mail, mass media, and other marketing.** Other sources of program marketing in PY2016–2017 included targeted bill inserts, direct mailers, email blasts, web promos, radio spots, and billboards.
- **POP marketing material presence.** Evaluators verified the presence of POP marketing materials as part of their visits to 10 participating retailers. POP marketing materials were present at 9 out of 10 participating locations.

Program Implementation Processes and Program Satisfaction

Program implementation processes were smooth and consistent, resulting in high levels of retailer and manufacturer satisfaction. Program staff whom we interviewed as part of the evaluation did not identify any implementation issues or bottlenecks. Corporate manufacturer contacts gave an average overall satisfaction rating of 9.3, and store employees gave an average rating of 8.9 on a scale of 0 to 10, where 0 is “extremely dissatisfied” and 10 is “extremely satisfied.”

“They’re in the top 1% of all the 50 or 60 utility programs we participate in.”

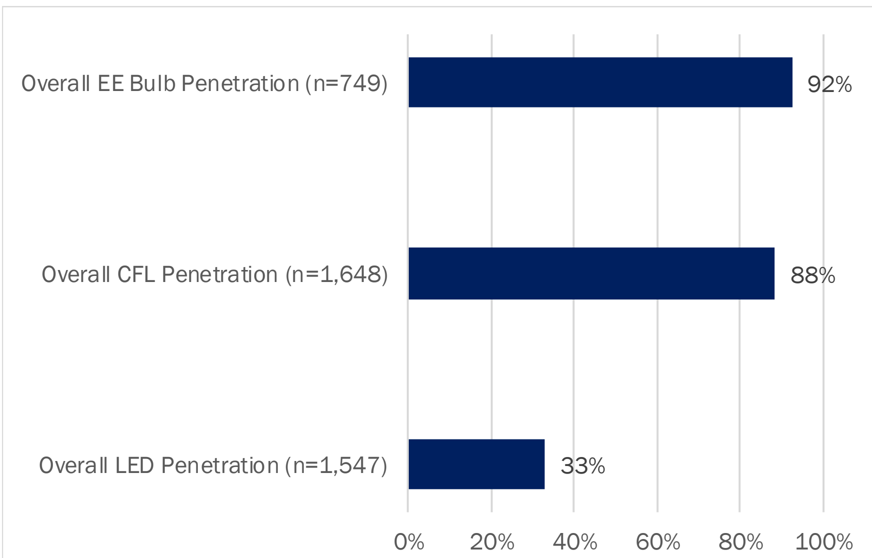
– *(Director of Sales at participating manufacturer)*

Corporate manufacturer contacts gave an average rating of 9.0 for the tracking and invoicing process, and had only positive feedback regarding interactions with Ecova. Satisfaction with the program's product mix received slightly lower ratings from both manufacturers and retailer staff (8.8 on average); some were confused by the exclusion of 60W and 75W standard bulbs. Store employees gave lower ratings to program marketing materials (7.4 on average), and suggested that sturdier signage might be helpful to avoid having it knocked down.

Program Impact in the DEC Service Territory and Market Trends

By discounting more than 1.3 million products since its inception, the program contributed to energy-efficient bulb penetration. In 2016, based on the results from the Residential Lighting Logger study, more than 9 in 10 (92%) customers had either LEDs or CFLs in their homes, 88% had CFLs, and 33% had LEDs (Figure 7-20).

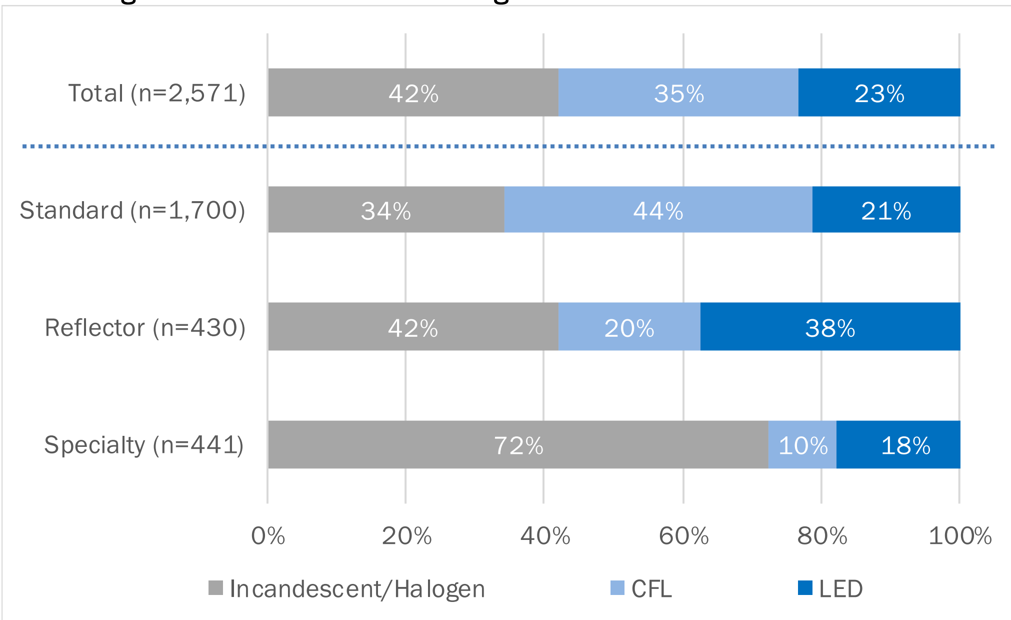
Figure 7-20. DEC Retail LED Program Energy-Efficient Product Penetration



Source: Opinion Dynamics analysis of site visit data.

As part of the lighting logger study, we collected detailed information on the lighting inventory in homes with LEDs. We found that even in home with LEDs, a considerable number of sockets, especially specialty ones, contain less-efficient technologies. Figure 7-21 details the results. As can be seen in the figure, 23% of all sockets in homes with LEDs contain LEDs and 35% contain CFLs. LEDs are much more prominent among reflector products, accounting for 38% of all sockets, than in standard and specialty sockets, where 21% and 18% of sockets, respectively, contain LEDs. Overall, 43% of all sockets and 72% of specialty sockets still have less-efficient light bulbs.

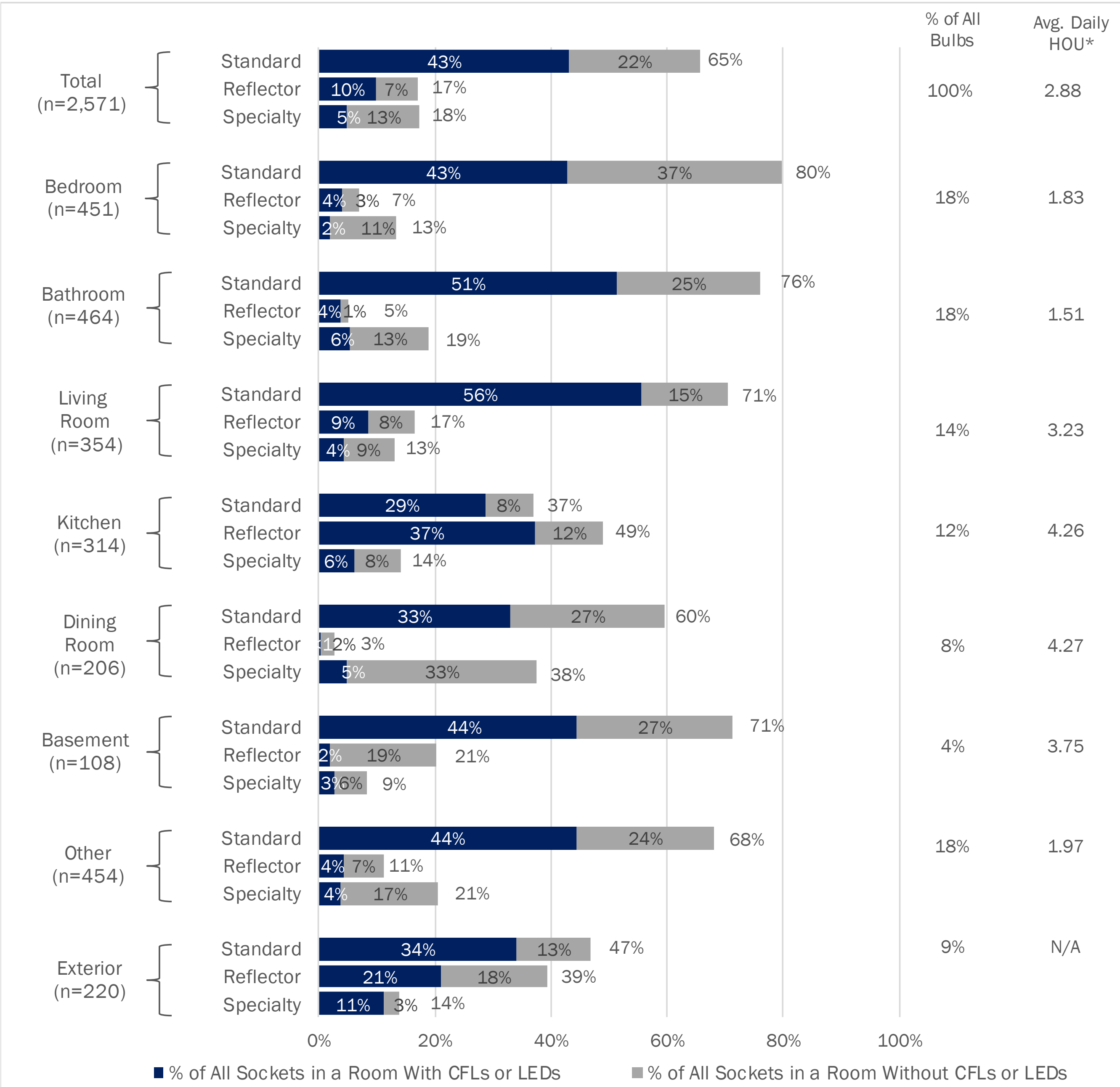
Figure 7-21. DEC Retail LED Program Bulb Mix in Homes with LEDs



Source: Opinion Dynamics analysis of site visit data.

An analysis of product mix by room in homes with LEDs shows pockets of opportunity. Figure 7-22 provides a breakdown of lighting products by technology and type in homes with LEDs. The figure also provides a percent distribution of all bulbs by room type, as well as average daily HOU by room type. As can be seen in the figure, across nearly all room types, energy efficient bulbs are used more frequently in standard sockets than in specialty sockets. Energy-efficient product shares vary by room type, with kitchens having the highest share of energy-efficient products (72%) and dining rooms having the lowest (38%). A considerable percent of light sockets in dining rooms (40%) are specialty sockets, and few of them have energy-efficient bulbs in them, which explains the low energy-efficient bulb share in this room type. Yet at the same time, dining rooms feature high average HOU (4.27 hours a day on average). Focusing program messaging on specialty products in dining rooms may help increase the marketing relevance and help the program reach these underserved sockets.

Figure 7-22. DEC Retail LED Program Product Mix by Room Type



Source: Opinion Dynamics analysis of site visit data.

* The average daily HOU values are for the DEP and DEC jurisdictions combined.
Note that percentages may not add up due to rounding.

A detailed analysis of the reported CFL and LED penetration among DEC customers, as well as an analysis of lighting composition in homes with LEDs, shows that there remain underserved customer segments. Table 7-6 provides a comparative analysis of the reported CFL and LED penetration rates among DEC customers, as well as the percent of sockets with LEDs among a subset of DEC customers with LEDs. As can be seen in the table, customers residing in multifamily and mobile homes, older customers (ages 65+), customers with lower education levels, and customers with lower income levels (<$50,000) are less likely to have CFLs or LEDs in their homes. Furthermore, customers in these segments who have LEDs generally tend to have fewer LEDs. The program's continued focus on these underserved segments will ensure further transformation of the lighting market.

Table 7-6. DEC Retail LED Program CFL and LED Penetration by Customer Segment

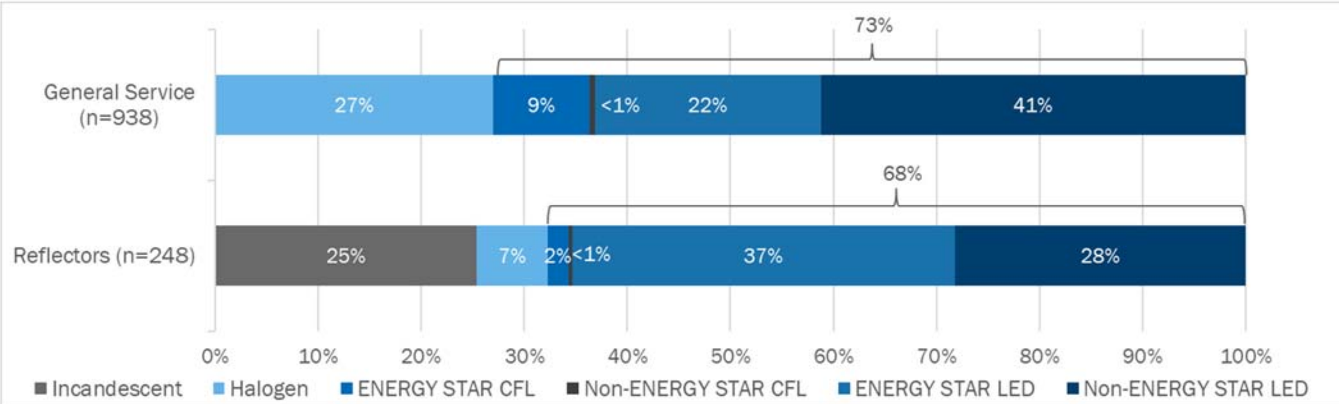
Customer Segment	Energy-Efficient Light Bulb Penetration	CFL Penetration	LED Penetration	% of Sockets with LEDs
Home Type				
Single-family	94%	90%	37%	23%
Multifamily	89%	85%	24%	32%
Mobile home	89%	85%	22%	35%
Homeownership				
Own	93%	89%	38%	23%
Rent	92%	88%	24%	32%
Age				
<35	93%	90%	27%	36%
35-64	94%	90%	36%	39%
65+	88%	81%	32%	21%
Education				
Less than college degree	91%	86%%	29%	25%
College degree +	95%	92%	39%	23%
Income				
<$50,000	90%	86%	25%	21%
$50,000+	96%	92%	96%	24%

Source: Opinion Dynamics analysis of site visit data.

Energy-efficient lighting products are not only prominent in DEC customers' homes but also on the store shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Figure 7-23 provides a breakdown of the shelf space across lighting technologies. As can be seen in the figure, close to three-quarters of the general service products on the retailer shelves (73%) are CFLs and LEDs, and 63% are LEDs. Incandescent products are not available and halogen products represent just over a quarter (27%) of all general service products. General service ENERGY STAR LEDs are more prominent than non-ENERGY STAR LEDs (41% vs. 22% of all general service products).

In the reflector product category, incandescent products are much more prominent than in the general service category, CFLs are a lot less prominent, and ENERGY STAR LEDs are more common than non-ENERGY STAR LEDs. Incandescent products account for a quarter of all products (25%), while CFLs and LEDs account for 68%, and LEDs account for 65%. ENERGY STAR LEDs account for a larger share of all reflector products than non-ENERGY STAR LEDs (37% vs. 28%). The reflector category may present a program opportunity due to a higher share of incandescent and halogen products.

Figure 7-23. DEC Retail LED Program Shelf Composition of General Service and Reflector Products



Source: Opinion Dynamics analysis of shelf audit data.

The mix of bulb technologies varies by retailer channel, with Club stores carrying only CFLs and LEDs in the general service category and only LEDs in the reflector category. Both DIY and Big Box stores carried halogen general service products (26% and 29%, respectively) and halogen and incandescent reflector products (36% and 32%, respectively). Focusing program efforts on further shifting the shelf space away from incandescent and halogen products at these retailer channels, while further reducing program presence at the Club stores, can help increase program impact on the market. As presented in Section 6.2 of this report, based on the retailer and manufacturer interviews, the NTGR is the lowest for the Club retailer channel (0.33) compared to the Big Box, DIY, and Dollar/Discount channels (0.46, 0.51, and 1.00, respectively). Further decreasing focus on the Club retailer channel could help increase the program's net impacts.

Table 7-7. DEC Retail LED Program Lighting Shelf Space Composition by Retailer Channel

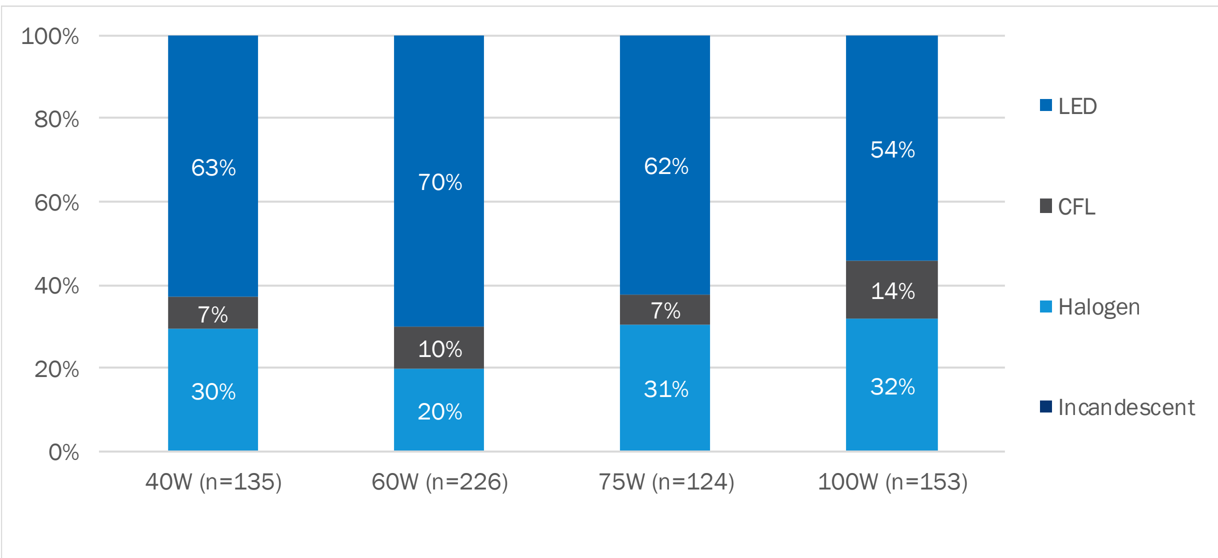
Retailer Channel	Big Box (3 stores)	Club (6 stores)	DIY (6 stores)	Total (15 stores)
Number of Products (n=)	*296*	*18*	*324*	*638*
Incandescent	–	–	–	–
Halogen	26%	0%	29%	27%
CFLs (Non-ENERGY STAR)	0%	0%	1%	0%
CFLs (ENERGY STAR)	0%	0%	19%	9%
LEDs (Non-ENERGY STAR)	56%	39%	27%	41%
LEDs (ENERGY STAR)	18%	61%	24%	22%
Total	100%	100%	100%	100%
Number of Products (n=)	*74*	*10*	*164*	*248*
Incandescent	36%	0%	22%	25%

Retailer Channel	Big Box (3 stores)	Club (6 stores)	DIY (6 stores)	Total (15 stores)
Halogen	0%	0%	10%	7%
CFLs (Non-ENERGY STAR)	0%	0%	1%	0%
CFLs (ENERGY STAR)	0%	0%	3%	2%
LEDs (Non-ENERGY STAR)	31%	0%	29%	28%
LEDs (ENERGY STAR)	32%	100%	35%	37%
Total	100%	100%	100%	100%

Source: Opinion Dynamics analysis of shelf audit data.

An analysis of shelf space by most common bulb wattage shows that the share of energy-efficient products is relatively evenly distributed across standard bulb wattages. As can be seen in Figure 7-24, between 20% and 32% of products within a given wattage category are halogen. LEDs, however, are slightly more prominent in the most popular 60-watt equivalent category, accounting for 70% of all products.

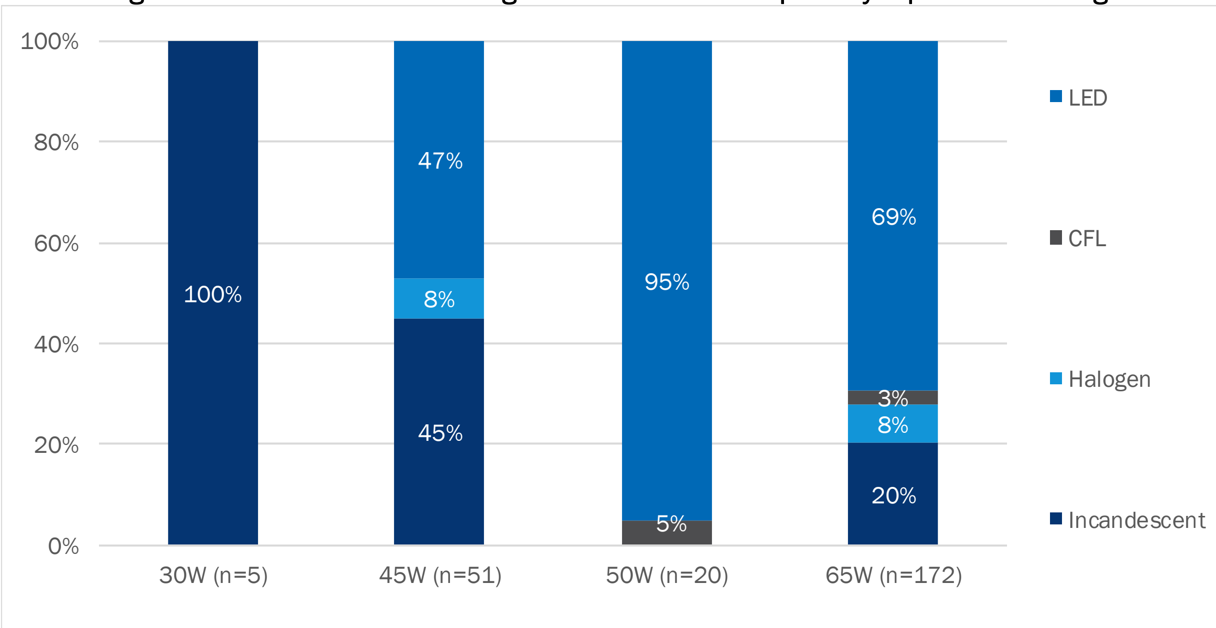
Figure 7-24. DEC Retail LED Program General Service Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

When it comes to reflectors, however, the technology mix varies considerably depending on the wattage. Lower-wattage reflectors (30-watt equivalent) are dominated by incandescents (100% of all products), while 50-watt and 65-watt equivalents are dominated by LEDs (95% and 69%, respectively). Across all stores, lower-wattage reflector products (30-watt and 45-watt) account for just under a quarter of all reflector products (23%). Increasing the volume of lower-wattage reflector products discounted through the program may help further increase program impact on the lighting market transformation.

Figure 7-25. DEC Retail LED Program Reflector Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

Despite their prominence on the store shelves, CFLs and LEDs continue to be the most expensive product on the market, and halogens continue to be the least expensive one. As can be seen in Table 7-8, the average price is $1.99 for a general service halogen, $2.87 for a general service CFL, and $4.87 for a general service LED. Average price for a reflector incandescent is $4.26, a reflector halogen is $5.33, a reflector CFL is $6.26, and reflector LED is $7.01. For the price-sensitive customer segments, such as lower-income residential customers, program incentives can help bring LEDs on par with the halogen and incandescent pricing, thus making the technology an affordable alternative.

Table 7-8. DEC Retail LED Program General Service and Reflector Pricing

	Average Price (15 stores)	Min Price (15 stores)	Max Price (15 stores)
General Service Products (n=638)			
Halogen	$1.99	$1.54	$2.44
CFLs	$2.87	$2.54	$3.21
LEDs	$4.87	$3.92	$5.81
Reflector Products (n=248)			
Incandescent	$4.26	$3.84	$4.68
Halogen	$5.33	$5.33	$5.33
CFLs	$6.26	$5.99	$6.52
LEDs	$7.01	$6.10	$7.91

Source: Opinion Dynamics analysis of shelf audit data.

7.2.3 Future Trends

We asked retailers and manufacturers about future trends in the lighting industry. Almost unanimously, respondents predicted further increase in LED shelf space and market shares at the expense of both CFL and halogen products. Many retailer and manufacturer contacts predicted that CFLs would be completely or nearly gone from shelves in the next 5 years. Some alluded to increased prominence of alternative technologies, such as smart bulbs or even some new unforeseen technology.

"I think [CFLs] are going to be done. They are slowly going to start trickling away…and the price points of LEDs are going to contribute to the demise of CFLs."

Market trends and developments support these finding. General Electric stopped manufacturing CFLs as of early 2017.[22] New ENERGY STAR standards, put into effect in January 2017, increased lumen per-watt standards for CFLs and relaxed lifetime standards for LEDs, meaning current CFLs lost their ENERGY STAR designation and many LEDs gained it.[23] As more LED products become ENERGY STAR certified, demand for those products is likely to increase further. Finally, EISA 2020 is not far off, which will further increase lighting energy efficiency standards and likely drive manufacturing and distribution practices away from halogens, leaving energy-efficient LEDs and CFLs as the only options in the market. However, when we asked manufacturers whether they had plans in place to change their manufacturing practices in anticipation of EISA 2020, none of the respondents said that they did, citing, among other reasons, general uncertainty related to the current political climate.

As part of the interviews, we also asked retailers and manufacturers about their expectations for the future lighting market both with and without the program. Opinions about the program's value in shifting the lighting market going forward were mixed. More than a third (36%) of store-level interviewees expected that the market would be unaffected by the program moving forward, while just over one-quarter (27%) thought customers would revert to less-efficient alternatives, and slightly less than one-quarter of respondents (23%) expected that the adoption of new technologies would be slowed somewhat in the absence of the program.

[22] http://pressroom.gelighting.com/news/leave-cfl-in-the-dark-and-light-up-your-love-for-led#.Vs56ksv2Zkg.

[23] https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2_0%20Program%20Requirements.pdf.

8. Conclusions and Recommendations

8.1 DEP EEL Program

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[24] divide the adjusted number of program bulbs by the total number of residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use. The program continued efforts to reach underserved customer segments and sockets by maintaining a relatively high share of sales through the Dollar/Discount channel (which attracts lower-income shoppers) and increasing the focus on specialty products (standard bulb sales decreased by 8% between PY2015 and PY2016–2017).

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 744 unique products across 289 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

The transition of the lighting market in the DEP jurisdiction continued at an accelerated pace. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves in the DEP jurisdiction, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, LEDs grew from 38% to 57% of all lighting products on store shelves.

LED prices have decreased dramatically over time. More specifically, based on the shelf audit research conducted over time, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68 in 2016, which represents a 68% drop in price. Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. These decreasing prices made LEDs more affordable and accessible to the broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs no longer eligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated in the energy-efficient lighting penetration in the DEP jurisdiction: Nearly 9 in 10 DEP customers (88%) reported having CFLs or LEDs in their homes and 42% reported having LEDs in their homes.

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among

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[24] Assuming a 5-year expected useful life (EUL) for a CFL.

a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are bound to take place in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEP EEL program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase underserved customer segments through the mass market program design. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage products, and by adjusting program marketing and messaging to focus on underserved sockets and to increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion.

8.2 DEC Retail LED Program

By discounting more than 1.3 million products since its inception, the DEC Retail LED program contributed to the lighting market transformation in the DEC jurisdiction. Program interventions indisputably contributed to energy-efficient bulb penetration.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 384 unique products across 300 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-base venues.

The program made efforts to reach underserved customer segments and sockets by targeting Dollar/Discount retailers (which attracts lower income shoppers), and focusing on specialty products. In PY2016–2017, 44% of program participating storefronts were Dollar/Discount, and they accounted for 10% of program sales.

Energy-efficient lighting products were prominent on the store shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Close to three-quarters of the general service products on the retailer shelves (73%) were CFLs and LEDs, and 63% were LEDs. Incandescent products were not available and halogen products represented just over a quarter (27%) of all general service products.

Shelf audits conducted over time in the neighboring DEP jurisdiction show that LED prices have decreased dramatically over time. More specifically, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68

in 2016, which represents a 68% drop in price.[25] Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. Average LED prices in the DEC jurisdiction, based on the results of the 2016 shelf audits, mimic DEP's, with the per-bulb price for standard LEDs averaging $4.87 and the per-bulb price for reflector LEDs averaging $7.01. These decreasing prices made LEDs more affordable and accessible to a broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs no longer eligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated by findings regarding overall energy-efficient lighting penetration in the DEC jurisdiction. More than 9 in 10 DEC customers (92%) reported having CFLs or LEDs in their homes and 33% reported having LEDs in their homes.[26]

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are bound to take place in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEC Retail LED program will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase underserved customer segments through the mass market program design. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage products, and by adjusting program marketing and messaging to focus on underserved sockets and to increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phrase of EISA to identify optimal timing for program completion.

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[25] Note that this analysis is based on the light bulbs of all wattages, including those not discounted through the DEC Retail LED program.

[26] Note that these results include LED penetration across lighting products of all wattages, and not just the wattages discounted through the program.

9. DEP EEL Program Summary Form

DEP Energy Efficient Lighting Program

Completed EMV Fact Sheet

Duke Energy Progress partners with retailers and manufacturers across North and South Carolina to provide price markdowns on efficient lighting products. The program promotes customer awareness and purchase of the program-discounted products through a range of marketing and outreach strategies and provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR fixtures, including a wide range of products in each product category. Participating retailers include a variety of retail channels including Do-It-Yourself, Club, Dollar/Discount, and Big Box stores.

Date	July 14, 2017
Region(s)	Duke Energy Progress
Evaluation Period	January 1, 2016 – March 12, 2017
Gross Annual kWh Impact	125,001,897 kWh (89% realization rate)
Gross Coincident kW Impact	21,962 Summer kW (95% realization rate) 8,066 Winter kW (113% realization rate)
Net-to-Gross Ratio	0.40
Process Evaluation	Yes
Previous Evaluation(s)	PY2014 and PY2015

Evaluation Methodology

The evaluation team reviewed ex ante per-unit savings assumptions and verified values matched those provided as part of the program's previous evaluation. The evaluation team also performed an engineering analysis of energy and demand savings to develop evaluated savings estimates, conducted a residential lighting logger study to update residential hours of use and in-service rate for LEDs, estimated leakage based on GIS analysis, and estimated a net-to-gross ratio using sales data modeling and direct feedback from retailers and manufacturers. The evaluation team also completed a process analysis based on retailer shelf audits, interviews with program staff, program tracking data analysis, review of program materials, and interviews with retailer and manufacturer staff.

Evaluation Details

- North Carolina Utilities Commission requires that evaluations of DEP's Energy Efficient Lighting program include Carolinas-specific data.
- North Carolina Utilities Commission require that evaluations of DEP's Energy Efficient Lighting program include a discussion of the impacts of LEDs, the Energy Independence and Security Act (EISA), and other innovations in lighting technology on the calculations of measure impacts and the baseline measures used in those calculations
- The evaluation team used the most recent available Carolinas-specific energy savings estimates
- The evaluation team used the Uniform Methods Project (UMP) recommended approach to estimate gross energy savings and incorporated additional adjustments as necessary
- The evaluation team developed evaluated savings assumptions using detailed product information provided as part of the program tracking data extract
- The evaluation team used a 'discounted savings approach' to claiming savings from future installations
- Assessment of program attribution relied on a combination of results from sales data modeling and interviews with participating retailers and manufacturers

10. DEC Retail LED Program Summary Form

DEC Retail LED Program

Completed EMV Fact Sheet

Duke Energy Carolinas partners with retailers and manufacturers across North and South Carolina to provide price markdowns on efficient lighting products. The program promotes customer awareness and purchase of the program-discounted products through a range of marketing and outreach strategies and provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, and ENERGY STAR fixtures, including a wide range of products in each product category. Participating retailers include a variety of retail channels including Do-It-Yourself, Club, Dollar/Discount, and Big Box stores.

Date	July 14, 2017
Region(s)	Duke Energy Carolinas
Evaluation Period	March 21, 2016 – March 12, 2017
Gross Annual kWh Impact	57,846,855 kWh (110% realization rate)
Gross Coincident kW Impact	10,676 Summer kW (121% realization rate) 4,045 Winter kW (155% realization rate)
Net-to-Gross Ratio	0.41
Process Evaluation	Yes
Previous Evaluation(s)	PY2014 and PY2015

Evaluation Methodology

The evaluation team reviewed ex ante per-unit savings assumptions and verified values matched those provided as part of the previous evaluation of the DEP Energy Efficient Lighting program. The evaluation team also performed an engineering analysis of energy and demand savings to develop evaluated savings estimates, conducted a residential lighting logger study to update residential hours of use and in-service rate for LEDs, estimated leakage based on GIS analysis, and estimated a net-to-gross ratio using sales data modeling and direct feedback from retailers and manufacturers. The evaluation team also completed a process analysis based on retailer shelf audits, interviews with program staff, program tracking data analysis, review of program materials, and interviews with retailer and manufacturer staff.

Evaluation Details

- North Carolina Utilities Commission requires that evaluations of DEP's Energy Efficient Lighting program include Carolinas-specific data.
- North Carolina Utilities Commission require that evaluations of DEP's Energy Efficient Lighting program include a discussion of the impacts of LEDs, the Energy Independence and Security Act (EISA), and other innovations in lighting technology on the calculations of measure impacts and the baseline measures used in those calculations
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For more information, please contact:

Kessie Avseikova
Director, Opinion Dynamics

617 492 1400 tel
617 497 7944 fax
kavseikova@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Progress & Duke Energy Carolinas

Energy Efficient Lighting & Retail LED Programs Appendices

April 6, 2018

Opinion Dynamics

Contributors

Tami Buhr
Vice President, Opinion Dynamics

Kessie Avseikova
Director, Opinion Dynamics

Katherine Randazzo
Senior Director, Opinion Dynamics

Kai Zhou
Managing Consultant, Opinion Dynamics

Dan Chen
Senior Consultant, Opinion Dynamics

Evan Tincknell
Consultant, Opinion Dynamics

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Table of Contents

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Table of Tables

Appendix A. Detailed Analysis Tables

The Excel spreadsheet is provided as a separate submission and contains detailed analysis of program gross and net impacts. The data in the file are at the invoice a unique product level measure. The file contains ex ante savings, gross savings assumptions, ex post gross savings, NTGR, and ex post net savings.

Appendix B. Chart with Measure-Level Inputs for Duke Energy Analytics

The Excel spreadsheet is provided as a separate submission and contains measure-level inputs for Duke Energy Analytics. Per-measure savings values in the spreadsheet are based on the engineering estimates presented in this report. Measure life estimates are based on previous evaluations and review of relevant TRMs. Update as necessary based on source of values.

Appendix C. Retailer and Manufacturer Interview Guide

Opinion Dynamics

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Participating Retailer and Manufacturer Interview Guide

FINAL

October 26, 2016

The main purpose of this interview guide is to measure program impact on retailer and manufacturer stocking and sales practices to estimate program net-to-gross ratio (NTGR). As part of the interviews, we will also explore retailer satisfaction with key program processes and recommendations for program improvement.

Introduction

Hello, may I speak with <NAME>?

My name is <NAME> and I am calling from Opinion Dynamics on behalf of Duke Energy. We are currently evaluating <PROGRAM> program, and I have a few questions that I would like to ask you about your experiences with the program. Do you have 15 minutes to speak with me? Your responses will be confidential, and we will not link you or your company with anything we report to Duke Energy. I do not work for Duke Energy. I am a third-party evaluator hired to help Duke Energy evaluate their <PROGRAM> program.

[OBTAIN PERMISSION TO RECORD CONVERSATION]

1. First, can you tell me your job title and major responsibilities? How long have you held this position?
2. Prior to this interview, were you aware that Duke Energy offers discounts on energy efficient light bulbs at select retailers that reduce the purchase price for customers buying bulbs?
   a. [IF YES] What is your level of involvement with the program? What has that involvement looked like?
   b. [IF NO] Are you in contact with anyone more directly involved with the program? If so, might you be able to put us in touch?
3. When did [COMPANY] begin participating in Duke Energy <PROGRAM> program?

Product Presence

[ASK STORE MANAGERS ONLY]
I would now like to ask you a few questions about the products that you have available at your store.

4. What types of CFL and LED products did your store stock in 2016? [PROBE FOR STANDARD AND SPECIALTY, CFLS AND LEDS]
   a. What product type did your store sell the most of in 2016?
5. Did you sell standard CFLs that were not ENERGY STAR certified in 2016? What about LEDs?

Market Trends and Market Effects

6. As you probably know, Duke Energy <PROGRAM> program has been around since 2009. How effective would you say the program has been in helping to increase the market (consumer demand) for high efficiency lighting products in Duke Energy's service territory? Why do you say that?
   [IF UNABLE TO COMMENT ON DUKE ENERGY SERVICE TERRITORY, PROBE FOR THE SOUTHEAST REGION OR AT THE NATIONAL LEVEL]

[ASK OF MANUFACTURERS]

7. The types of lighting products manufactured has changed quite a bit over the past ten years. The rate of changes has accelerated in the past few years in terms of the reduction in traditional incandescents and the introduction of EISA-compliant halogens and LEDs. What have been the main factors driving these changes? [PROBE FOR RELATIVE INFLUENCE OF EISA, THE DEP PROGRAM, EE LIGHTING PROGRAMS MORE GENERALLY ACROSS THE COUNTRY, NEED TO STAY AHEAD OF COMPETITORS, TECHNOLOGICAL ADVANCEMENTS IN OTHER FIELDS (E.G. CONNECTED HOMES)].
   a. How, if at all, has the program affected your manufacturing practices? What about your distribution practices? Do you vary your product distribution by existing consumer demand in a region?
   b. What is the impact of the federal legislation, namely EISA, on the changes in the manufacturing and distribution practices?
   c. Do you currently manufacture and/or distribute EISA-affected incandescent products?
   d. If EISA legislation were to be overturned tomorrow, how likely is it that [COMPANY] would start manufacturing and distributing EISA-affected incandescent products? Why do you say that?

[ASK OF STORE MANAGERS]

8. How do you determine which products to stock at your store(s)? [PROBE FOR ABILITY OF INDIVIDUAL STORES TO INFLUENCE WHAT IS STOCKED]

9. How, if at all, has the program affected CFL and LED stocking and product availability? Why do you say that? [PROBE SEPARATELY FOR ENERGY STAR VS. NON-ENERGY STAR PRODUCTS]
   a. Would the shelf space dedicated to CFLs and LEDs be different in the absence of the program? How different would it look? [PROBE FOR STANDARD AND SPECIALTY PRODUCTS]
   b. What is the impact of the federal legislation, namely EISA, on the changes in the stocking practices?

[ASK OF CORPORATE LEVEL CHAIN RETAILER CONTACTS]

10. Do your company's stocking practices vary by store or do you stock the same types of products across all stores?
    a. Do the stocking practices differ based on whether the store is participating in the program or not? [IF DIFFER] How do the practices differ? [PROBE FOR CFLS VS. LEDS VS. LESS EFFICIENT OPTIONS, ENERGY STAR VS. NON-ENERGY STAR CFLS AND LEDS]

[ASK ALL]

11. How much customer interest is there in the market in CFLs? What about LEDs? [PROBE FOR DIFFERENCES IN INTEREST BY STANDARD AND SPECIALTY PRODUCTS]

12. What influence does the ENERGY STAR label play in customer purchase decisions? How important would you say it is for customers that CFLs and LEDs are ENERGY STAR certified? [PROBE FOR DIFFERENCES BETWEEN CFLS AND LEDS]

13. How, if at all, has the program affected customer interest and lighting preferences? Why do you say that? What other factors played a role in the change in customer interest and preferences? [PROBE FOR RETAILER/MANUFACTURER GREEN PRACTICES, ENERGY STAR MARKETING AND EDUCATIONAL EFFORTS, OTHER EFFORTS]

14. Overall, what are the main barriers to increased adoption of CFLs and LEDs? How, if at all, do they differ for CFLs versus LEDs?

15. What changes do you expect to see in the lighting market in the next five years? Why do you say that? [Probe for changes in market share of incandescents, halogens, CFLs, ENERGY STAR LEDS AND NON-ENERGY STAR LEDS. Ask if this is the same for specialty bulbs as well]

16. Looking into the future, if the program incentive and other support were to be withdrawn, what would the lighting market look like? How, if at all, would the lighting market change without future program support? How likely is it that the sales of CFLs and LEDs would sustain in the absence of the program? What about the sales of ENERGY STAR CFLs and LEDs specifically?

Program Impacts on Product Availability and Sales

17. Thinking about your sales of lighting products in 2016 so far, are there any energy efficient lighting products that <COMPANY> would not carry or would sell substantially different quantities of if it did not participate in the Duke Energy <PROGRAM> program? [PROBE BY PRODUCT TYPE: STANDARD VS. SPECIALTY, CFLS VS. LEDS]
    [IF APPLICABLE, ASK SEPARATELY FOR EACH OF THE FOLLOWING TECHNOLOGIES:
    - Standard CFLs
    - Specialty CFLs
    - Standard LEDs
    - Specialty LEDs
    - CFL or LED fixtures]

[FOR MANUFACTURERS ONLY WHERE APPLICABLE, ASK BY RETAIL CHANNEL]

18. If Duke Energy discontinued its program, do you think sales of [TECHNOLOGY] would stay the same or change?
    a. [IF SALES WOULD CHANGE] What would the percent change in sales for [TECHNOLOGY]? [IF UNABLE TO PROVIDE EXACT PERCENTAGE, PROBE FOR BEST ESTIMATE]

19. Why do you think the sales would have been [INSERT RESPONSE FROM Q18A]? How did you come up with this percent change estimate?
    [ASK IF INCREASE IN EFFICIENT BULB SALES WAS REPORTED DUE TO THE PROGRAM]

20. If the DEP program did not exist and you were selling fewer ENERGY STAR [TECHNOLOGY] as a result, what type of light bulb do you think customers would have purchased instead? Would they have purchased less efficient technologies such as incandescents and halogens, would they have shifted to non-ENERGY STAR CFLs or LEDs, or would they just purchased fewer light bulbs overall?

[ASK OF MANUFACTURERS]

21. Are there any retailers or retailer categories that would not be selling energy efficient lighting products if the program had not been available?
    a. Why do you say that?
    b. What retailers are they?

Program Satisfaction

I would now like to ask you a few questions about your satisfaction with Duke Energy <PROGRAM> program.

22. Using a scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, overall, how satisfied are you with Duke Energy program?
    a. Why do you give it this rating?
    b. What aspects of Duke Energy program work particularly well? Why do you say that?
    c. What aspects of the program do not work well and could be improved?

23. Using that same scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the variety and types of products discounted through the program?
    a. Why do you give it this rating?
    b. Are there any types of lighting you would like to see added to the program? If so, what are they? Why would you like to see these products discounted through the program?

24. Using that same scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the size of discounts provided through Duke Energy program? [IF NEEDED, PROBE FOR SATISFACTION WITH DISCOUNTS BY LIGHTING TECHNOLOGY]
    a. Why do you give it this rating?
    b. Are you ever concerned that the discounts may be so large that the increased sales won't cover your loss in topline revenue due to the discount?

25. Using that same 0 to 10 scale, how satisfied are you with the program tracking and invoicing process?
    a. Why do you give it this rating?

Marketing and Education

[SKIP FOR MANUFACTURERS]

26. Using a scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the program marketing materials? [IF NEEDED, PROBE FOR POP AS WELL AS OTHER PROGRAM MARKETING]
    a. Why do you give it this rating?
    b. Do you have a sense of the impact of the signage and marketing materials on bulb sales?

27. Are there additional types of marketing that you would like the program to provide or that you think would encourage the sales of energy efficient bulbs?

Suggestions for Program Improvement

28. Do you have any other suggestions about how the Duke Energy program could be improved? What suggestions do you have to make it easier for retailers/manufacturers like <RETAILER/MANUFACTURER> to participate in the program?

These are all the questions that I have for you. Thank you very much for your time and participation.

Appendix D. Shelf Audit Data Collection Instrument

DEP Residential Energy Efficient Lighting & DEC Retail LED Lighting Programs

Retailer Lighting Shelf Audit

DRAFT

September 7, 2016

The main purpose of this data collection instrument is to collect information on the lighting products available at a sample of participating and non-participating retailers. The results will be used to adjust baseline wattages, describe shelf space dedicated to various technologies, and describe the presence of program marketing materials.

Retailer Information

S1. Enter the following information for the store you are about to visit.
- a. Utility:
- b. Retailer ID:
- c. Store Name:
- d. Store Address:
- e. Participating Retailer: Yes, No

Lighting Inventory – General Service Products

GS1. Please indicate whether each of the following lighting products are available at the store.
- a. General service medium screw-based incandescent
- b. General service medium screw-based halogen
- c. General service medium screw-based CFL
- d. General service medium screw-based LED
  1. Yes
  2. No

General Service – Incandescent

GSI1. Please indicate which incandescent wattage(s) is (are) available at this store.

	[SHOW IF GS1A=1] Incandescent Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSI2. For each of the following wattages, please provide the count of SKUs available at this store. [ONLY SHOW WATTAGES WITH YES RESPONSES TO GSI1]

	a. Count of SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]

GSI3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSI1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price	c. Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – Halogen

GSH1. Please indicate which equivalent halogen wattages are available at this store.

	[SHOW IF GS1B=1] Halogen Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSH2. For each of the following wattages, please provide the count of SKUs available at this store. [ONLY SHOW WATTAGES WITH YES RESPONSES TO GSH1]

	a. Count of SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]

GSH3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSH1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price	c. Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – CFL

GSC1. Please indicate which equivalent CFL wattages are available at this store.

	[SHOW IF GS1C=1] CFL Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSC1aa. Are there only ENERGY STAR CFLs, a mix of ENERGY STAR and non-ENERGY STAR CFLs, or only non-ENERGY STAR CFLs available?

1. Only ENERGY STAR CFLs
2. A mix of ENERGY STAR and non-ENERGY STAR CFLs
3. Only non-ENERGY STAR CFLs

[DO NOT SHOW GSC2AA IF GSC1AA=3]
[DO NOT SHOW GSC2BB IF GSC1AA=1]
GSC2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSC1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW GSC3A-C IF GSC1AA=3]
[DO NOT SHOW GSC3D-F IF GSC1AA=1]
GSC3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the CFL bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSC1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. ENERGY STAR Four-bulb Pack Price	d. Non-ENERGY STAR One-bulb Pack Price	e. Non-ENERGY STAR Two-bulb Pack Price	f. Non-ENERGY STAR Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – LED

GSL1. Please indicate which equivalent LED wattages are available at this store.

	[SHOW IF GS1D=1] LED Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSL1aa. Are there only ENERGY STAR LEDs, a mix of ENERGY STAR and non-ENERGY STAR LEDs, or only non-ENERGY STAR LEDs available?
1. Only ENERGY STAR LEDs
2. A mix of ENERGY STAR and non-ENERGY STAR LEDs
3. Only non-ENERGY STAR LEDs

[DO NOT SHOW GSL1b IF GSL1aa=1]
GSL1bb. What is the longevity of the bulb life for NON-ENERGY STAR LEDs?
1. 25 years
2. 20 years
3. 15 years
4. 10 years
5. 7 years
6. 5 years
00. (Other, please specify)

[DO NOT SHOW GSL2AA IF GSL1AA=3]
[DO NOT SHOW GSL2BB IF GSL1AA=1]
GSL2. For each of the following wattages, please provide the count of SKUs available at this store.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSL1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW GSL3A-C IF GSL1AA=3]
[DO NOT SHOW GSL3D-F IF GSL1AA=1]
GSL3. For each of the following wattages, please provide the count of SKUs available at this store and the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSL1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. ENERGY STAR Four-bulb Pack Price	d. Non-ENERGY STAR One-bulb Pack Price	e. Non-ENERGY STAR Two-bulb Pack Price	f. Non-ENERGY STAR Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Lighting Inventory – Reflector Products

R1. Please indicate whether each of the following lighting products are available at the store.
- a. Reflector medium screw based incandescent
- b. Reflector medium screw based Halogen
- c. Reflector medium screw based CFL
- d. Reflector medium screw based LED
  1. Yes
  2. No

Reflectors – Incandescent

RI1. Please indicate which incandescent wattage(s) is (are) available at this store.

	[SHOW IF R1A=1] Incandescent Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RI2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RI1]

	a. Count of SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]

RI3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the incandescent bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RI1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – Halogen

RH1. Please indicate which equivalent halogen wattages are available at this store.

	[SHOW IF R1B=1] Halogen Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RH2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RH1]

	a. Count of SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]

RH3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the halogen bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RH1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – CFL

RC1. Please indicate which equivalent CFL wattages are available at this store.

	[SHOW IF R1C=1] CFL Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RC1aa. Are there only ENERGY STAR CFLs, a mix of ENERGY STAR and non-ENERGY STAR CFLs, or only non-ENERGY STAR CFLs available?

1. Only ENERGY STAR CFLs
2. A mix of ENERGY STAR and non-ENERGY STAR CFLs
3. Only non-ENERGY STAR CFLs

[DO NOT SHOW RC2AA IF RC1AA=3]
[DO NOT SHOW RC2BB IF RC1AA=1]
RC2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RC1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW RC3A-B IF RC1AA=3]
[DO NOT SHOW RC3C-D IF RC1AA=1]
RC3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the CFL bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RC1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. Non-ENERGY STAR One-bulb Pack Price	d. Non-ENERGY STAR Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – LED

RL1. Please indicate which equivalent LED wattages are available at this store.

	[SHOW IF R1D=1] LED Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

[DO NOT SHOW RL2AA IF RL1A=3]
[DO NOT SHOW RL2BB IF RL1A=1]

RL2. For each of the following wattages, please provide the count of SKUs.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RL1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW RL3A-B IF RL1A=3]
[DO NOT SHOW RL3C-D IF RL1A=1]

RL3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the LED bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RL1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. Non-ENERGY STAR One-bulb Pack Price	d. Non-ENERGY STAR Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Photos

PH1. Please take photos of the lighting aisle and confirm once done.
1. Confirm

Program Point-of-Purchase Marketing

[COLLECT FOR PARTICIPATING RETAILERS ONLY]

M1. Are there any Duke Energy Lighting program point-of-purchase marketing materials at this store?

1. Yes
2. No

[ASK IF M1=1]

M2. What types of materials are present at the store? Select all that apply

01. Was…now price signs
02. Shelf labels
03. End-caps
04. Sponsor signs
05. Hand tags
06. Point-of-Purchase displays
07. Wobblers
08. Shelf-hanging banners
09. Sponsor posters
10. Window clings
11. Stickers
00. Other, specify

M3. Please take photos of marketing materials and select confirm once done.

1. Confirm

This completes the visit.

Appendix E. Residential Lighting Logger Recruitment Survey

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study Recruitment Instrument

FINAL

March 30, 2016

Survey Background

The primary goal of this recruitment survey is to identify DEP and DEC residential customers who have at least one LED in their home and recruit them for the lighting logger study. In addition, we will use the survey to collect key sociodemographic and household information for sampling purposes and better planning of the lighting logger deployment site visits.

Introduction – Telephone

Hello, my name is _________ and I'm calling from Opinion Dynamics on behalf of Duke Energy. May I please speak with <CUSTOMER NAME> or the person responsible for paying your utility bills? [ASK TO SPEAK TO CORRECT PERSON: "Is there anyone else in your household who is knowledgeable about your electric bill?"]

Just to confirm, do you receive an electric bill from Duke Energy at <ADDRESS>? [IF NO, THANK AND TERMINATE]

Your household has been randomly selected to participate in a lighting study for Duke Energy. This study is a part of the energy efficiency programs that Duke Energy is administering in North and South Carolina. Your participation is very important and will help improve Duke Energy energy efficiency offerings moving forward. Your responses will be used for analytic purposes only and will remain strictly confidential. If you qualify and agree to participate in the study, we will give you $100 as a token of appreciation. Let me assure you that we are not selling anything.

[IF NEEDED: This survey will only take a few minutes of your time.]

[IF NEEDED: IF YOU HAVE QUESTIONS ABOUT THIS SURVEY OR WOULD LIKE TO VERIFY THE LEGITIMACY OF THIS STUDY, PLEASE CONTACT MELINDA GOINS at 704-382-3827 OR BY EMAIL AT MELINDA.GOINS@DUKE-ENERGY.COM]

C1. Are you currently talking to me on a regular landline phone or a cell phone?
1. Regular landline phone
2. Cell phone
8. (Don't know)
9. (Refused)

[ASK IF C2 = 2]

C2. Are you currently in a place where you can talk safely and answer my questions?
1. Yes
2. No [SCHEDULE CALL BACK]
8. (Don't know) [SCHEDULE CALL BACK]
9. (Refused) [SCHEDULE CALL BACK]

Introduction – Internet

Welcome to the Duke Energy Progress survey! Thank you for participating in this important study. This study is a part of the energy efficiency programs that Duke Energy is administering in North and South Carolina. Your participation is will help improve Duke Energy efficiency offerings moving forward. If you qualify and agree to participate in this study, we will give you $100 as a token of appreciation.

Please have the person knowledgeable about your electric bill you receive at 935 Burkett Rd Dover NC, 28526 take this survey. That person can either take over the survey from you or you can close out of the survey and have that person start the survey again using the same five-digit pin number on the invitation letter or reminder letter.

QI1. To start, can you please confirm if you receive an electric bill from Duke Energy at <ADDRESS>?
1. Yes, correct
2. No, incorrect [THANK & TERMINATE]

Study Eligibility

Before I can confirm your participation, I need to ask you a few additional questions to ensure you are eligible for the study. The questions will take just a few minutes to complete.

S3. Do you have any CFLs installed inside or outside your home?

[FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] CFLs are also known as compact fluorescent lamps. The most common type is made with a glass tube bent into a spiral shape resembling soft-serve ice cream. Some CFLs may have a plastic or glass cover over the spiral tube.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
CFLs are also known as compact fluorescent lamps. The most common type is made with a glass tube bent into a spiral shape resembling soft-serve ice cream. Some CFLs may have a plastic or glass cover over the spiral tube. Below are some examples of what CFLs look like.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure [DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

[ASK IF S3=1]

S3a. Do you have CFLs installed inside your home, outside your home, or both inside and outside your home? Consider any CFLs installed in garages as installed outside your home.

1. Inside
2. Outside
3. Both inside and outside
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

[ASK IF S3=1]

S3b. About how many CFLs would you estimate you have installed both inside and outside your home in total? Your best estimate is fine. [NUMERIC OPEN END]

0000. NUMERIC OPEN END
9998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9999. (Refused)

[ASK IF S3A=1,3]

S3c. Thinking just about CFLs installed **inside** your home, do you have any of the following CFL products?

a. Standard CFLs. Standard CFLs are spiral shaped CFLs that fit into a regular light socket and can be used to replace your basic general purpose light bulbs (traditionally incandescent).
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of standard CFLs.

b. Reflector CFLs or CFL flood lights. These bulbs are generally used in recessed ceiling fixtures.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of reflector CFLs.

c. Specialty CFLs. Specialty CFLs include bulbs with small candelabra base or pin base, three-way bulbs, and globe shaped bulbs.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of specialty CFLs.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

S4. Do you have any LEDs installed inside or outside your home?
[FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] LEDs or light emitting diode lamps are the newest type of bulb in the market. They often have a plastic base between the screw and the glass, sometimes with ridges. LEDs typically cost more and last longer than the other types of light bulbs.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
LEDs or light emitting diode lamps are the newest type of bulb in the market. They often have a plastic base between the screw and the glass, sometimes with ridges. Below are some examples of what LEDs look like.

Please do not include LED Christmas tree lights or LED night lights.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

[ASK IF S4=1]
S4a. Do you have LEDs installed inside your home, outside your home, or both inside and outside your home? Consider any LEDs installed in garages as installed outside your home.

1. Inside
2. Outside
3. Both inside and outside
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

[ASK IF S4=1]
S4b. About how many LEDs would you estimate you have installed both inside and outside your home in total? Your best estimate is fine. [NUMERIC OPEN END]

00. NUMERIC OPEN END
9998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9999. (Refused)

[ASK IF S4A=1,3]

S4c. Thinking just about LEDs installed **inside** your home, do you have any of the following LED products?

a. Standard LEDs. Standard LEDs fit into a regular light socket and can be used to replace your basic general purpose light bulbs (traditionally incandescent).

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of standard LEDs.

b. Reflector LEDs or LED flood lights. These bulbs are generally used in recessed ceiling fixtures.

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of reflector LEDs.

c. Specialty LEDs. Specialty LEDs include bulbs with small candelabra base or pin base, three-way bulbs, and globe shaped bulbs.

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of specialty LEDs.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

I now have just a few questions about your residence and your household.

D1. Which of the following best describes your home/residence?
- 01. Single-family detached home (Not a duplex, townhome, or apartment; attached garage is OK)
- 02. Single family attached home (Row house or townhouse)
- 03. Mobile home (Single-family)
- 04. Apartment or condominium (Multifamily)
- 00. (Other, specify)
- 98. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 99 IN THE ONLINE RECRUITER]
- 99. (Refused)

[ASK IF D1 = 4]

D2. How many apartments/housing units are in your building?
- 1. 1
- 2. 2-3
- 3. 4-9
- 4. 10 or more
- 8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
- 9. (Refused)

D3. Do you own or rent this residence?
- 1. Own
- 2. Rent
- 8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
- 9. (Refused)

D4. Including yourself, how many people currently live in your residence year-round?
- 00. [NUMERIC OPEN END]

[DO NOT SHOW OPTIONS 98 AND 99 IN THE ONLINE RECRUITER]
- 98. (Don't know)
- 99. (Refused)

D5. How many people under the age of 18 live in your residence?
- 00. [NUMERIC OPEN END]

[DO NOT SHOW OPTIONS 98 AND 99 IN THE ONLINE RECRUITER]
- 98. (Don't know)
- 99. (Refused)

D6. Approximately, how many square feet is your residence?
- 00. [NUMERIC OPEN END]
- 99998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 99999 IN THE ONLINE RECRUITER]
- 99999. (Refused)

[ASK IF D6=99998]

D7. What would you estimate the square footage of your residence to be?

1. Less than 1,000 sqft
2. Between 1,001 and 2,000 sqft
3. Between 2,001 and 3,000 sqft
4. Between 3,001 and 4,000 sqft
5. Between 4,001 and 5,000 sqft
6. Greater than 5,000 sqft
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

I have just a few final questions.

D8. In what year were you born? [RESPONSE NOT REQUIRED]

0000. [NUMERIC OPEN END 1900-2015]

[DO NOT SHOW OPTIONS 9998 AND 9999 IN THE ONLINE RECRUITER]

9998. (Don't know)

9999. (Refused)

D9. What is your highest level of education? [RESPONSE NOT REQUIRED]

1. Less than a high school degree
2. High school degree
3. Technical/trade school program
4. Associates degree or some college
5. Bachelor's degree
6. Graduate / professional degree, e.g., J.D., MBA, MD, etc.
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

D10. Which of the following best describes your current employment status? [RESPONSE NOT REQUIRED]

1. Employed full-time
2. Employed part-time
3. Retired
4. Not employed, but actively looking
5. Not employed, and not looking
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

D11. Which category best describes your annual household income in 2015? [RESPONSE NOT REQUIRED]

1. Less than $25,000
2. $25,000 to just under $50,000
3. $50,000 to just under $75,000
4. $75,000 to just under $100,000
5. $100,000 to just under $150,000
6. $150,000 or more
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

D12. [FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] Record Gender. Do not ask.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
What is your gender?
1. Male
2. Female
[DO NOT SHOW OPTIONS 8 AND 9 IN THE ONLINE RECRUITER]
8. (Don't know)
9. (Refused)

[TERMINATE IF S4CA AND S4CB<>1]

Lighting Logger Study Recruitment

L1. Great, you qualify! We would like to invite you to participate in a study that will help Duke Energy Progress understand how customers like you use lighting. As a token of appreciation, we will give $100 if you participate in the study.

As part of the study, we will visit your home and install small devices called light loggers on various light fixtures in your home. These loggers simply measure lighting usage and will not interfere with how you use your lighting or affect the look or quality of your lighting. The visit will be brief and will be scheduled based on your availability. We will leave loggers in place for a few months, and will then schedule a second visit to retrieve them. Would you be willing to participate in this study?
1. Yes
2. No [THANK AND TERMINATE]
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER] [THANK AND TERMINATE]
9. (Refused) [THANK AND TERMINATE]

L2. A technician will be following up with you to schedule a site visit in the next couple of weeks. Do you have any general preference of days and/or times that would work for this visit? We are not scheduling your appointment at this time, but we will try to accommodate your preference as best we can. [PROBE: WOULD WEEKDAYS OR WEEKENDS WORK BETTER FOR YOU? ARE MORNINGS, AFTERNOONS OR NIGHTS BETTER?]
1. Yes – [RECORD PREFERENCES (INCLUDE AM/PM)]
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

L3. Thank you. Let me confirm your address.
<ADDRESS>
<CITY>
<ZIP>
Is that correct?
1. Correct
2. Incorrect

[ASK IF L3=2]
L4. What is the correct address?
00. Address:
01. City:
02. Zip:

L5. [SHOW FOR PHONE SURVEY] And is <PHONE> the best number to reach you at, or is there a better number we can use to reach you?
- 01. Phone number on record is the best number.
- 00. Alternative phone number provided [RECORD ALTERNATIVE PHONE NUMBER]

L5. [SHOW FOR WEB SURVEY] Is there a phone number we can use to reach you? [RESPONSE NOT REQUIRED]
- 00. [NUMERIC OPEN END]

EMAIL. [ONLY SHOW FOR PHONE SURVEY]
- 00. Would you like to provide an email address we can use to schedule the visit?
- 99. (Does not wish to provide email)

[ASK IF NAME IS AVAILABLE]
L6. When calling back to schedule an appointment, should we ask for you or is there someone else that we could also schedule the appointment with?
- 01. Just me
- 00. [RECORD THE NAME]

[ASK IF NAME IS NOT AVAILABLE]
L7. When calling back to schedule an appointment, who should we ask for?
- 00. [OPEN END]

Those are all the questions I have for you. Thank you very much for your time. If you are selected, a technician will be contacting you within the next couple of weeks to schedule an appointment for the visit.
IF NEEDED: If you have any questions about the study, please feel free to contact Dan Chen at 617-301-4636.
IF NEEDED: To verify this study, please contact Melinda Goins at Duke Energy at 704-382-3827 or by email at melinda.goins@duke-energy.com

Thank you again for your time. Duke Energy greatly appreciates your participation.

Appendix F. Residential Lighting Logger Deployment Instrument

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study Onsite Data Collection Instrument

Final

March 30, 2016

Survey Background

The primary goal of this instrument is to support lighting inventory and logger deployment in residential homes in Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) jurisdictions.

General Information

[FIELD TECHNICIANS CAN FILL THIS SECTION PRIOR TO THE START OF THE VISIT]

I1. Please enter customer's ODCID number: [NUMERIC 10000-99999]

I2. Please enter inspector's name.

I3. Please enter the customer's name. [OPEN RESPONSE]

I4. Please enter address of the residence.

Building Information

B1. What is the residence type? [IF NEEDED, CONFIRM WITH THE CUSTOMER]
- 01. Single-family detached building
- 02. Mobile Home/Manufactured home
- 03. Condominium
- 04. Duplex/Two-family
- 05. Multi-family building (3 or more units)
- 06. Townhouse
- 00. Other, specify [OPEN END]
- 99. Can't assess

[ASK IF B1=3 OR B1 = 5]
B2. How many units are in this building? [IF NEEDED, CONFIRM WITH THE HOMEOWNER]
1. Between 3 to 5 units
2. Between 6 to 10 units
3. Greater than 10 units
8. Don't know
9. Can't assess

[ASK CUSTOMER]
B3. Approximately how many square feet is this residence? [NUMERIC OPEN END]
99998. Don't know
99999. Can't assess

[ASK IF B3=99998]
[ASK CUSTOMER]
B4. What would you estimate the square footage of your residence to be?
1. Less than 1,000 sqft
2. Between 1,001 and 2,000 sqft
3. Between 2,001 and 3,000 sqft
4. Between 3,001 and 4,000 sqft
5. Between 4,001 and 5,000 sqft
6. Greater than 5,000 sqft
8. Don't know
9. Can't assess

[ASK CUSTOMER]
B5. Does this home have central air conditioning?
1. Yes
2. No
9. Can't assess

[ASK CUSTOMER]
B6. What is the primary heating fuel used to heat this home?
01. Electric
02. Gas
03. Propane
04. Oil
00. Other, specify [OPEN END]
99. Can't assess

[ASK IF B6=1]
[ASK CUSTOMER]
B6a. Which of the following is the system used to heat the majority of your home?
01. Heat pump
02. Electric resistance heat
00. Other, specify [OPEN END]
99. Can't assess

Socket Selection for Logger Placement

B7a. Please conduct an initial walk-through of the home and record rooms that contain at least one LOGGABLE switch.

B7. Please enter the number of rooms with loggable switches (MUST CONTAIN AT LEAST ONE LED BULB). [NUMERIC 0-20; 98= Not available, 99=Can't assess]
1. Kitchen (Up to 2)
2. Living room (Up to 3)
3. Bedroom (Up to 6)
4. Bathroom (Up to 4)
5. Dining room (Up to 2)
6. Basement (Up to 2)
7. Other (Hallway/Laundry/Office/Storage/Closet) (Up to 9)

[CREATE A TABLE BASED ON <B7 RESPONSE>]

B8. Please record the LOGGABLE switches in the following LOGGABLE rooms.
[NUMERIC 0-20; 98= Not available, 99=Can't assess]
NUMBER OF SWITCHES PER ROOM (UP TO 10 EACH)

[CREATE UP TO 8 RANDOM SELECTIONS OF LOGGABLE SWITCHES FOR LOGGER INSTALLATION]

B9. Please record the randomly selected switches on the paper form and take a photo of the form.
1. Confirm
0. Other, specify [OPEN END]

Lighting in Storage

LS1. Are there any light bulbs in storage? [IF NECESSARY: ASK HOMEOWNER]
1. Yes
2. No
9. Can't assess

LS2. Please record the following information for each bulb in storage with the same base type, bulb type, and bulb shape.

[SKIP TO R1 IF LS1 = 2 OR 9]
SS1. Please select the base type of bulb in storage:
1 Medium screw-based
2. Small/Candelabra screw-based
3. Large/Mogul screw-based
4. Pin-based
0. Other, specify [OPEN END]
9. Can't assess

SS2. Please select the bulb type:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
0. Other, specify [OPEN END]
9. Can't assess

SS3. Please select the bulb shape:
1. Standard shape/A Lamp/Pear shape [HIDE IF SS2 = 3]
2. Twist/Spiral [ALLOW IF SS2 = 0, SS2 =2]
3. Globe [HIDE IF SS2 = 3]
4. Bullet/Torpedo/Candelabra [HIDE IF SS2 = 3]
5. Bug light [HIDE IF SS2 = 3]
6. Spot/Reflector/Flood [HIDE IF SS2 = 3]
0. Other, specify [OPEN END]
9. Can't assess

SS5. How many total bulbs in storage are exactly like this one? (SAME BASE TYPE, BULB TYPE, AND BULB SHAPE) [NUMERIC OPEN END, 0 – 100]

SS6. Is there another type of bulb in storage?
1. Yes
2. No

[GO THROUGH LOOP SS1 – SS6 IF SS6=1, IF NOT SKIP TO R1]

Interior Lighting Inventory

TR1. Please go through the house room by room recording the following information for each room.

[BEGIN ROOM BY ROOM LIGHTING INVENTORY AND LIGHTING LOGGING LOOP]
R1. Please select a room type to collect lighting inventory:
01. Basement (finished)
02. Basement (unfinished)
03. Foyer/Hallway
04. Bathroom
05. Laundry
06. Bedroom
07. Kitchen
08. Living room/Family room
09. Garage
10. Office
11. Dining room
12. Enclosed porch/Sunroom/3 season room
13. Storage
14. Closets
15. Attic
16. Crawlspace
00. Other, specify [OPEN END]
99. Can't assess

R2. Do you have access to this room to collect lighting data?
1. Yes
2. No (provide reasons)

[ASK IF R2=1, ELSE SKIP TO END OF LOOP]
R3. Is there a window in this room?
1. Yes
2. No
9. Can't assess

R4. How many total light switches are in this room? [NUMERIC OPEN END]

S1. Please record the following information for each switch in the room.
S2. What is the control type of this switch?
1. On/off switch
2. Dimmable
3. 3-way
4. Motion sensor
5. Timer
0. Other, specify [OPEN END]
9. Can't assess

S3. Are there any empty sockets on this switch?
1. Yes
2. No
9. Can't assess

[ASK IF S3=1]
S4. How many empty sockets are there on this switch? [NUMERIC OPEN END]

Questions S5-S9 are about each unique socket type on this switch. [EACH SOCKET TYPE SHOULD HAVE THE SAME CONTROL, SOCKET TYPE, BULB TYPE, AND BULB SHAPE]

S5. Please select the socket type on this switch: [IF MORE THAN ONE SOCKET TYPE, RESPOND FOR FIRST, THEN FOR ADDITIONAL TYPES IN QUESTION S9]
1. Medium screw-based
2. Small/Candelabra screw-based
3. Large/Mogul screw-based
4. Pin-based
0. Other, specify [OPEN END]
9. Can't assess

S6. Please select the bulb type in this socket:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
6. Infrared
0. Other, specify [OPEN END]
9. Can't assess

S7. Please select the bulb shape for this socket:
1. A-Lamp
2. Twist/Spiral
3. Globe
4. Bullet/Torpedo/Candelabra
5. Spot/Reflector/Flood
0. Other, specify [OPEN END]
9. Can't assess

S7a. Please select the fixture type:
- 01. Recessed ceiling fixture
- 02. Non-recessed ceiling fixture
- 03. Ceiling fan
- 04. Table/Desk lamp
- 05. Floor Lamp/Torchiere
- 06. Wall mounted
- 07. Track lighting
- 08. Garage door
- 10. Chandelier
- 11. Pendant
- 00. Other, specify [OPEN END]
- 99. Can't assess

S8. How many total sockets on this switch are exactly like this one? [NUMERIC OPEN END] [NOTE TO AUDITOR: "LIKE" SOCKETS SHOULD HAVE THE SAME CONTROLS, SOCKET TYPE, BULB TYPE, AND BULB SHAPE.]

S9. Is there another socket type on this switch?
1. Yes
2. No

[IF S9=1 REPEAT LOOP S5-S9 (UP TO 3 TIMES), ELSE GO TO S10]

[CALCULATE S8_SUM = SUM OF RESPONSES FROM S8]

S10. Please confirm that there is a total of <S8_SUM> bulbs on this switch.
1. Yes
2. No [GO BACK TO S5]
9. Can't assess

S11. Is this a randomly selected switch for logger installation?
- 01. Yes
- 02. Yes, but logger cannot be placed (light is too high in the ceiling, configuration does not allow for logger placement, customer prefers not to log the switch).
- 03. No, switch is not randomly selected
- 00. Other, specify [OPEN END]

[ASK IF S11=1]
P1. Record the serial number of the logger you are placing on this switch. [OPEN END]

P2. Please enter a description of the lamp/fixture that the you are placing this logger on. [OPEN END]

P3. Please calibrate the logger and confirm.
0. Calibration confirmed.

P4. Please take photos of the socket the logger was placed on and a close-up photo of the logger ID and confirm.
0. Photo confirmed.

S12. Is there lighting in this room controlled by other switches?
1. Yes
2. No

R5. Are there any more rooms?
1. Yes
2. No

[IF S12=1 REPEAT LOOP S1-S12, ELSE GO TO EL1]

Exterior Lighting Inventory

EL1. Does the home exterior have any light sockets? [DO NOT AUDIT LIGHT BULBS THE RESIDENT DOES NOT PAY FOR, SUCH AS EXTERIOR LIGHTING AT AN APARTMENT COMPLEX].
1. Yes
2. No
9. Can't assess

EL2. What type of bulb(s) is/are in the primary exterior light fixture? [MULTIPLE RESPONSE]
1. CFL
2. Incandescent
3. Halogen
4. LED
0. Other, specify [OPEN END]
9. Can't assess

EX1. Please select the socket type for each exterior light socket.
1. Screw-based
2. Pin-based
0. Other, specify [OPEN END]

EX2. Please select the control type for this socket:
1. On-Off
2. Dimmable
3. 3-Way
4. Motion Sensor
5. Programmable
0. Other, specify [OPEN END]
9. Can't assess

EX3. Please select the bulb type in this socket:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
6. Empty [SKIP TO EX6]
0. Other, specify [OPEN END]

EX4. Please select the bulb shape for this socket:
- 01. Standard shape/ A lamp /pear shape [HIDE IF EX3 = 3]
- 02. Twist/Spiral [ALLOW IF EX3 = 2]
- 03. Globe [HIDE IF EX3 = 3]
- 04. Bullet/Torpedo/Candelabra [HIDE IF EX3 = 3]
- 05. Bug light [HIDE IF EX3 = 3]
- 06. Spot/Reflector/Flood [HIDE IF EX3 = 3]
- 00. Other, specify [OPEN END]
- 98. Not applicable
- 99. Can't assess

[ASK IF EX4 = 1]
EX4a. Please select the fixture type:
- 1. Recessed ceiling fixture
- 2. Non-recessed ceiling fixture
- 3. Wall mounted
- 4. Lamp post or other free standing light
- 0. Other, specify [OPEN END]
- 9. Can't assess

EX5. How many total exterior sockets are exactly like this one? [NUMERIC OPEN END] (NOTE TO AUDITOR THAT A SOCKET TYPE SHOULD HAVE THE SAME BULB TYPE, BULB SHAPE, AND CONTROL TYPE)

EX6. Is there another socket type on the exterior of the home?
- 1. Yes
- 2. No

[GO THROUGH LOOP EX1-EX6 IF EX6=1, IF NOT SKIP TO LR1]

LED Replacement

LR1. Approximately when did you first install LEDs in your home? [RECORD YEAR AND MONTH] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

LR1a. What prompted you to try LEDs over other bulb types? [OPEN END]

LR2. Did you install all of your LEDs at the same time or did you install them over time?
- 1. Same time
- 2. Over time
- 8. Can't recall

LR3. When was the most recent time that you installed an LED? [RECORD YEAR AND MONTH] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

LR4. I would also like to know what was in the sockets before you installed LEDs in them. Did you replace working light bulbs with LEDs, did you replace burnt out bulbs with LEDs, or did you install LEDs in empty sockets? [MULTIPLE RESPONSE]
- 1. Replaced working bulbs
- 2. Replaced burnt out bulbs
- 3. Installed in empty sockets
- 8. Can't recall

[ASK IF LR4=1]
LR5. If you were to estimate, how many sockets had working bulbs in them before you installed LEDs in them? [NUMERIC OPEN END] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

[ASK IF LR4=1 OR 2]
LR6. And what type or types of bulbs did the LEDs replace? [MULTIPLE RESPONSE]
1. Incandescents
2. Halogens
3. CFLs

[ASK IF LR6=3]
LR7. Approximately, how many LEDs were installed in sockets with CFLs in them? [NUMERIC OPEN END] [IF NEEDED: YOUR BEST ESTIMATE IS FINE] [IF NEEDED: CFLS ARE ALSO KNOWN AS COMPACT FLUORESCENT LAMPS. THE MOST COMMON TYPE IS MADE WITH A GLASS TUBE BENT INTO A SPIRAL SHAPE RESEMBLING SOFT-SERVE ICE CREAM. SOME CFLS MAY HAVE A PLASTIC OR GLASS COVER OVER THE SPIRAL TUBE.]

[ASK IF LR7=9998]
LR8. Would you say you had CFLs in most, some, or just a few of the sockets where you installed LEDs?
1. Most
2. Some
3. Just a few
4. Can't recall

Closing

Thank you very much for participating in this study. I have a $50 gift card for you, and we will be in touch in about 6 months to come and retrieve the loggers we installed today. Upon retrieval of those loggers, you will receive another $50 gift card. Thank you again for taking the time to be a part of this important study.

G1. Record gift card number [Numeric 00000000-99999999].

Appendix G. Residential Lighting Logger Retrieval Instrument

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study On-Site Logger Retrieval Instrument

FINAL

October 25, 2016

Study Background

The residential lighting logger study is a part of the impact evaluation of the PY2017 Duke Energy Progress (DEP) Energy Efficient Lighting program and Duke Energy Carolinas (DEC) Energy Efficient Appliances and Devices program. The key goal of the study is to estimate hours of use and coincidence factors for LEDs among residential customers in DEP and DEC jurisdictions. As part of the study, we will also develop updated estimates of LED in-service rate (ISR). The results from this study will be used to estimate program energy and demand savings impacts for PY2017 and beyond.

This data collection instrument will guide the retrieval of lighting loggers deployed in the spring 2016.

General Information

[FIELD TECHNICIANS CAN FILL THIS SECTION PRIOR TO THE START OF THE VISIT]

I1. Please enter customer's ODCID number. [NUMERIC OPEN END]

I2. Please enter field technician's name. [OPEN END]

I3. Please enter the customer's name. [OPEN RESPONSE]

I4. Please enter the address of the residence. [OPEN RESPONSE]

Logger Retrieval

L0. [ASK CUSTOMER] Now, I'm going to remove all of the loggers we placed in your home. Would you please accompany me?

[PLEASE DO NOT RETRIEVE OR MOVE THE LOGGER UNTIL AFTER TESTING ITS SENSITIVITY IN ITS CURRENT POSITION]

Please select the switch of the logger you are about to retrieve.
[LIST OF SWITCH NAMES BY ROOM TYPE, SWITCH TYPE, AND LOGGER ID; 97=Switch not listed (1) 98=Switch not listed (2); 99=No more loggers to collect]

[REPEAT L1A-L10 FOR ALL SWITCHES WITH LOGGERS]

[SKIP TO L11 IF L0=99]

[ASK IF L0<>97,98]
L1a. Please confirm the room type where this logger is installed.
[READ IN ROOM TYPE]
1. Confirm that the room type is correct
2. Room type is different

[ASK IF L0=97,98 OR L1a=2]
L2a. Please select the room type from which you are retrieving this logger.
01. Basement (finished)
02. Basement (unfinished)
03. Foyer/Hallway
04. Bathroom
05. Laundry
06. Bedroom
07. Kitchen
08. Living room/Family room
09. Garage
10. Office
11. Dining room
12. Enclosed porch/Sunroom/3 season room
13. Storage
14. Closets
15. Attic
16. Crawlspace
00. Other, specify [OPEN END]

[ASK IF L0<>97, 98]
L1b. Please confirm the control type associated with this logged switch.
[READ IN SWITCH TYPE]
1. Confirm that the control type is correct
2. Control type is different

[ASK IF L0=97,98 OR L1B=2]
L2b. What is the control type on this switch?
1. On/off switch
2. Dimmable
3. 3-way
4. Motion sensor
5. Timer
0. Other, specify [OPEN END]

[ASK IF L0<>97, 98]
L1c. Please confirm that the following bulbs are associated with this logged switch.
[READ IN BULB COUNTS BY BULB TYPE]
1. Confirm that the bulb count by technology is correct
2. Bulb type by technology is different

[ASK IF L0=97,98 OR L1C=2]
L2c. Please record the current counts of bulbs on this switch by technology.

Incandescents	Halogens	CFLs	LEDs	Other	Cannot Assess	Empty Sockets
a.	b.	c.	d.	e.	f.	g.

L1d. [ASK CUSTOMER] During the time the logger was installed or since [LOGGER INSTALL DATE], how often did you turn on this switch?
1. Never
2. Occasionally
3. Every day
4. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)
0. Other, specify [OPEN END]

L1e. [ASK CUSTOMER] Is it possible that this light was turned on either ALL the time or MOST of the time since [LOGGER INSTALL DATE]?
1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

L1f. Is there a potential for light interference that the logger can be picking up on?
00. Yes – please describe [OPEN END]
02. No
99. Cannot assess

L3. Please retrieve the logger. Prior to retrieving, please test the logger's ability (in its current position) to sense whether the switch is on or off. As currently installed, does the logger correctly register whether the switch is on or off?
1. Yes
2. No, registers as ON when switch is OFF
3. No, registers as OFF when switch is ON
4. No, logger does not register ON or OFF
0. Other, specify

L4. What is the current condition of this logger?
1. Functioning normally
2. Dead battery (blank screen)
3. Melted
4. Otherwise broken/non-operational
0. Other, specify

[ASK IF L0<>97, 98]
L5. Please confirm the logger ID.
[READ IN LOGGER ID]
1. Confirm that the logger ID is accurate
2. Logger ID is different

[ASK IF L0=97,98 OR L5=2]
L6. Please enter logger ID. [OPEN END]

L7. [ASK CUSTOMER] Did you or anyone else in your household remove the logger at any point since the installation?
1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF L7=1]

L8. [ASK CUSTOMER] When was the logger removed? [RECORD DAY AND MONTH] [IF NECESSARY: AN APPROXIMATE DATE IS FINE]

1. [OPEN END]
2. Don't remember
9. Cannot assess (customer unable to provide an answer)

[ASK IF L7=1]

L9. [ASK CUSTOMER] When was the logger reinstalled? [RECORD DAY AND MONTH] [IF NECESSARY: AN APPROXIMATE DATE IS FINE]

1. [OPEN END]
2. Don't remember
9. Cannot assess (customer unable to provide an answer)

L10. [ASK CUSTOMER] Who reattached this logger?

01. Field representative
02. Customer/household member
00. Other; specify
98. Not sure (customer response)
99. Cannot assess (customer unable to provide an answer)

[LOOP BACK TO QL0 FOR NEXT LOGGER OR TO MARK IF DONE]

L11. [ASK CUSTOMER] Are there any loggers that were removed and not reattached?

1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF L11=1]

L12. List logger ID, approximate date of logger removal and any notes related to logger removal, such as the room type the logger was installed in, the switch information, if available, etc.
[REPEAT FOR UP TO 4 LOGGERS] [ALLOW TO SKIP OUT STARTING AT SECOND LOGGER IF JUST ONE]
Logger ID [OPEN END]
Date of removal [DAY AND MONTH]
Relevant notes [OPEN END]

[ASK IF NUMBER OF RETRIEVED LOGGERS (INCLUDING L12 LOGGERS) IS LESS THAN THE NUMBER OF DEPLOYED LOGGERS]

L13. Our records show that the total of [DEPLOYED LOGGER COUNT] were deployed in this home and so far, [RETRIEVED LOGGER COUNT] were retrieved. Please record the reasons for the missing loggers. [ASK HOMEOWNER IF NEEDED] [OPEN END. PROVIDE SPECIFICS FOR EACH MISSING LOGGER IF NEEDED]

Occupancy

[ASK CUSTOMER]

O1. During the time that loggers were installed or since [LOGGER INSTALL DATE] were there any people at home all or most weekdays?

1. Yes
2. No
3. Cannot remember (customer response)
9. Cannot assess (customer unable to provide an answer)

O2. Since the loggers were installed on <DEPLOYDATE>, has there been any change(s) to your schedule that kept you away from home more than usual, such as business travel, vacations, or other changes?

1. Yes
2. No
3. Cannot remember (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF O2=1]
O2A. When did these changes to your routine happen?

1. Period 1: [START MONTH] to [END MONTH]
2. Period 2: [START MONTH] to [END MONTH]; 98=No more periods to list
3. Period 3: [START MONTH] to [END MONTH]; 98=No more periods to list

Lighting Purchases

LP1. Since [LOGGER INSTALL DATE], did you purchase any light bulbs for use in your home?

1. Yes
2. No
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP1=1]
LP2. What light bulbs did you purchase? [MULTIPLE RESPONSE. READ RESPONSE OPTIONS IF NEEDED. EXPLAIN WHAT EACH TYPE OF TECHNOLOGY IS]

1. Incandescents/halogens
2. CFLs
3. LEDs
0. Other, specify
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP1=1]
LP3. Did you install all some or none of the bulbs that you purchased?

1. All
2. Some
3. None
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP2=3]
LP4. Why did you purchase LEDs and not other bulb types such as incandescents or CFLs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=2]
LP5. Why did you purchase CFLs and not other bulb types such as incandescents or LEDs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=1]
LP6. Why did you purchase incandescent bulbs and not other bulb types such as CFLs or LEDs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]]

[ASK IF LP2=2 AND LP2=3]
LP7. Why did you purchase CFLs and LEDs and not incandescents? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=1 AND LP2=2 OR LP2=3]
LP8. Why did you purchase a mix of incandescents and [CFLs/LEDs] and not just [CFLs/LEDs]? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

Closing

Thank you very much for participating in this study. I have a $50 gift card for you in exchange for your participation. Thank you again for taking the time to be a part of this important study.

[REMINDER] Please collect customer's signature on the "Duke Energy Lighting Logger Study Gift Card Receipts" form.

G1. Record gift card number [Numeric 00000000-99999999].

Appendix H. Retailer and Manufacturer Interview Results

The Excel spreadsheets are provided as a separate submission and contain tabulated and anonymized responses from retailer and manufacturer interviews as well as the calculation of NTG ratios from the retailer and manufacturer interviews.

Appendix I. Shelf Audit Results

We provide the final shelf audit data package as a separate submission. As part of the package, we provide a data file in Stata and Excel accompanied by a data dictionary.

Appendix J. Residential Lighting Logger Study Results

We provide the residential lighting logger study package as a separate submission. As part of the package, we provide the following data files in Stata and Excel with associated data dictionaries:

- Hourly logger data file
- Logger-level data file

Appendix K. Sales Data Modeling Datafile

We provide the final sales data used for sales data modeling as a separate submission. As part of the package, we provide a data file in Stata and Excel accompanied by a data dictionary.

Appendix L. Leakage Rate Analysis Results

We provide the final data used for leakage rate analysis as a separate submission. As part of the package, we provide data files in Stata and Excel accompanied by a data dictionary.

Appendix M. Ex Ante Savings Assumptions and Their Sources

Table M-1 details ex ante savings assumptions and their sources for the DEP EEL and DEC Retail LED programs.

Table M-1. Ex Ante Savings Assumptions and Their Sources

<table>
<tr><th>Assumption</th><th>Residential Savings Assumption</th><th>Commercial Savings Assumption</th><th>Residential Assumption Source</th><th>Commercial Assumption Source</th></tr>
<tr><td>Sales to residential/ commercial customers*</td><td>0.823</td><td>0.10</td><td colspan="2" rowspan="2">• 2011 and 2012 DEP Intercept Surveys</td></tr>
<tr><td>Leakage rate</td><td colspan="2">0.077</td></tr>
<tr><td>Delta watts</td><td colspan="2">Baseline wattage – efficient wattage</td><td colspan="2">• Program tracking data
• 2015 Retailer Shelf Audit</td></tr>
<tr><td>HOU</td><td>2.922</td><td>6.930 (CFLs)
5.783 (LEDs)</td><td rowspan="2">• 2012 DEP Residential Metering Study</td><td rowspan="2">• 2015–2016 DEP Commercial Lighting Logger Study</td></tr>
<tr><td>CF</td><td>Summer:
0.1138
Winter:
0.0960</td><td>Summer:
0.497 (CFLs)
0.547 (LEDs)
Winter:
0.174 (CFLs)
0.120 (LEDs)</td></tr>
<tr><td>Interactive effects</td><td>0.94 (Energy savings)
1.27 (Summer peak demand savings)
0.50 (Winter peak demand savings)</td><td>1</td><td>• 2012 DOE2 Simulation Models</td><td>• No interactive effects applied</td></tr>
<tr><td>First-year ISR and carryover savings</td><td>0.795 (CFLs)
0.744 (LEDs)
1.00 (Fixtures)</td><td>0.879 (CFLs)
0.979 (LEDs)
1.00 (Fixtures)</td><td colspan="2">• 2013 General Population Survey (for CFLs and LEDs)
• Assumed value (for fixtures)
• 2014 Storage Log Study (for carryover savings trajectory)</td></tr>
</table>

* Together with the leakage rate, these values add up to 1.

Appendix N. Residential Lighting Logger Study – Additional Results

Overall average daily HOU for LEDs from the residential lighting logger study are 2.88 hours, the average summer peak CF is 0.128, and the average winter peak CF is 0.145. Table N-1 provides HOU and CF estimates from the study, along with the standard errors and relative precision surrounding the estimates.

Table N-1. HOU and Coincidence Factor Estimates

Statistic	Result	Standard Error	Relative Precision
HOU	2.881	0.151	9%
Summer CF	0.1283	0.010	12%
Winter CF	0.1451	0.011	12%

HOU and CFs vary by room type, with living rooms, kitchens, and dining rooms generating the highest HOU and CF values and bedrooms, bathrooms, and other room types generating the lowest HOU and CF values. Table N-2 provides HOU and CF estimates by room, as well as percent of sockets with LEDs in each room.

Table N-2. HOU and Coincidence Factor Estimates by Room

Room Type	# of Loggers	% of Sockets with LEDs	HOU	Summer CF	Winter CF
Dining room	20	17%	4.27	0.235	0.198
Kitchen	35	45%	4.26	0.220	0.266
Basement	2	14%	3.75	0.335	0.230
Living room	85	32%	3.23	0.115	0.110
Bedroom	49	16%	1.83	0.055	0.095
Bathroom	27	20%	1.51	0.050	0.080
Other	44	18%	1.91	0.084	0.097
Total	262	30%	2.88	0.128	0.145

HOU vary considerably by home type, homeownership, education, and income, as can be seen in Table N-3, HOU are much higher in multifamily homes, in homes that are rented, and in homes occupied with customers with higher income levels and higher levels of education.

Table N-3. HOU Estimates by Customer Characteristics

Room Type	n	% of Sockets with LEDs	HOU	Relative Precision
Home type				
Single-family	100	24%	2.76	8%
Multi-family	7	30%	5.05	38%
Homeownership				
Own	90	23%	2.82	8%
Rent	17	31%	3.23	32%
Income				
<$50,000	32	24%	2.15	17%
$50,000–$100,000	41	22%	3.22	11%
$100,000+	32	25%	3.04	15%
Education				
Less than college	45	24%	2.68	14%

Room Type	n	% of Sockets with LEDs	HOU	Relative Precision
Bachelor's degree	33	31%	2.62	12%
Graduate degree	28	33%	3.36	17%

To place the HOU estimates derived through this study in perspective, Opinion Dynamics compiled the results from the other HOU studies from across the country. Table N-4 presents the results. As can be seen in the table, the HOU from this study are within the range of the other studies' estimates.

Table N-4. Comparison of HOU Estimates across Studies

Study Name	Study Timing	n	HOU Result	Notes
New England HOU Study	2013	848	3.0	Efficient bulbs
Pennsylvania Statewide Residential Light Metering Study	2014	206	3.0	Efficient bulbs
DEP 2012 CFL HOU Study	2012	100	2.92	CFLs only
DEP-DEC Residential Lighting Logger Study	2016	107	2.88	LEDs only
Indiana Statewide CFL HOU Study	2012-2013	67	2.47	CFLs
EmPOWER Maryland HOU Metering Study	2014	111	2.46	Efficient bulbs
ComEd PY5/PY6 Lighting Logger Study	2014	85	2.32	Standard CFLs

For more information, please contact:

Kessie Avseikova
Director

617 492 1400 tel
617 497 7944 fax
kavseikova@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Duke Carolinas 2017 Power Manager Evaluation

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Principal authors:

Ankit Jain, M.P.P.
Greg Sidorov, M.S.

Table of Figures

Table of Tables

1 Executive Summary

This report presents the results of Nexant's 2017 Power Manager impact evaluation for the Duke Energy Carolinas territory. Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioners' outdoor compressors and fans on summer days with high energy usage. Events are typically called on weekday afternoons to ensure power reliability during high summer peak demand periods. Air conditioning control is conducted in one of three options: 50% cycling; 64% cycling; and 100% shed. During 50% and 64% cycling events, air conditioner control is randomly phased in over the first half hour of the event. At the end of those first 30 minutes, the cycling reduction is sustained through the remainder of the event (typically two or three hours). Over the last 30 minutes of a cycling event, air conditioning control is phased out in the order in which it began. During 100% shed events, which are designed for use during emergency conditions, all devices are instructed to immediately shed loads and deliver larger demand reductions than cycling events.

A key objective of the 2016 evaluation was to quantify the relationship between demand reductions, temperature, hour of day, and cycling strategy—referred to as the time-temperature matrix. This tool is leveraged in this study to predict the actual load reductions achieved during the 2017 Power Manager events, as well as the program capability under extreme conditions. In order to develop the time-temperature matrix, the 2016 events were intentionally called for a range of different temperatures, under different cycling strategies and for different dispatch data. The data collected on the weather sensitivity of air conditioner load and the reductions observed for events tested were used to develop estimates of demand reduction for a range of temperatures, including the 102˚F conditions that drive resource planning. The system temperature conditions are calculated by averaging hourly temperatures of weather stations in Greenville/Spartanburg, South Carolina, Charlotte, North Carolina, and Greensboro, North Carolina. Because dispatch hours vary for individual events, throughout this document, the maximum system temperature for the day is reported for comparison.[1] More information on the 2016 evaluation and results can be found in Appendix C.

One Power Manager event was called in 2017: a general population 64% cycling event called for 3 hours starting at 3pm. During the 64% cycling event, the time-temperature matrix predicted a per device impact of 0.88 kW. With 250,400 devices dispatched, this would have yielded an aggregate load drop of 220.9 MW during the 3 hour event window. These impacts are at the meter, as is the case for all impacts mentioned in this report.

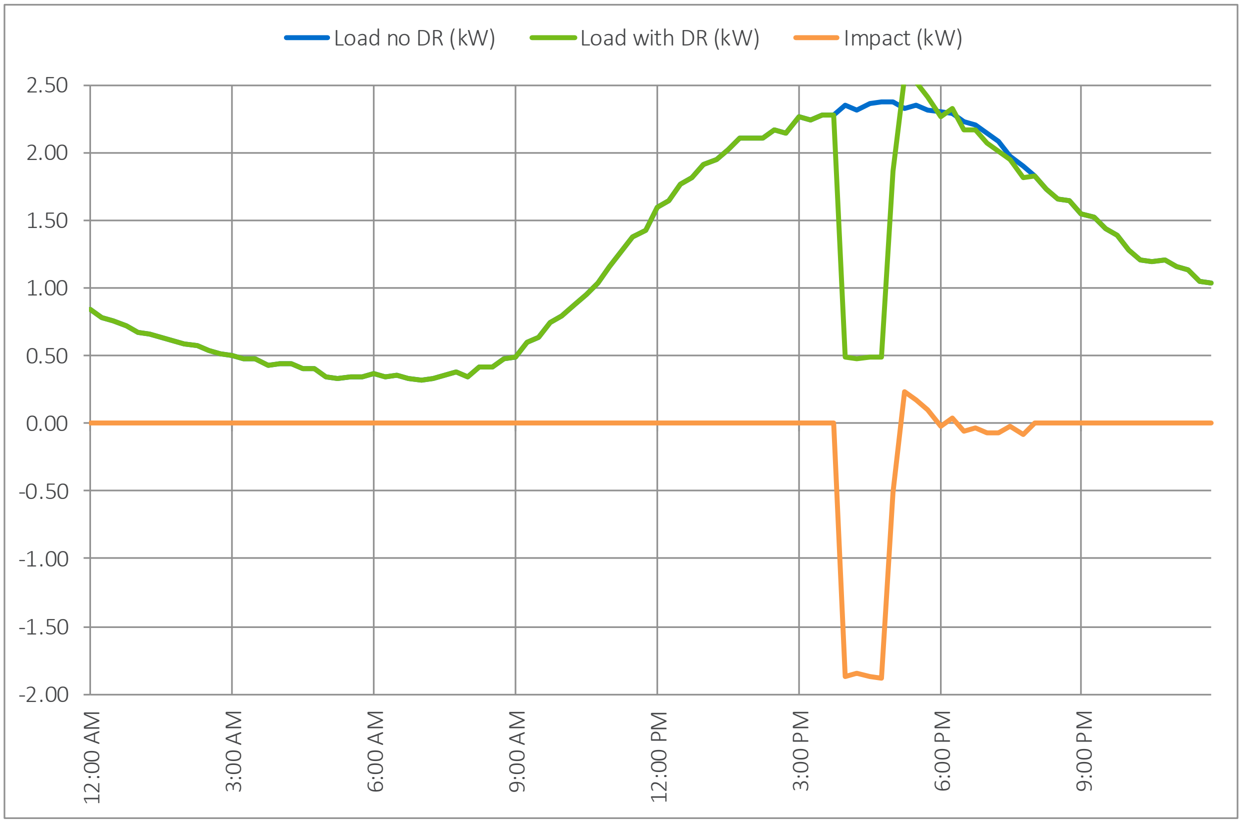
Because Power Manager delivers larger reductions when temperatures are hotter, the expected load reduction for a 102˚F day are 1.87 kW per device or 2.22 kW per household using 100% shed during the peak hour, giving an aggregate load reduction of 467 MW as seen in Figure 1-1. At that temperature, expected reductions from non-emergency dispatch – defined as a three hour 64% cycling event, starting at 3pm – is 1.46 kW per device or 1.74 kW per customer. With 50% cycling, reductions are 0.89 kW per device or 1.05 kW per customer for a three hour event.

[1] The temperatures during event hours may be lower since electric loads lag temperature peaks due to insulation in homes, coincidence of residential and nonresidential loads and occupancy patterns.

Figure 1-1: Demand Reduction Capability on a 102˚F with 100% Emergency Shed

INPUTS	
True Cycle	100
Event start (excludes phase in)	4 PM
Event duration	1
Daily Max Temp (F)	102
Devices	250,400

Event Window Avg. Impacts		
Load without DR	2.35	kW per device
Load with DR	0.49	kW per device
Impact per device	-1.87	kW per device
Impact (MW)	-467.0	MW



Key findings of the impact evaluation include:

- While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager;
- Not only do Power Manager demand reductions grow on a percentage basis with hotter weather and with deeper cycling, but so do the air conditioner loads available for curtailment;
- If 100% emergency shed becomes necessary on a 102˚F day, Power Manager can deliver 1.87 kW of demand reductions per device or 2.22 kW per household;
- Because there are approximately 250,400 devices, the expected aggregate reductions total 467 MW;
- Reductions are larger with hotter temperatures and more aggressive load control operations; and
- The event start time also influences the magnitude of reductions which, generally, are larger during hours when air conditioner loads are highest.

2 Introduction

This report presents the results of the 2017 Power Manager impact evaluation for the Duke Energy Carolinas (DEC) territory. Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioner's outdoor compressor and fan during summer days with high energy usage. The DEC operations team schedules and calls Power Manager events for testing, economic, or system emergency purposes.

2.1 Key Research Questions

The study analysis was designed to leverage the prior year's study to answer a few key questions related to the load reduction capability of the program:

- What demand reductions were achieved during the event called in 2017?
- What demand reduction is the program capable of delivering under emergency conditions?

To answer these questions, Nexant used the results from the 2016 load impact evaluation to estimate the load impacts that were actually delivered during 2017 events, as well as what the program is capable of delivering under extreme conditions. More information on the 2016 analysis and results can be found in Appendix C.

2.2 Program Description

Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to cycle their central air conditioner's outdoor compressor and fan on summer days with high energy usage. All Power Manager participants have a load cycling switch device installed on all of their outdoor air conditioner units. The device reduces the customer's air conditioner run time when a Power Manager event is called. Duke Energy Carolinas (DEC) initiates events by sending a signal to all participating devices through its own paging network. The signal instructs the switch devices to cycle or fully shed the air conditioning system, reducing AC load during events. The DEC operations team schedules and calls Power Manager events for testing, economic, or system emergency purposes.

The DEC Power Manager event season runs during the summer cooling season and participants receive financial incentives for their participation in the form of $8 credits applied to each of their July through October bills. DEC switches use a TrueCycle algorithm, which uses stored historic data, to estimate the run time (or duty cycle) of air conditioners as a function of hour of day and temperature at each specific site, and aims to curtail use by a specified amount—50%, 64%, or 100% (emergency shed).

2.3 Participant Characteristics

The Duke Energy Carolinas service territory spans much of the western half of North Carolina and northwestern South Carolina. By early summer of 2017, slightly more than 208,000 customers and 250,000 air conditioners were participating in Power Manager. On average, there are 1.20 air conditioner units per customer. Duke Energy Carolinas serves approximately 2.15 million residential customers, of which roughly 1.27 million are eligible for the Power Manager program. Overall, Duke Energy Carolinas has enrolled 16.4% of eligible customers to date.

2.4 2017 Demand Reduction

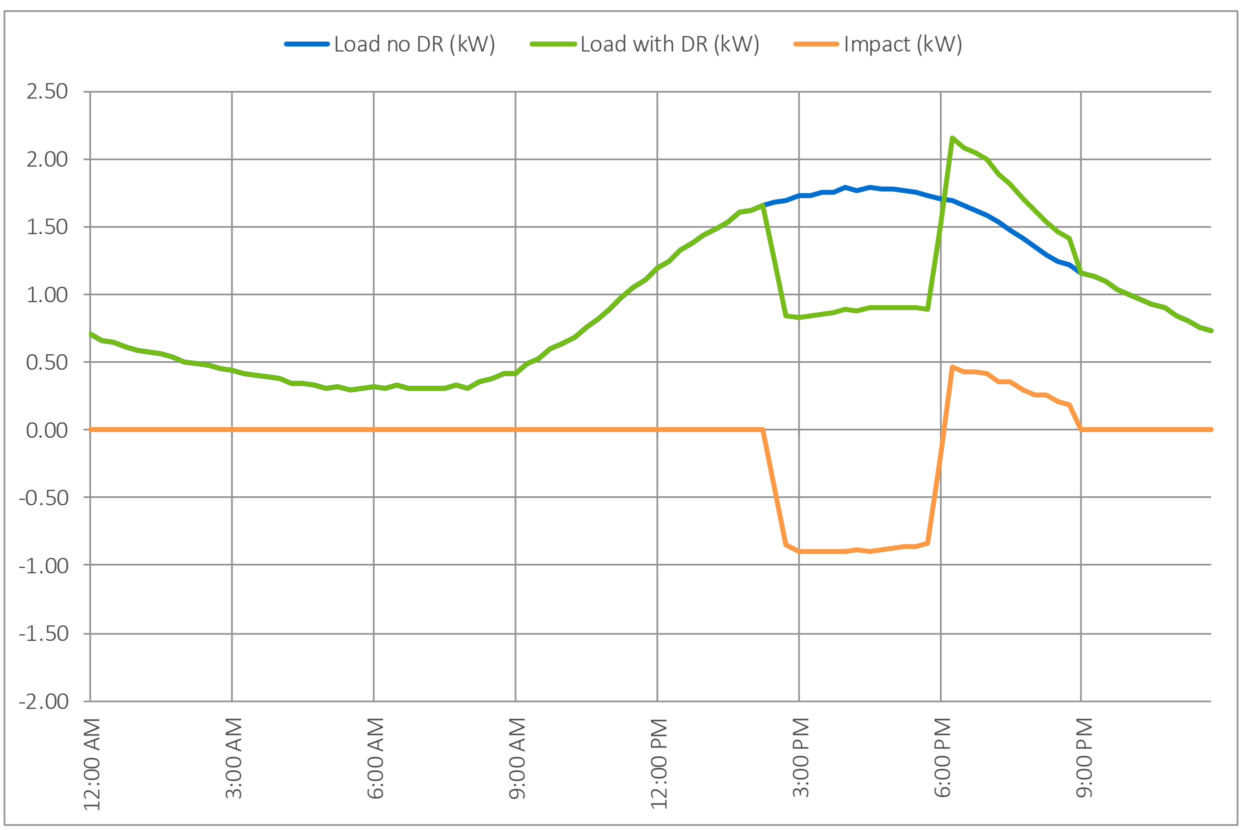
On July 13th, Power Manager was used in response to an unexpected reduction in system capacity. During the general population event, 209,000 customers (250,400 devices) were dispatched from 3pm to 6pm. The maximum temperature on that day, as an average of the same three weather station measurements, was 93.7°F.

The event was called on a day with a maximum temperature just under 94°F. The predicted load impacts are presented in Figure 2-1. It was modeled as a 64% true cycle event to reflect that it was not dispatched as an emergency shed (100% true cycle).

Figure 2-1: Predicted Load Impacts for July 13, 2017 General Population Event

INPUTS	
True Cycle	64
Event start (excludes phase in)	3 PM
Event duration	3
Daily Max Temp (F)	94
Devices	250,400

Event Window Avg. Impacts		
Load without DR	1.76	kW per device
Load with DR	0.88	kW per device
Impact per device	-0.88	kW per device
Impact (MW)	-220.9	MW



The load profiles generated by the time-temperature matrix do not exactly reflect the actual event conditions. The event was called due to a capacity shortage and did not have a half hour ramp-in period as is typically the case during general population events. Normally, events that are dispatched under non-emergency conditions have a half hour period prior to the official start of the event window when devices are gradually dispatched, resulting in a pre-event load reduction. While this graph shows that ramp-in, in actuality the load reduction would have begun promptly at 3pm with a steep drop in load amongst the Power Manager participants.

The time-temperature matrix predicted a per device impact of 0.88 kW. With 250,400 devices dispatched, this would have yielded an aggregate load drop of 220.9 MW during the 3 hour event window.

2.5 Demand Reduction Capability for 102˚F Conditions

While Power Manager is typically dispatched for economic reasons or research, its primary purpose is to deliver demand relief during extreme conditions when demand is high and capacity is constrained. Since 2006, Duke Energy Carolinas has experienced 5 weekdays and 2 weekend days when system temperatures reached 100˚F or more. Several of these days occurred in 2007, when on the hottest weekday system temperatures reached 103˚F. Extreme temperature conditions can trigger Power Manager emergency operations where all devices are instructed to instantaneously shed loads and deliver larger demand reductions than normal cycling events (100% emergency shed). While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager.

Figure 2-2: Demand Reduction Capability on a 102˚F with 100% Emergency Shed

INPUTS	
True Cycle	100
Event start (excludes phase in)	4 PM
Event duration	1
Daily Max Temp (F)	102
Devices	250,400

Event Window Avg. Impacts		
Load without DR	2.35	kW per device
Load with DR	0.49	kW per device
Impact per device	-1.87	kW per device
Impact (MW)	-467.0	MW
% Impact	-79.3%	%

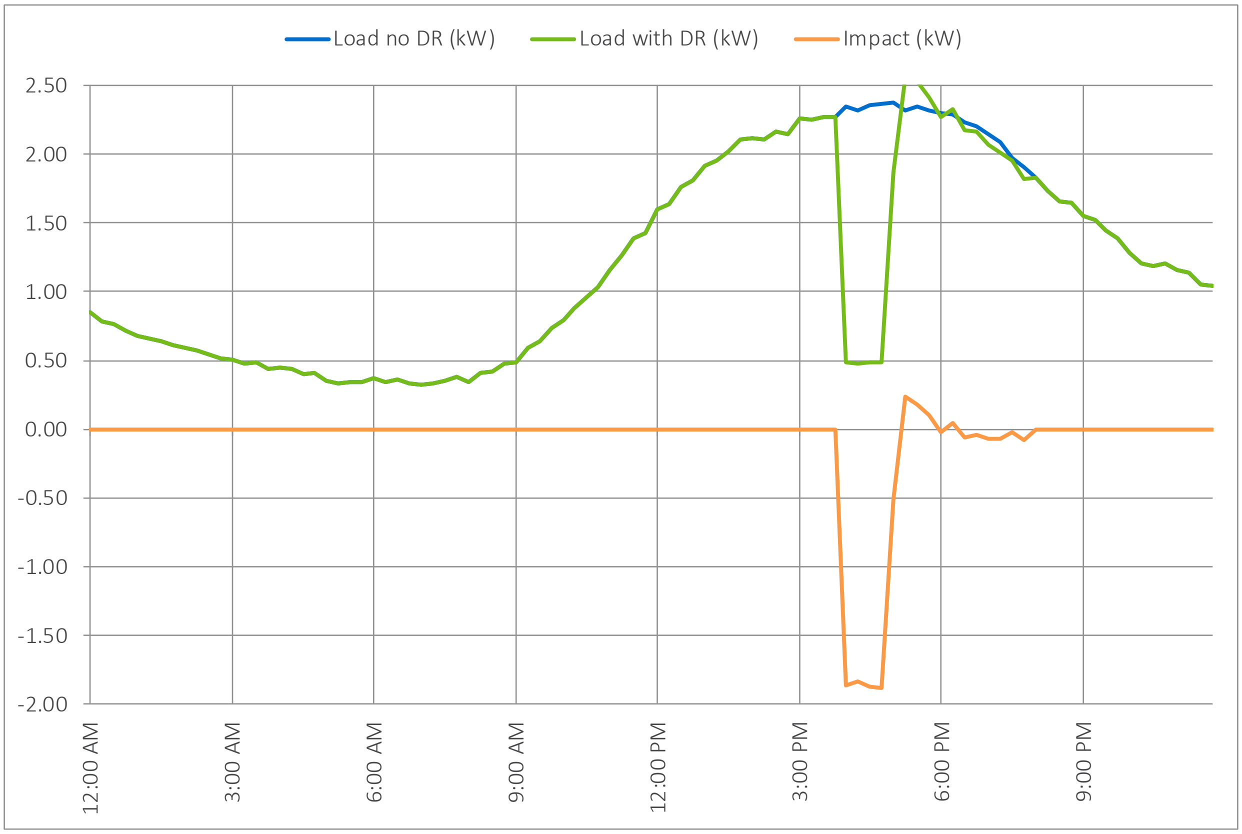


Figure 2-2 shows the demand reduction capability of the program if 100% shed becomes necessary on a 102˚F day for a single hour. Individual air conditioner units are expected to deliver 1.87 kW of demand reduction or 2.22 kW per household (on average Power Manager participants have 1.19 units). Because there are approximately 250,400 devices, the expected aggregate reductions total is 467 MW.

Power Manager can deliver substantial demand reductions under 102˚F conditions, even if emergency shed operations are not employed and non-emergency dispatch is employed. With a three hour 64% cycling event, demand reductions average 365.5 MW across the dispatch hours, as shown in Figure 2-3. With longer events, reductions vary slightly across fifteen minute intervals but are generally larger when air conditioner use is highest. The reduction capability is lowest, averaging 221.8 MW across three dispatch hours, when less extensive load control strategies, such as 50% cycling, are employed, as show in Figure 2-4.

Figure 2-3: Demand Reduction Capability on a 102˚F with 64% Cycling

INPUTS	
True Cycle	64
Event start (excludes phase in)	3 PM
Event duration	3
Daily Max Temp (F)	102
Devices	250,400

Event Window Avg. Impacts		
Load without DR	2.32	kW per device
Load with DR	0.86	kW per device
Impact per device	-1.46	kW per device
Impact (MW)	-365.5	MW
% Impact	-62.9%	%

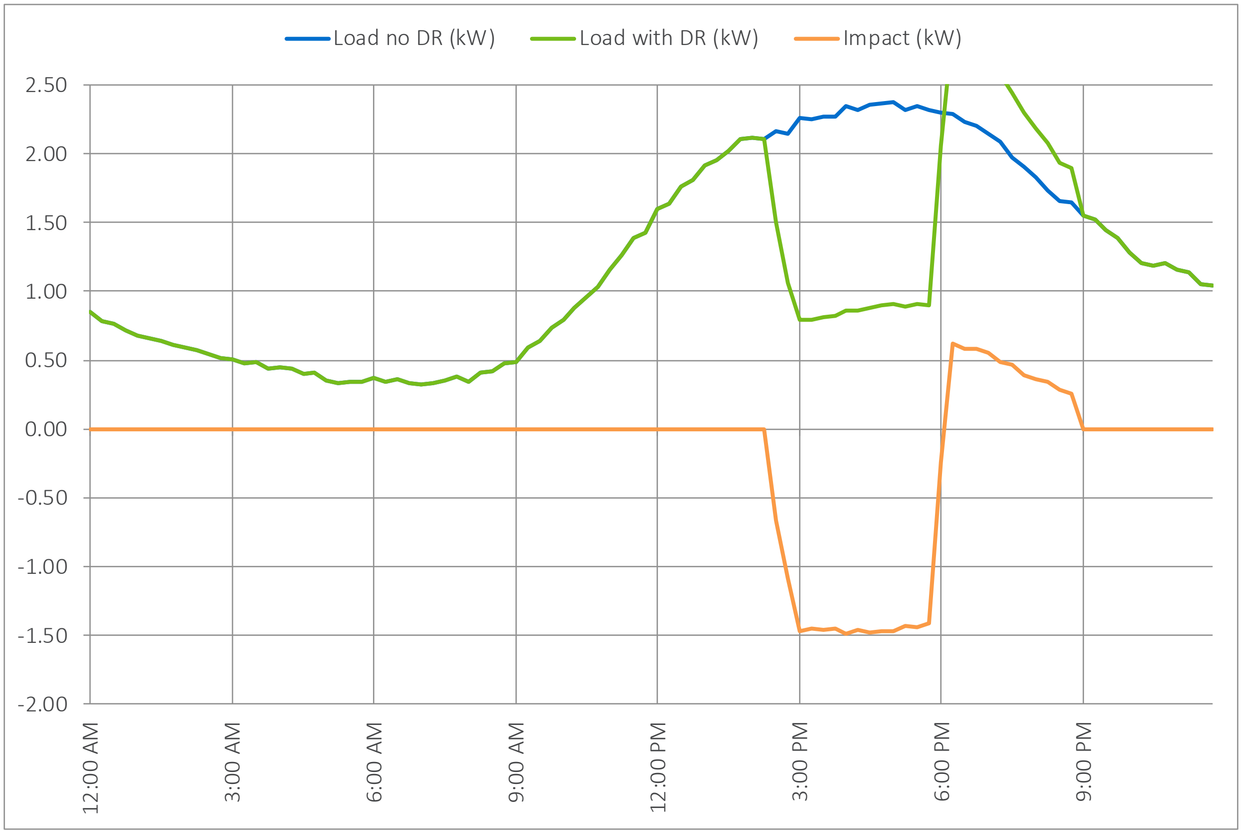
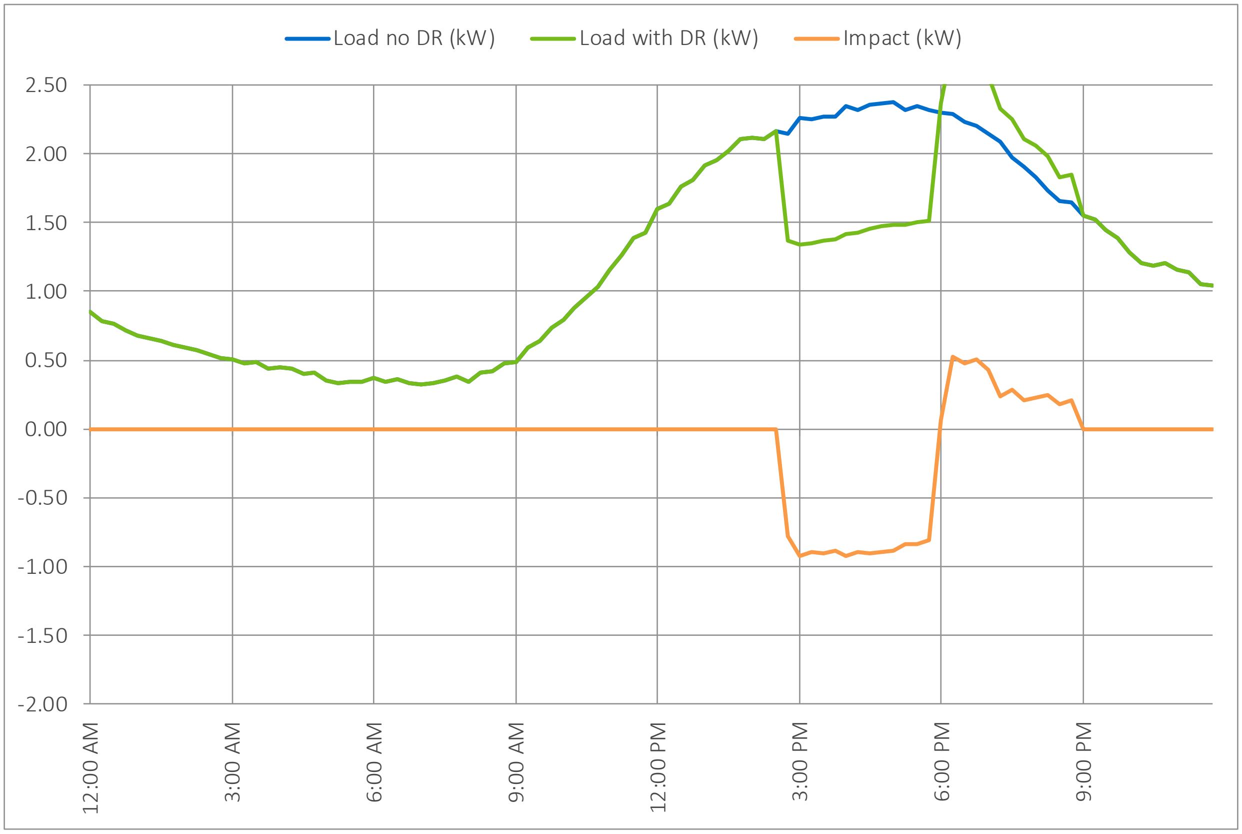


Figure 2-4: Demand Reduction Capability on a 102˚F using 50% Cycling

INPUTS	
True Cycle	50
Event start (excludes phase in)	3 PM
Event duration	3
Daily Max Temp (F)	102
Devices	250,400

Event Window Avg. Impacts		
Load without DR	2.32	kW per device
Load with DR	1.43	kW per device
Impact per device	-0.89	kW per device
Impact (MW)	-221.8	MW
% Impact	-38.2%	%



2.6 Demand Reduction Capability by Temperature, Cycling Strategy, and Event Start Time

Table 2-1 summarizes the estimated demand reduction for 100% emergency shed by event start time, and daily maximum system temperature, assuming a one hour event. Table 2-2 summarizes similar information for non-emergency dispatch operations assuming a three hour event. Most non-emergency operations start at 3pm or 4 pm. All estimated impacts exclude the 30 minute periods when the 64% and 50% cycling are randomly phased in and phased out. In practice, event day impacts may vary due to unique weather patterns or day characteristics.

Table 2-1: Emergency Shed Per Device Demand Impacts by Temperature and Event Start

True Cycle	Daily Max (F)	Start Time (1 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
100	74	-0.16	-0.20	-0.25	-0.26	-0.28	-0.30	-0.28
	76	-0.21	-0.27	-0.34	-0.37	-0.40	-0.41	-0.38
	78	-0.22	-0.28	-0.37	-0.41	-0.44	-0.46	-0.42
	80	-0.28	-0.37	-0.47	-0.52	-0.55	-0.56	-0.53
	82	-0.34	-0.45	-0.57	-0.63	-0.68	-0.69	-0.65
	84	-0.45	-0.58	-0.69	-0.75	-0.80	-0.80	-0.74
	86	-0.56	-0.71	-0.82	-0.89	-0.93	-0.93	-0.87
	88	-0.69	-0.84	-0.96	-1.02	-1.06	-1.05	-0.99
	90	-0.77	-0.94	-1.06	-1.13	-1.17	-1.15	-1.08
	92	-0.91	-1.09	-1.21	-1.27	-1.29	-1.26	-1.18
	94	-1.01	-1.19	-1.31	-1.37	-1.40	-1.38	-1.31
	96	-1.14	-1.33	-1.45	-1.51	-1.54	-1.53	-1.45
	98	-1.19	-1.41	-1.53	-1.60	-1.64	-1.62	-1.53
	100	-1.34	-1.57	-1.70	-1.79	-1.83	-1.81	-1.70
	102	-1.35	-1.59	-1.69	-1.80	-1.87	-1.86	-1.79

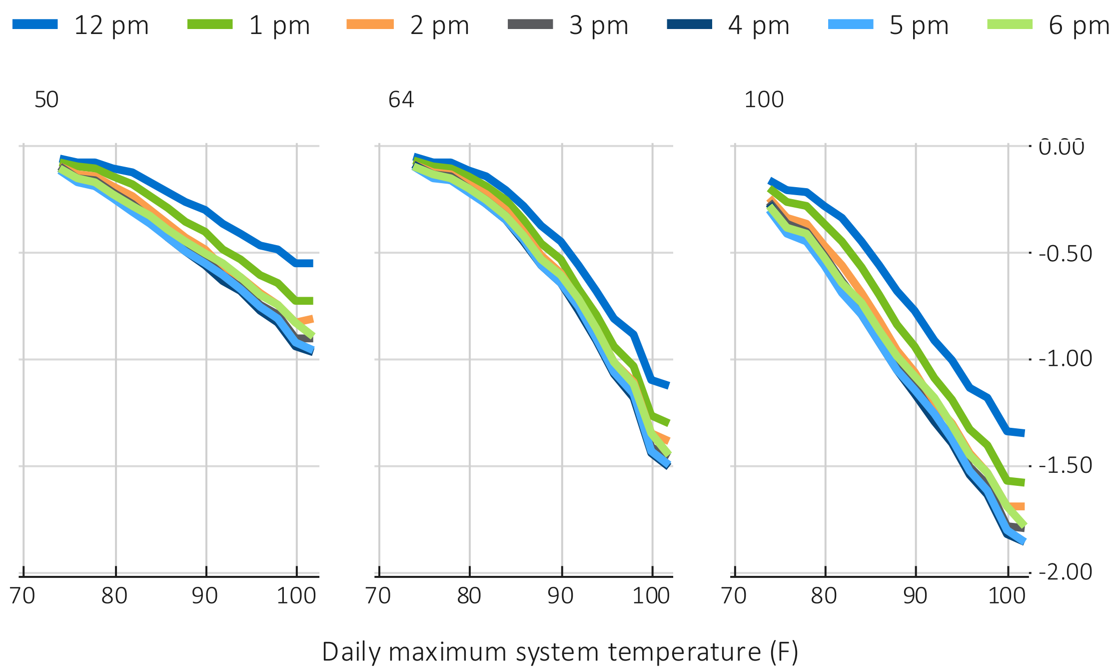
Table 2-2: Non-Emergency Dispatch Per Device Demand Impacts by Temperature and Event Start

True Cycle	Daily Max (F)	Start Time (3 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.07	-0.08	-0.09	-0.10	-0.10	-0.10	-0.10
	76	-0.09	-0.12	-0.14	-0.15	-0.15	-0.14	-0.13
	78	-0.10	-0.13	-0.15	-0.17	-0.17	-0.16	-0.14
	80	-0.13	-0.17	-0.20	-0.22	-0.22	-0.20	-0.18
	82	-0.17	-0.21	-0.25	-0.28	-0.28	-0.26	-0.23
	84	-0.21	-0.27	-0.31	-0.33	-0.33	-0.30	-0.26
	86	-0.27	-0.33	-0.37	-0.39	-0.39	-0.36	-0.31
	88	-0.32	-0.39	-0.43	-0.46	-0.45	-0.41	-0.35
	90	-0.37	-0.44	-0.49	-0.51	-0.50	-0.46	-0.39
	92	-0.44	-0.52	-0.56	-0.58	-0.56	-0.51	-0.43
	94	-0.48	-0.56	-0.61	-0.63	-0.62	-0.57	-0.48
	96	-0.55	-0.64	-0.69	-0.71	-0.70	-0.64	-0.54
	98	-0.58	-0.68	-0.74	-0.76	-0.75	-0.69	-0.58
	100	-0.65	-0.77	-0.84	-0.87	-0.85	-0.76	-0.64
	102	-0.65	-0.76	-0.84	-0.89	-0.88	-0.82	-0.69
64	74	-0.07	-0.08	-0.08	-0.09	-0.09	-0.09	-0.09
	76	-0.10	-0.11	-0.13	-0.14	-0.14	-0.13	-0.12
	78	-0.10	-0.12	-0.14	-0.15	-0.15	-0.14	-0.13
	80	-0.14	-0.17	-0.19	-0.20	-0.20	-0.19	-0.18
	82	-0.18	-0.22	-0.24	-0.26	-0.26	-0.25	-0.22
	84	-0.25	-0.29	-0.32	-0.33	-0.33	-0.31	-0.28
	86	-0.33	-0.38	-0.41	-0.43	-0.42	-0.40	-0.36
	88	-0.44	-0.49	-0.52	-0.54	-0.53	-0.51	-0.46
	90	-0.51	-0.57	-0.61	-0.62	-0.62	-0.59	-0.53
	92	-0.64	-0.70	-0.74	-0.75	-0.73	-0.69	-0.63
	94	-0.76	-0.83	-0.87	-0.88	-0.87	-0.83	-0.76
	96	-0.90	-0.98	-1.02	-1.04	-1.03	-0.98	-0.90
	98	-0.99	-1.07	-1.12	-1.14	-1.13	-1.08	-0.98
	100	-1.21	-1.32	-1.38	-1.40	-1.38	-1.31	-1.19
	102	-1.25	-1.36	-1.42	-1.46	-1.46	-1.40	-1.28

*Estimates exclude 30 minute phase in period and reflect the average reduction expected for the event

Figure 2-5 provides a visual summary of the reduction capability for a one hour event by cycling strategy and start time. As expected, reductions are larger with hotter temperatures and more aggressive load control operations. The start time also influences the magnitude of reductions which, generally, are larger during hours when air conditioner loads are highest. Appendix B includes the demand reduction capability for a range of event durations.

Figure 2-5: Per Device Demand Impacts by Cycling Strategy, Temperature Conditions, and Event Start



1 hour events, excluding 30 minute phase in period

2.7 Key Findings

Key findings from the development of the time temperature matrix include:

- While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager;
- Not only do Power Manager demand reductions grow on a percentage basis with hotter weather and with deeper cycling, but so do the air conditioner loads available for curtailment;
- If 100% emergency shed becomes necessary on a 102˚F day, Power Manager can deliver 1.87 kW of demand reductions per device or 2.22 kW per household;
- Because there are approximately 250,400 devices, the expected aggregate reductions total 467 MW;
- Reductions are larger with hotter temperatures and more aggressive load control operations; and
- The event start time also influences the magnitude of reductions which, generally, are larger during hours when air conditioner loads are highest.

Summary Form

Duke Energy Carolinas Power Manager® Program

Completed EMV Fact Sheet

The Duke Energy's Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioners' outdoor compressors and fans on summer days with high energy usage. Events are typically called on weekday afternoons to ensure power reliability during high summer peak demand periods.

Date	May 1, 2018
Region(s)	Duke Energy Carolinas
Evaluation Period	DEC: Summer 2017
Total kW Savings	DEC: 1.87 kW of demand reduction or 2.22 kW per household. Because there are approximately 250,400 devices, the expected aggregate reductions total is 467 MW.
Coincident kW Impact (net ex post)	DEC:
Measure Life	N/A
Net-to-Gross Ratio	
Process Evaluation	No
Previous Evaluation(s)	DEC: Duke Energy Carolinas Power Manager Program April 11, 2017

A key objective of the 2016 evaluation was to quantify the relationship between demand reductions, temperature, hour of day, and cycling strategy—referred to as the time-temperature matrix. This tool is leveraged in this study to predict the actual load reductions achieved during the 2017 Power Manager event, as well as the program capability under extreme conditions. In order to develop the time-temperature matrix, the 2016 events were intentionally called for a range of different temperatures, under different cycling strategies and for different dispatch data. The data collected on the weather sensitivity of air conditioner load and the reductions observed for events tested were used to develop estimates of demand reduction for a range of temperatures, including the 102˚F conditions that drive resource planning.

Appendix A Regression Models Tested

All regression models were performed and the average customer loads throughout the summer using 15 minute interval data. The same sample of customers was analyzed using whole house interval and air conditioner end use data. The analysis only included days when maximum temperature exceeded 75˚F.

For the individual event day impacts (ex post), the regression equation took the general form of Equation 1, which will be estimated using a dataset made up of hourly observations of the average load in the M&V sample. Equation 2 describes the model used to estimate average event impacts for the general population events. The average event impacts were estimated separately to account for the effect of repeated events on confidence intervals.

Equation 1 and Equation 2 represent a within-subjects approach in which the observations on nonevent days are used to predict the counterfactual load for Power Manager customers on event days. A few points are noteworthy. The models were run separately for each 15 minute interval (equivalent to a fully interacted model) to account for occupancy patterns and produce different weather coefficients and constants. The only component that varied across the 10 models tested was how the weather variables were specified. Table A-1 shows the weather variables and explains the underlying concept for each model tested. To improve precision, same-day loads for the pre-event hours of 11am to 1pm were included to capture any differences between event and nonevent days that are not reflected in the model. The pre-event same day load variable functions as a same-day adjustment and is included because customers are not notified of the event in advance.

Equation 1: Ex Post Regression Model Individual Events

$$kW_{t,i} = a_i + \sum_{j=1}^{J} b_{i,j}\mathrm{event}_{t,j} + c \cdot preeventkW_t + d_i \cdot weather_{i,t} + \sum_{k=1}^{7} e_{i,k}\mathrm{dayofweek}_{i,k} + \sum_{l=5}^{10} f_{i,l}\, month_t + \varepsilon_{i,t}$$

Equation 2: Ex Post Regression Model Average Event (General Population Events)

$$kW_{t,i} = a_i + b_i\mathrm{avgevent}_t + c \cdot preeventkW_t + d_i \cdot weather_{i,t} + \sum_{k=1}^{7} b_{i,k}\mathrm{dayofweek}_{i,k} + \sum_{l=5}^{10} f_{i,l}\, month_t + \varepsilon_{i,t}$$

Where:

a	Is the constant or intercept
$b_{i,j}$	Represents the event effect of Power Manager during each interval, i, and each event day, j
c-f	Are other model coefficients
i, k, l	i, k and l are indicators that represent individual 15 minute intervals (96 in a day), days of the week, and months of the year
t	Represents each date in the analysis dataset
$event$	Is a binary variable indicating whether Power Manager was dispatched on that day
$preeventKW$	Represents the same-day loads for the pre-event hours of 11am to 1pm. The variable functions as a same-day adjustment and is included because customers are not notified of the event in advance
$weather$	10 different ways to specify if weather was tested. Those are detailed in Table A-1
$dayofweek$	Are a set of mutually exclusive binary variables to capture day of week effects
$month$	Are a set of mutually exclusive binary variables to capture monthly or seasonal effects
ε	Represents the error term

Table A-1: Weather Variables by Model Tested

Model	Weather variables	Concept
1	Cooling Degree Hour Base 70˚F (CDH)	The same hour temperature drives electricity use but air conditioner loads are only linear when temperatures are above 70˚F
2	Cooling Degree Day Base 65˚F (CDD)	The overall daily average temperature drives electricity use but air conditioner loads are only linear when average daily temperatures exceed 65˚F
3	Daily Maximum Temperature	The daily maximum temperature drives air conditioner electricity use
4	Average temperature over the 24 hours immediately prior	Heat buildup over the 24 hours immediately prior to time period drives electricity use
5	CDH and CDD	Both the daily average temperatures and same hour temperatures drive air conditioner electricity use
6	Same hour CDH and average temperature over the 24 hours immediately prior	Air conditioner use if influenced both by the temperature during that hour and by average temperature over the 24 hours immediately prior
7	Same hour CDH and average CDH over the 6 hours immediately prior	Air conditioner use if influenced both by the temperature during that hour and by heat buildup, as measured by CDH, over the 6 hours immediately prior
8	Same hour CDH and average CDH over the 12 hours immediately prior	Air conditioner use if influenced both by the temperature during that hour and by heat buildup, as measured by CDH, over the 12 hours immediately prior
9	Same hour CDH and average CDH over the 18 hours immediately prior	Air conditioner use if influenced both by the temperature during that hour and by heat buildup, as measured by CDH, over the 18 hours immediately prior
10	Same hour CDH and average CDH over the 24 hours immediately prior	Air conditioner use if influenced both by the temperature during that hour and by heat buildup, as measured by CDH, over the 24 hours immediately prior

Appendix B Per Device Demand Reduction Tables

Table B-1: One Hour Event Per Device Demand Impacts by Cycling Strategy, Temperature, and Event Start

True Cycle	Daily Max (F)	Start Time (1 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.06	-0.08	-0.10	-0.10	-0.11	-0.12	-0.11
	76	-0.08	-0.10	-0.14	-0.15	-0.17	-0.17	-0.15
	78	-0.08	-0.11	-0.15	-0.17	-0.18	-0.19	-0.17
	80	-0.10	-0.15	-0.19	-0.22	-0.24	-0.24	-0.22
	82	-0.13	-0.18	-0.24	-0.28	-0.31	-0.31	-0.29
	84	-0.17	-0.23	-0.30	-0.34	-0.36	-0.36	-0.33
	86	-0.22	-0.29	-0.36	-0.41	-0.43	-0.43	-0.39
	88	-0.27	-0.36	-0.43	-0.47	-0.50	-0.49	-0.46
	90	-0.31	-0.41	-0.49	-0.53	-0.56	-0.55	-0.50
	92	-0.37	-0.49	-0.57	-0.61	-0.63	-0.61	-0.55
	94	-0.41	-0.53	-0.62	-0.66	-0.69	-0.67	-0.62
	96	-0.47	-0.61	-0.69	-0.75	-0.77	-0.76	-0.70
	98	-0.49	-0.65	-0.75	-0.80	-0.83	-0.82	-0.75
	100	-0.56	-0.73	-0.83	-0.91	-0.94	-0.93	-0.83
	102	-0.55	-0.73	-0.82	-0.91	-0.97	-0.96	-0.90
64	74	-0.06	-0.07	-0.08	-0.09	-0.09	-0.10	-0.10
	76	-0.08	-0.10	-0.13	-0.14	-0.15	-0.15	-0.14
	78	-0.08	-0.10	-0.13	-0.15	-0.16	-0.16	-0.15
	80	-0.12	-0.15	-0.18	-0.20	-0.21	-0.22	-0.20
	82	-0.15	-0.19	-0.23	-0.26	-0.27	-0.28	-0.26
	84	-0.21	-0.26	-0.31	-0.33	-0.35	-0.35	-0.33
	86	-0.28	-0.35	-0.40	-0.43	-0.45	-0.45	-0.42
	88	-0.38	-0.46	-0.51	-0.54	-0.56	-0.56	-0.53
	90	-0.45	-0.54	-0.60	-0.63	-0.65	-0.64	-0.61
	92	-0.57	-0.67	-0.73	-0.76	-0.78	-0.76	-0.72
	94	-0.68	-0.79	-0.86	-0.90	-0.91	-0.90	-0.86
	96	-0.82	-0.94	-1.02	-1.06	-1.08	-1.07	-1.02
	98	-0.89	-1.03	-1.11	-1.16	-1.18	-1.17	-1.12
	100	-1.10	-1.27	-1.36	-1.42	-1.45	-1.43	-1.36
	102	-1.13	-1.31	-1.39	-1.46	-1.51	-1.50	-1.45
100	74	-0.16	-0.20	-0.25	-0.26	-0.28	-0.30	-0.28
	76	-0.21	-0.27	-0.34	-0.37	-0.40	-0.41	-0.38
	78	-0.22	-0.28	-0.37	-0.41	-0.44	-0.46	-0.42
	80	-0.28	-0.37	-0.47	-0.52	-0.55	-0.56	-0.53
	82	-0.34	-0.45	-0.57	-0.63	-0.68	-0.69	-0.65
	84	-0.45	-0.58	-0.69	-0.75	-0.80	-0.80	-0.74
	86	-0.56	-0.71	-0.82	-0.89	-0.93	-0.93	-0.87
	88	-0.69	-0.84	-0.96	-1.02	-1.06	-1.05	-0.99
	90	-0.77	-0.94	-1.06	-1.13	-1.17	-1.15	-1.08
	92	-0.91	-1.09	-1.21	-1.27	-1.29	-1.26	-1.18
	94	-1.01	-1.19	-1.31	-1.37	-1.40	-1.38	-1.31
	96	-1.14	-1.33	-1.45	-1.51	-1.54	-1.53	-1.45
	98	-1.19	-1.41	-1.53	-1.60	-1.64	-1.62	-1.53
	100	-1.34	-1.57	-1.70	-1.79	-1.83	-1.81	-1.70
	102	-1.35	-1.59	-1.69	-1.80	-1.87	-1.86	-1.79

*Estimates exclude 30 minute phase in period and reflect the average reduction expected for the event

Table B-2: 2 Hour Event Per Device Demand Impacts by Cycling Strategy, Temperature, and Event Start

True Cycle	Daily Max (F)	Start Time (2 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.06	-0.08	-0.10	-0.10	-0.11	-0.11	-0.10
	76	-0.09	-0.11	-0.14	-0.15	-0.16	-0.16	-0.14
	78	-0.09	-0.12	-0.15	-0.17	-0.18	-0.18	-0.16
	80	-0.12	-0.16	-0.20	-0.22	-0.23	-0.23	-0.20
	82	-0.15	-0.20	-0.25	-0.28	-0.30	-0.29	-0.25
	84	-0.19	-0.26	-0.31	-0.34	-0.35	-0.34	-0.29
	86	-0.24	-0.32	-0.37	-0.40	-0.42	-0.40	-0.35
	88	-0.30	-0.38	-0.44	-0.47	-0.48	-0.46	-0.40
	90	-0.34	-0.43	-0.49	-0.53	-0.54	-0.51	-0.45
	92	-0.41	-0.51	-0.57	-0.60	-0.60	-0.56	-0.49
	94	-0.45	-0.55	-0.62	-0.65	-0.66	-0.62	-0.55
	96	-0.52	-0.63	-0.70	-0.74	-0.74	-0.71	-0.62
	98	-0.55	-0.67	-0.75	-0.79	-0.80	-0.76	-0.67
	100	-0.62	-0.75	-0.84	-0.90	-0.91	-0.85	-0.74
	102	-0.62	-0.75	-0.83	-0.91	-0.93	-0.90	-0.80
64	74	-0.06	-0.08	-0.08	-0.09	-0.10	-0.10	-0.09
	76	-0.09	-0.11	-0.13	-0.14	-0.15	-0.14	-0.13
	78	-0.09	-0.12	-0.14	-0.15	-0.16	-0.15	-0.14
	80	-0.13	-0.16	-0.19	-0.20	-0.21	-0.21	-0.19
	82	-0.16	-0.21	-0.24	-0.26	-0.27	-0.26	-0.24
	84	-0.23	-0.28	-0.31	-0.33	-0.34	-0.33	-0.30
	86	-0.31	-0.37	-0.41	-0.43	-0.44	-0.43	-0.39
	88	-0.41	-0.48	-0.52	-0.54	-0.55	-0.54	-0.50
	90	-0.49	-0.56	-0.61	-0.63	-0.64	-0.62	-0.57
	92	-0.61	-0.69	-0.74	-0.76	-0.76	-0.73	-0.67
	94	-0.73	-0.82	-0.87	-0.89	-0.90	-0.87	-0.82
	96	-0.87	-0.97	-1.02	-1.05	-1.06	-1.03	-0.96
	98	-0.95	-1.06	-1.12	-1.15	-1.16	-1.13	-1.06
	100	-1.17	-1.30	-1.37	-1.42	-1.42	-1.38	-1.28
	102	-1.21	-1.33	-1.41	-1.47	-1.49	-1.46	-1.38
100	74	-0.18	-0.23	-0.25	-0.27	-0.29	-0.29	-0.27
	76	-0.24	-0.30	-0.36	-0.39	-0.41	-0.40	-0.36
	78	-0.25	-0.32	-0.39	-0.43	-0.45	-0.44	-0.40
	80	-0.33	-0.42	-0.49	-0.54	-0.56	-0.55	-0.50
	82	-0.40	-0.51	-0.60	-0.66	-0.69	-0.67	-0.61
	84	-0.51	-0.63	-0.72	-0.77	-0.80	-0.77	-0.70
	86	-0.63	-0.76	-0.86	-0.91	-0.93	-0.90	-0.82
	88	-0.77	-0.90	-0.99	-1.04	-1.05	-1.02	-0.94
	90	-0.86	-1.00	-1.10	-1.15	-1.16	-1.12	-1.02
	92	-1.00	-1.15	-1.24	-1.28	-1.28	-1.22	-1.12
	94	-1.10	-1.25	-1.34	-1.39	-1.39	-1.35	-1.25
	96	-1.23	-1.39	-1.48	-1.53	-1.54	-1.49	-1.38
	98	-1.30	-1.47	-1.57	-1.62	-1.63	-1.58	-1.46
	100	-1.46	-1.63	-1.74	-1.81	-1.82	-1.75	-1.61
	102	-1.47	-1.64	-1.75	-1.83	-1.86	-1.82	-1.70

*Estimates exclude 30 minute phase in period and reflect the average reduction expected for the event

Table B-3: Three Hour Event Per Device Demand Impacts by Cycling Strategy, Temperature, and Event Start

True Cycle	Daily Max (F)	Start Time (3 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.07	-0.08	-0.09	-0.10	-0.10	-0.10	-0.10
	76	-0.09	-0.12	-0.14	-0.15	-0.15	-0.14	-0.13
	78	-0.10	-0.13	-0.15	-0.17	-0.17	-0.16	-0.14
	80	-0.13	-0.17	-0.20	-0.22	-0.22	-0.20	-0.18
	82	-0.17	-0.21	-0.25	-0.28	-0.28	-0.26	-0.23
	84	-0.21	-0.27	-0.31	-0.33	-0.33	-0.30	-0.26
	86	-0.27	-0.33	-0.37	-0.39	-0.39	-0.36	-0.31
	88	-0.32	-0.39	-0.43	-0.46	-0.45	-0.41	-0.35
	90	-0.37	-0.44	-0.49	-0.51	-0.50	-0.46	-0.39
	92	-0.44	-0.52	-0.56	-0.58	-0.56	-0.51	-0.43
	94	-0.48	-0.56	-0.61	-0.63	-0.62	-0.57	-0.48
	96	-0.55	-0.64	-0.69	-0.71	-0.70	-0.64	-0.54
	98	-0.58	-0.68	-0.74	-0.76	-0.75	-0.69	-0.58
	100	-0.65	-0.77	-0.84	-0.87	-0.85	-0.76	-0.64
	102	-0.65	-0.76	-0.84	-0.89	-0.88	-0.82	-0.69
64	74	-0.07	-0.08	-0.08	-0.09	-0.09	-0.09	-0.09
	76	-0.10	-0.11	-0.13	-0.14	-0.14	-0.13	-0.12
	78	-0.10	-0.12	-0.14	-0.15	-0.15	-0.14	-0.13
	80	-0.14	-0.17	-0.19	-0.20	-0.20	-0.19	-0.18
	82	-0.18	-0.22	-0.24	-0.26	-0.26	-0.25	-0.22
	84	-0.25	-0.29	-0.32	-0.33	-0.33	-0.31	-0.28
	86	-0.33	-0.38	-0.41	-0.43	-0.42	-0.40	-0.36
	88	-0.44	-0.49	-0.52	-0.54	-0.53	-0.51	-0.46
	90	-0.51	-0.57	-0.61	-0.62	-0.62	-0.59	-0.53
	92	-0.64	-0.70	-0.74	-0.75	-0.73	-0.69	-0.63
	94	-0.76	-0.83	-0.87	-0.88	-0.87	-0.83	-0.76
	96	-0.90	-0.98	-1.02	-1.04	-1.03	-0.98	-0.90
	98	-0.99	-1.07	-1.12	-1.14	-1.13	-1.08	-0.98
	100	-1.21	-1.32	-1.38	-1.40	-1.38	-1.31	-1.19
	102	-1.25	-1.36	-1.42	-1.46	-1.46	-1.40	-1.28
100	74	-0.20	-0.24	-0.26	-0.28	-0.29	-0.28	-0.27
	76	-0.27	-0.33	-0.37	-0.40	-0.40	-0.38	-0.35
	78	-0.29	-0.35	-0.41	-0.44	-0.44	-0.42	-0.38
	80	-0.37	-0.45	-0.51	-0.55	-0.55	-0.52	-0.47
	82	-0.45	-0.55	-0.63	-0.67	-0.67	-0.64	-0.57
	84	-0.57	-0.67	-0.75	-0.78	-0.78	-0.73	-0.65
	86	-0.70	-0.81	-0.88	-0.91	-0.91	-0.85	-0.76
	88	-0.83	-0.94	-1.01	-1.04	-1.03	-0.98	-0.87
	90	-0.93	-1.05	-1.12	-1.15	-1.13	-1.07	-0.96
	92	-1.07	-1.19	-1.26	-1.27	-1.25	-1.16	-1.04
	94	-1.17	-1.29	-1.36	-1.38	-1.37	-1.29	-1.17
	96	-1.30	-1.43	-1.50	-1.53	-1.51	-1.43	-1.29
	98	-1.38	-1.51	-1.59	-1.62	-1.60	-1.51	-1.36
	100	-1.54	-1.69	-1.77	-1.81	-1.78	-1.67	-1.50
	102	-1.54	-1.69	-1.79	-1.84	-1.84	-1.75	-1.59

*Estimates exclude 30 minute phase in period and reflect the average reduction expected for the event

Table B-4: Four Hour Event Per Device Demand Impacts by Cycling Strategy, Temperature, and Event Start

True Cycle	Daily Max (F)	Start Time (4 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.07	-0.08	-0.09	-0.10	-0.10	-0.10	-0.09
	76	-0.10	-0.12	-0.14	-0.14	-0.14	-0.13	-0.12
	78	-0.11	-0.13	-0.15	-0.16	-0.16	-0.15	-0.13
	80	-0.14	-0.17	-0.20	-0.21	-0.20	-0.18	-0.16
	82	-0.18	-0.22	-0.25	-0.26	-0.26	-0.23	-0.20
	84	-0.23	-0.27	-0.30	-0.31	-0.30	-0.27	-0.23
	86	-0.28	-0.33	-0.36	-0.37	-0.36	-0.32	-0.27
	88	-0.34	-0.39	-0.42	-0.43	-0.41	-0.37	-0.31
	90	-0.38	-0.44	-0.48	-0.48	-0.46	-0.41	-0.35
	92	-0.45	-0.52	-0.55	-0.54	-0.51	-0.45	-0.38
	94	-0.49	-0.56	-0.59	-0.60	-0.57	-0.50	-0.42
	96	-0.56	-0.63	-0.67	-0.67	-0.64	-0.57	-0.47
	98	-0.60	-0.68	-0.72	-0.72	-0.69	-0.61	-0.51
	100	-0.68	-0.77	-0.82	-0.82	-0.77	-0.67	-0.55
	102	-0.67	-0.77	-0.83	-0.85	-0.81	-0.72	-0.60
64	74	-0.07	-0.08	-0.08	-0.09	-0.09	-0.09	-0.08
	76	-0.10	-0.12	-0.13	-0.13	-0.13	-0.13	-0.12
	78	-0.11	-0.13	-0.14	-0.14	-0.14	-0.14	-0.12
	80	-0.15	-0.17	-0.19	-0.19	-0.19	-0.18	-0.16
	82	-0.19	-0.22	-0.24	-0.25	-0.25	-0.23	-0.21
	84	-0.26	-0.29	-0.31	-0.32	-0.31	-0.29	-0.26
	86	-0.35	-0.38	-0.41	-0.41	-0.40	-0.37	-0.34
	88	-0.45	-0.49	-0.52	-0.52	-0.51	-0.47	-0.43
	90	-0.53	-0.58	-0.60	-0.61	-0.59	-0.55	-0.50
	92	-0.65	-0.70	-0.73	-0.72	-0.70	-0.65	-0.58
	94	-0.78	-0.83	-0.86	-0.86	-0.84	-0.78	-0.71
	96	-0.92	-0.98	-1.02	-1.02	-0.99	-0.92	-0.84
	98	-1.01	-1.08	-1.12	-1.12	-1.09	-1.01	-0.92
	100	-1.24	-1.33	-1.37	-1.37	-1.33	-1.24	-1.11
	102	-1.28	-1.37	-1.42	-1.44	-1.41	-1.32	-1.20
100	74	-0.22	-0.25	-0.27	-0.28	-0.28	-0.27	-0.26
	76	-0.30	-0.35	-0.38	-0.39	-0.39	-0.37	-0.34
	78	-0.32	-0.37	-0.42	-0.43	-0.42	-0.40	-0.36
	80	-0.41	-0.48	-0.53	-0.54	-0.53	-0.49	-0.44
	82	-0.50	-0.58	-0.64	-0.66	-0.65	-0.60	-0.53
	84	-0.62	-0.70	-0.76	-0.77	-0.75	-0.69	-0.60
	86	-0.74	-0.84	-0.89	-0.90	-0.87	-0.80	-0.71
	88	-0.88	-0.97	-1.02	-1.03	-1.00	-0.92	-0.82
	90	-0.98	-1.08	-1.13	-1.13	-1.09	-1.01	-0.90
	92	-1.12	-1.22	-1.26	-1.25	-1.20	-1.10	-0.98
	94	-1.22	-1.32	-1.37	-1.37	-1.32	-1.22	-1.09
	96	-1.36	-1.46	-1.51	-1.51	-1.46	-1.35	-1.20
	98	-1.43	-1.54	-1.60	-1.60	-1.54	-1.43	-1.27
	100	-1.60	-1.72	-1.78	-1.78	-1.71	-1.58	-1.40
	102	-1.61	-1.74	-1.80	-1.83	-1.78	-1.65	-1.48

*Estimates exclude 30 minute phase in period and reflect the average reduction expected for the event

Table B-5: Five Hour Event Per Device Demand Impacts by Cycling Strategy, Temperature, and Event Start

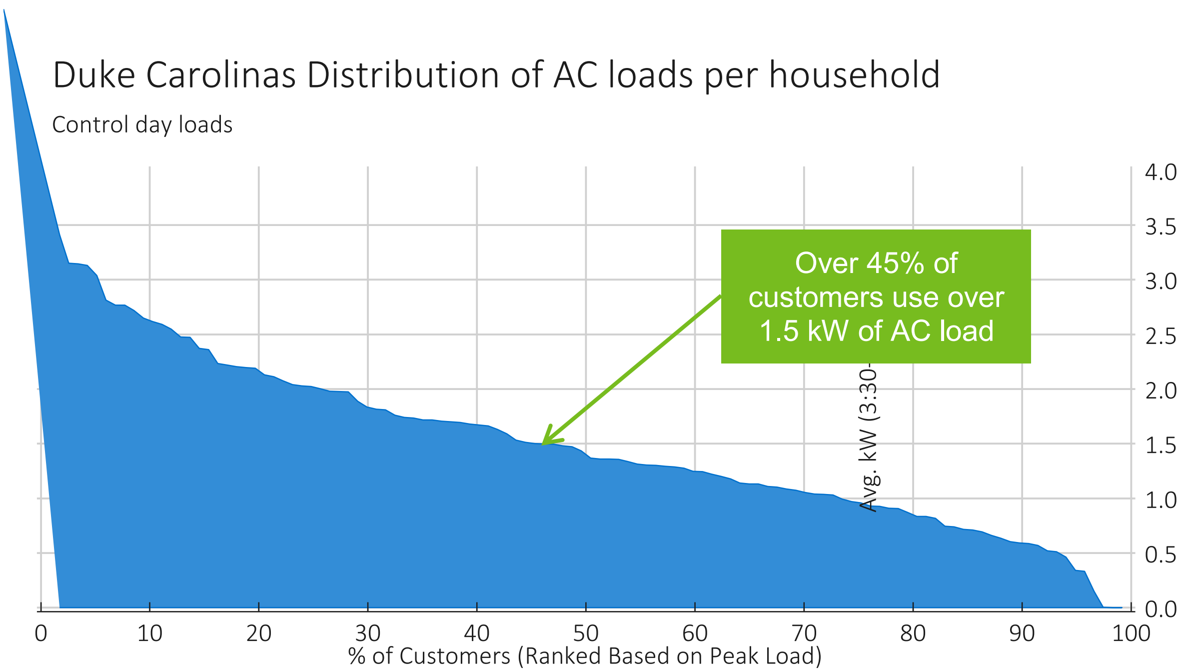
True Cycle	Daily Max (F)	Start Time (5 Hour Event)*						
		12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM
50	74	-0.07	-0.08	-0.09	-0.09	-0.09	-0.09	-0.09
	76	-0.10	-0.12	-0.13	-0.13	-0.13	-0.12	-0.11
	78	-0.11	-0.13	-0.14	-0.15	-0.14	-0.13	-0.12
	80	-0.15	-0.17	-0.19	-0.19	-0.18	-0.17	-0.14
	82	-0.19	-0.22	-0.24	-0.24	-0.23	-0.21	-0.18
	84	-0.23	-0.27	-0.29	-0.29	-0.27	-0.24	-0.20
	86	-0.29	-0.33	-0.35	-0.34	-0.32	-0.28	-0.24
	88	-0.34	-0.39	-0.41	-0.40	-0.37	-0.33	-0.28
	90	-0.39	-0.44	-0.46	-0.45	-0.41	-0.36	-0.31
	92	-0.46	-0.50	-0.52	-0.50	-0.46	-0.40	-0.33
	94	-0.50	-0.55	-0.57	-0.55	-0.51	-0.45	-0.37
	96	-0.56	-0.62	-0.64	-0.62	-0.57	-0.50	-0.41
	98	-0.60	-0.67	-0.69	-0.67	-0.62	-0.54	-0.44
	100	-0.68	-0.76	-0.78	-0.76	-0.69	-0.59	-0.48
	102	-0.68	-0.76	-0.80	-0.79	-0.73	-0.63	-0.52
64	74	-0.07	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08
	76	-0.11	-0.12	-0.13	-0.13	-0.13	-0.12	-0.11
	78	-0.11	-0.13	-0.14	-0.14	-0.13	-0.13	-0.12
	80	-0.16	-0.17	-0.19	-0.19	-0.18	-0.17	-0.15
	82	-0.20	-0.22	-0.24	-0.24	-0.23	-0.21	-0.19
	84	-0.27	-0.29	-0.31	-0.31	-0.29	-0.27	-0.24
	86	-0.35	-0.38	-0.40	-0.40	-0.38	-0.35	-0.31
	88	-0.46	-0.49	-0.51	-0.50	-0.48	-0.44	-0.40
	90	-0.54	-0.58	-0.59	-0.58	-0.56	-0.51	-0.46
	92	-0.66	-0.70	-0.71	-0.70	-0.66	-0.61	-0.54
	94	-0.79	-0.83	-0.84	-0.83	-0.79	-0.73	-0.66
	96	-0.93	-0.98	-1.00	-0.98	-0.94	-0.87	-0.78
	98	-1.02	-1.08	-1.10	-1.08	-1.03	-0.95	-0.86
	100	-1.26	-1.33	-1.34	-1.32	-1.26	-1.16	-1.04
	102	-1.30	-1.37	-1.40	-1.39	-1.33	-1.24	-1.11
100	74	-0.23	-0.26	-0.27	-0.28	-0.27	-0.27	-0.26
	76	-0.32	-0.36	-0.38	-0.38	-0.38	-0.36	-0.33
	78	-0.34	-0.39	-0.42	-0.42	-0.41	-0.38	-0.34
	80	-0.44	-0.50	-0.53	-0.53	-0.50	-0.47	-0.41
	82	-0.54	-0.61	-0.64	-0.64	-0.61	-0.56	-0.49
	84	-0.65	-0.72	-0.76	-0.75	-0.71	-0.64	-0.56
	86	-0.78	-0.85	-0.89	-0.88	-0.83	-0.75	-0.66
	88	-0.91	-0.99	-1.02	-1.00	-0.95	-0.87	-0.77
	90	-1.02	-1.09	-1.12	-1.10	-1.04	-0.95	-0.84
	92	-1.16	-1.23	-1.24	-1.21	-1.14	-1.03	-0.91
	94	-1.26	-1.33	-1.36	-1.33	-1.26	-1.15	-1.02
	96	-1.39	-1.47	-1.50	-1.47	-1.39	-1.27	-1.13
	98	-1.47	-1.56	-1.58	-1.55	-1.47	-1.34	-1.20
	100	-1.64	-1.74	-1.76	-1.73	-1.63	-1.48	-1.32
	102	-1.66	-1.76	-1.80	-1.78	-1.70	-1.56	-1.38

Appendix C 2016 Power Manager Evaluation

In 2016, a sample of 122 Power Manager participants were selected for inclusion in Nexant's impact evaluation, comprising a total of 144 end use (AC) loggers. Nexant compiled end use data from the 144 loggers and assessed it for quality and completeness. Of the 144 devices installed, 119 loggers returned usable end use data, making up the final impact analysis dataset.

Nexant isolated customers' AC system loads during peak hours (3:30 to 6:00pm) on nonevent days with high average temperatures in order to examine typical AC loads on hot summer days. These are generally analogous to event days and provide a reasonable estimate of what customer AC loads would have been in the absence of a curtailment event. Figure C-1 shows the distribution of average customer loads (kW) during peak hours on nonevent days. Roughly 45% of sampled customers use more than 1.5 kW of AC load under these typical event conditions.

Figure C-1: Distribution of Air Conditioner Peak Period Loads

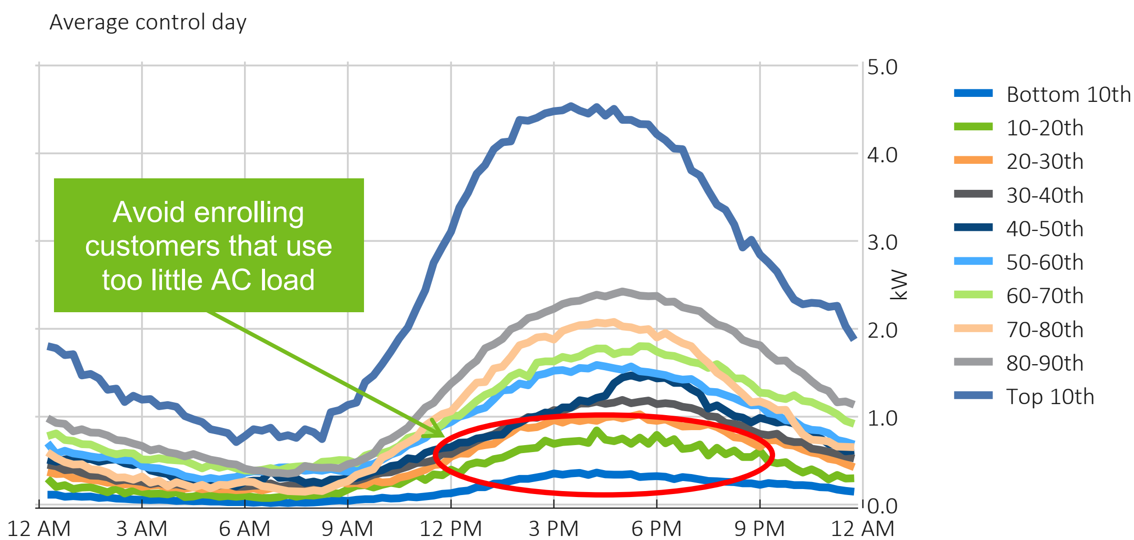


One of the advantages of end use data collection is the ability to assess whether customers use their air conditioners during key hours on hotter days. By design, events were not called on all of the hottest summer days, enabling Nexant to assess typical air conditioner use absent load curtailment events. A total of 47 nonevent days were identified having daily maximum temperatures exceeding 86°F and an average daily maximum temperature of 90°F, compared to an average maximum temperature of 92°F for actual event days.

Figure C-1 shows the distribution of average air conditioner unit demand during peak hours across sampled customers on nonevent days. Nexant isolated the hours 4 to 6pm to generate the distribution as this period aligns with the timing for most Power Manager events. Power Manager participants' air conditioner use varies substantially, reflecting different occupancy schedules, comfort preferences, and thermostat settings. Roughly 45% of air conditioner loads exceed 1.5 kW during peak hours. As with any program, consumption varies by customer for a variety of reasons. A portion of enrolled customers use little or no air conditioning during late afternoon hours on hotter days. These customers are, in essence, free riders since they receive the participation incentive without providing AC load for curtailment. However, the bulk of the costs for recruitment, equipment, and installation have already been sunk for these customers and, as a result, removing them from the program may not substantially improve cost effectiveness.

Nexant then categorized customers into deciles by average daily loads on nonevent days. This process allows for more targeted consideration of customers that typically use either extremely high or extremely low loads during event-like conditions. Figure C-2 shows average AC load shapes by decile for sampled participants on nonevent days that are comparable to event days. Despite the general size of AC loads, some customers have small AC loads during peak hours. In general, customers that make up these lower deciles are not ideal candidates for program participation due to relatively low potential for load shed impacts.

Figure C-2: Air Conditioner End Use Hourly Loads by Size Decile



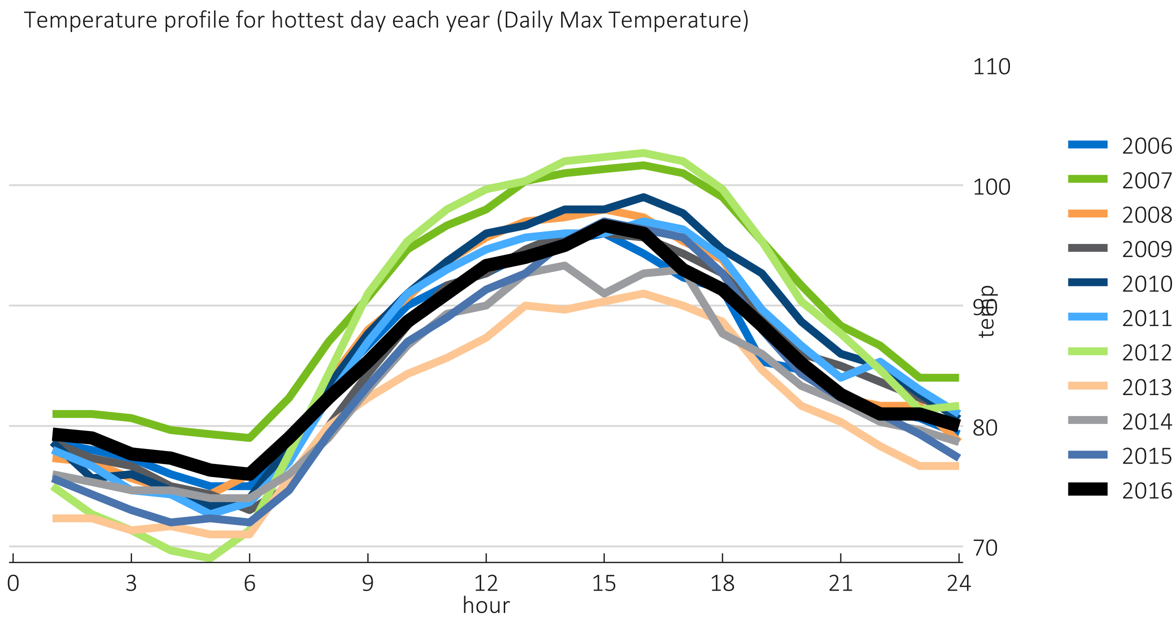
In 2016, Duke Energy Carolinas dispatched Power Manager events 14 times. Some of these events involved dispatching all of the customers enrolled in the program, while other events were only called for customers in the research group in order to provide data for this analysis. By design, events included a wide range of dispatch hours, weather conditions, and control levels. Both test events of the 100% emergency shed lasted 20 minutes; and, all systems were affected simultaneously at the outset of the event window. All of the 50% and 64% cycling events were called at 1:30 pm, 2:30 pm, or 3:30 pm and lasted either 2.5 hours or 3.5 hours. Control of affected air conditioning units was phased in at random over the first 30 minutes of each event. Likewise, the last 30 minutes of these events allowed air conditioning units to resume normal operations in the order they were first controlled. The demand reductions reported in this report for 50% and 64% cycling events exclude the random phase-in and phase-out periods of each event because those periods do not reflect demand reductions when all units are being cycled. Table C-1 lists the events that were called during the summer of 2016.

Table C-1: 2016 Event Operations and Characteristics

TrueCycle Level	Event Date	Start Time	End Time	Temperature	# of Customers
50%	7/20/2016	3:30 PM	6:00 PM	91.0	~120
	9/6/2016	1:30 PM	4:00 PM	90.3	~120
	9/8/2016	3:30 PM	6:00 PM	93.0	189,605
	9/14/2016	3:30 PM	6:00 PM	90.7	~120
64%	6/16/2016	1:30 PM	4:00 PM	94.0	~120
	6/23/2016	2:30 PM	5:00 PM	94.0	185,928
	7/8/2016	3:30 PM	6:00 PM	95.2	~120
	7/14/2016	2:30 PM	6:00 PM	95.7	186,744
	8/12/2016	3:30 PM	6:00 PM	89.7	~120
	8/31/2016	3:30 PM	6:00 PM	90.0	~120
	9/15/2016	1:30 PM	4:00 PM	89.0	~120
	9/19/2016	2:30 PM	6:00 PM	86.7	190,564
100%	8/26/2016	4:00 PM	4:20 PM	93.9	~120
	9/7/2016	5:00 PM	5:20 PM	91.7	~120

In comparison to the immediately prior 10 years, 2016 was neither extremely hot nor cool for DEC territory. Figure C-3 shows how the maximum temperature in 2016 compares to historical hourly temperatures for the weekday with the highest daily maximum temperature. The peak day temperatures, however, fell short of the 102°F used for planning.

Figure C-3: Comparison of 2016 Maximum Temperature to Historical Years (2006-2016)



A key objective of the 2016 evaluation was to quantify the relationship between demand reductions, temperature, hour of day, and cycling strategy—referred to as the time-temperature matrix. By design, a large number of events were called under different weather conditions, for different dispatch windows, using various cycling strategies so that demand reduction capability could be estimated for a wide range of operating and planning conditions. The tool that was created using 2016 event data was then applied to 2017 event conditions to predict load reductions that were achieved during those events.

The tool was also used to predict load reduction capability under extreme weather conditions, defined as a 102°F day. Weather conditions vary substantially from year to year as shown earlier in Figure C-3. Because 2016 conditions did not approach the 102˚F conditions Duke Carolinas has previously experienced multiple times, the reductions capability had to be estimated based on the data available.

Figure C-4 illustrates the essential trends and challenges. Not only do Power Manager demand reductions grow on a percentage basis with hotter weather and with deeper cycling, but so do the air conditioner loads available for curtailment. The implication is that larger percent reductions are attainable from larger loads when temperatures are hotter. However, producing estimates of the reduction capability for 102˚F, unavoidably requires extrapolation of patterns observed in 2016 to conditions that were hotter than those experienced in 2016.

Figure C-4: Both Air Conditioning Loads and Percent Demand Reductions are Weather Sensitive

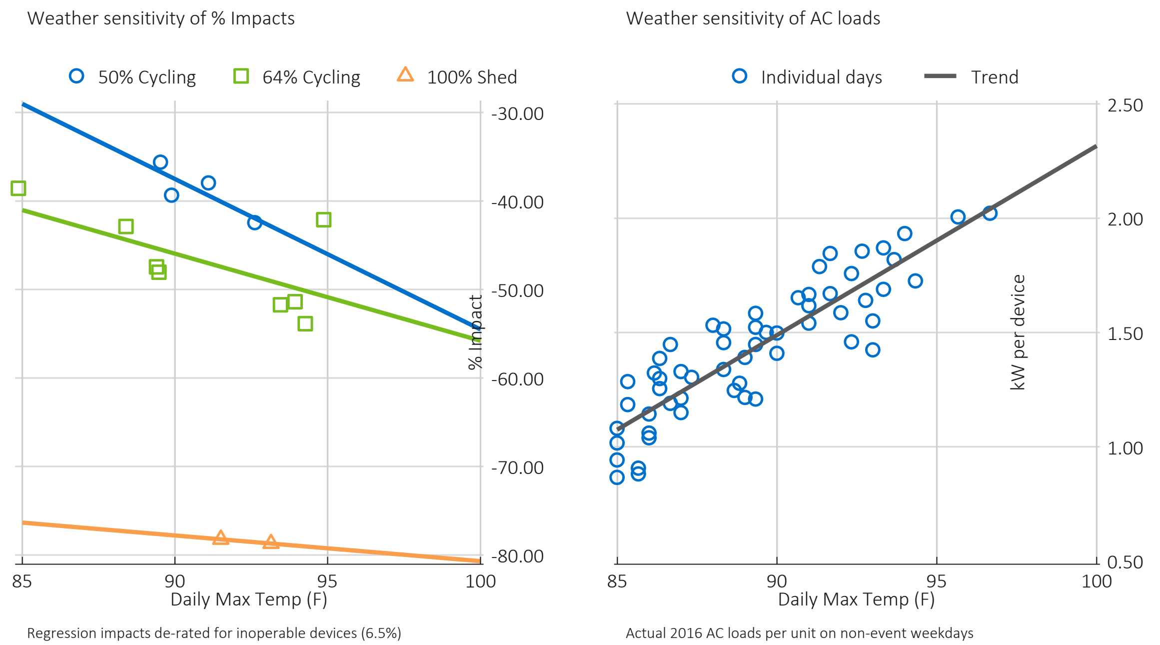


Figure C-5: Time Temperature Matrix Development Process

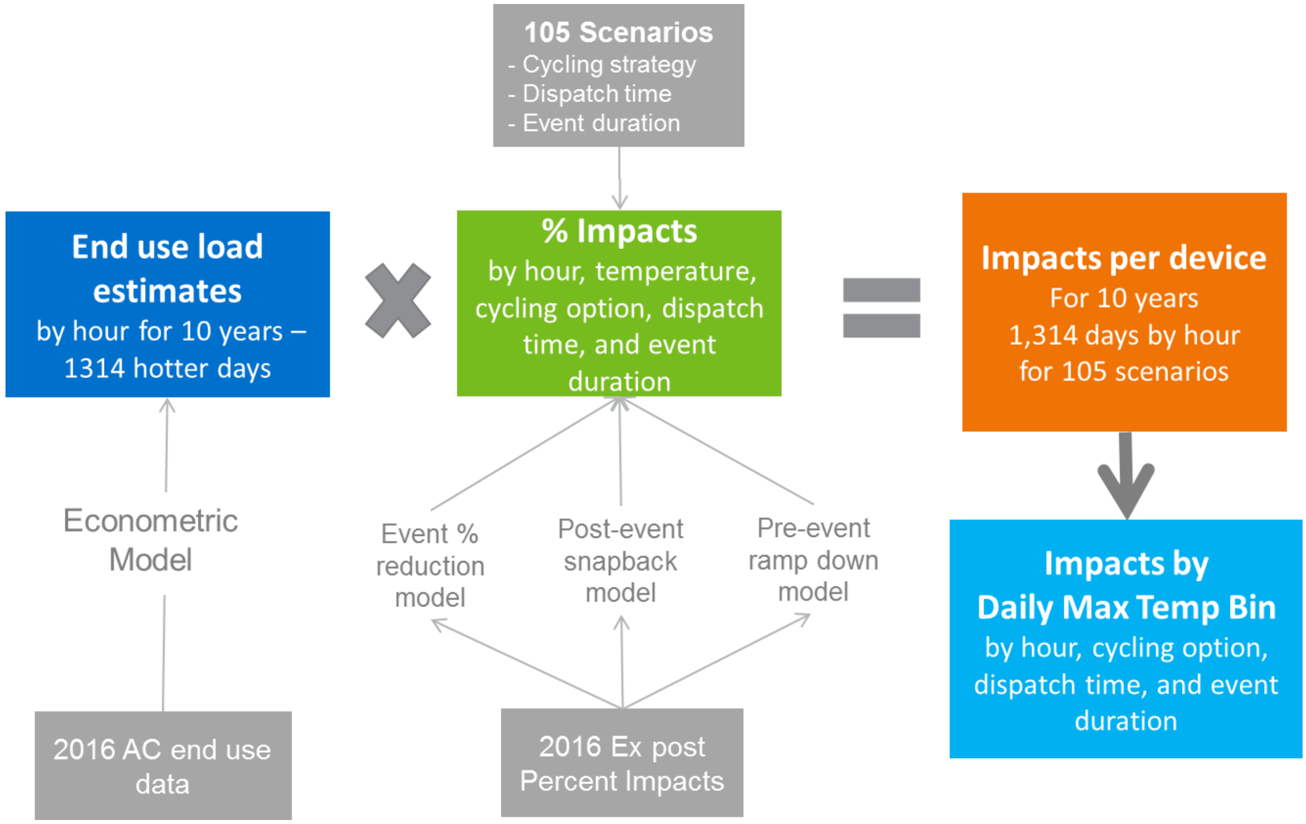
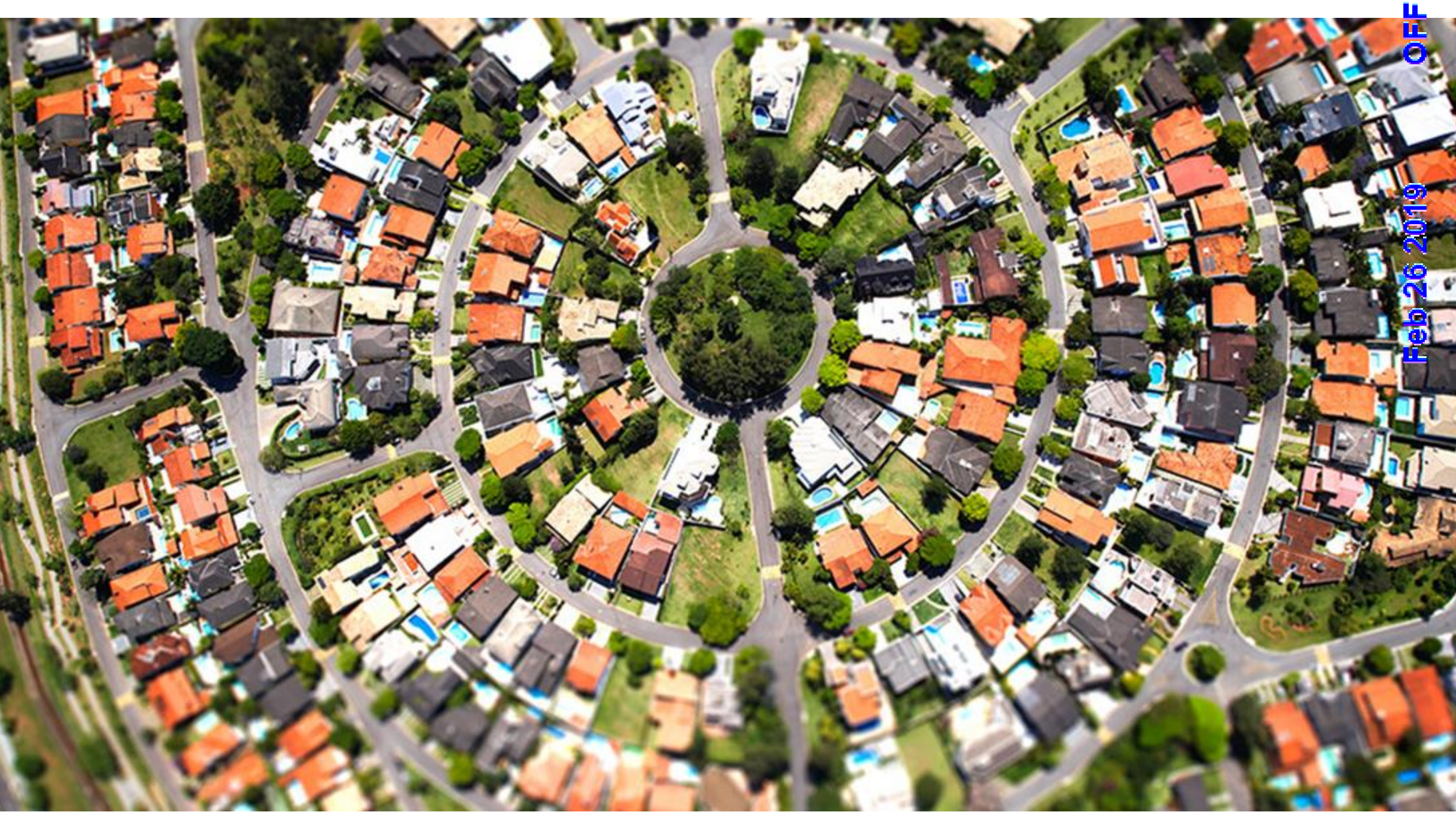


Figure C-5 illustrates the process used to estimate the demand reduction capability under various conditions:

- Estimates of air conditioner loads were developed using the 2016 air conditioner end use data and using the same regression models used to estimate impacts. All weekdays with daily maximum temperatures above 75˚F were included in the models. The models were used to estimate air conditioner load patterns for 1,314 days in 10 years. Because the models were based on 2016 data, they reflect current usage patterns and levels of efficiency. The 2016 air conditioner patterns were applied to actual weather patterns experienced in past 10 years and not hypothetical weather patterns.
- Estimates of the percent reductions were based on three distinct econometric models of load control phase in, percent reductions during the event, and post-event snapback. The models were based on the percent impacts and temperatures experienced during 2016 events.
- A total of 105 scenarios were develop to reflect various cycling/control strategies, event dispatch times, and event lengths.
- Estimated impacts per device were produced. This was done by combining the estimated air conditioner loads, estimated percent reductions, and dispatch scenarios. The process produced estimated hourly impacts for each of 1,314 hotter weekdays in 2006-2016 under 105 scenarios each.

- Multiple days in narrow temperature bins were averaged to produce an expected reduction profile. Days with the similar daily maximum temperature can have distinct temperature profiles and the heat buildup influenced the amount of air conditioner load.

REPORT



Smart $aver Evaluation Report — May 1, 2016 – April 30, 2017

Submitted to Duke Energy Carolinas in partnership with Research into Action

May 25, 2018

Principal authors:

Nexant: Patrick Burns, Wyley Hodgson, Andrew Dionne

Research Into Action: Jane Peters, Jordan Folks, Doré Mangan, Anne Weaver

Contents

List of Figures

List of Tables

Equations

1 Executive Summary

1.1 Program Summary

The Smart $aver program offers Duke Energy Carolina ("Duke" or "DEC") existing and new construction residential customers incentives for improving their home's energy efficiency through the installation of energy efficient heating, ventilating, and air conditioning (HVAC) units, smart thermostats, water heating equipment, pool pump, duct sealing and insulation, and attic insulation with air sealing[1]. A tiered incentive structure offers larger rebates for higher efficiency units. Quality install and smart thermostat incentives are not offered as standalone incentives; customers must receive a rebate for a new HVAC system to be eligible for these additional incentives. The program is provided through independent, prequalified contractors who install the eligible energy efficiency measures consistent with the program standards and guidelines, and submit the rebate application documentation on behalf of the customer.

1.2 Evaluation Objectives and Results

This report presents the results and findings of evaluation activities for the Smart $aver program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Research into Action, in the evaluation period of May 1, 2016 – April 30, 2017.

1.2.1 Impact Evaluation

We conducted this evaluation of the Smart $aver program to estimate gross and net energy, summer demand, and winter demand savings for the entire program and for each major measure type. The evaluation team reviewed available program databases to help inform the design of the evaluation effort and sampling approach. Activities included an in-situ metering study (n=44) to estimate operational hours of air source heat pumps and central air conditioners paired with engineering desk analyses to estimate gross savings for all measures in the program during the evaluation period of May 1, 2016 – April 30, 2017. Net savings are a reflection of the degree to which the gross impacts are a result of the program-specific efforts and incentives. Therefore, we implemented attribution surveys with program participants and contractors to estimate the rates of free ridership and spillover. Program level results for the Smart $aver program are provided in Table 1-1.

[1] HVAC tune-ups were also included in the program offering; however, there was no participation for this service during the evaluation timeframe.

Table 1-1: Program Impact Results

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	9,593,312	83.0%	7,960,401	66.9%	5,324,635
Summer Demand (MW)	2.95	70.5%	2.08		1.39
Winter Demand (MW)	1.30	196.8%	2.50		1.67

In the evaluation period of May 1, 2016 – April 30, 2017, the program provided rebates for 21,817 measures installed in single family homes, resulting in 7,960 MWh in gross verified energy savings. The program primarily incentivized HVAC equipment and related add-on measures (quality installation and smart thermostats), which accounted for 80% of rebated measures and 76% of verified energy savings, as shown in Figure 1-1 and Figure 1-2.

Figure 1-1: Smart $aver Rebated Measures

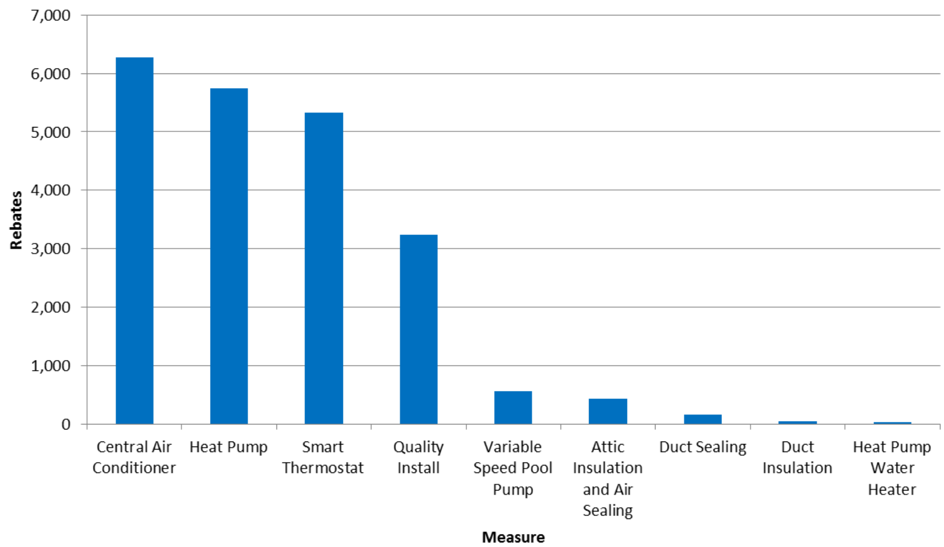


Figure 1-2: Smart $aver Verified Energy Savings

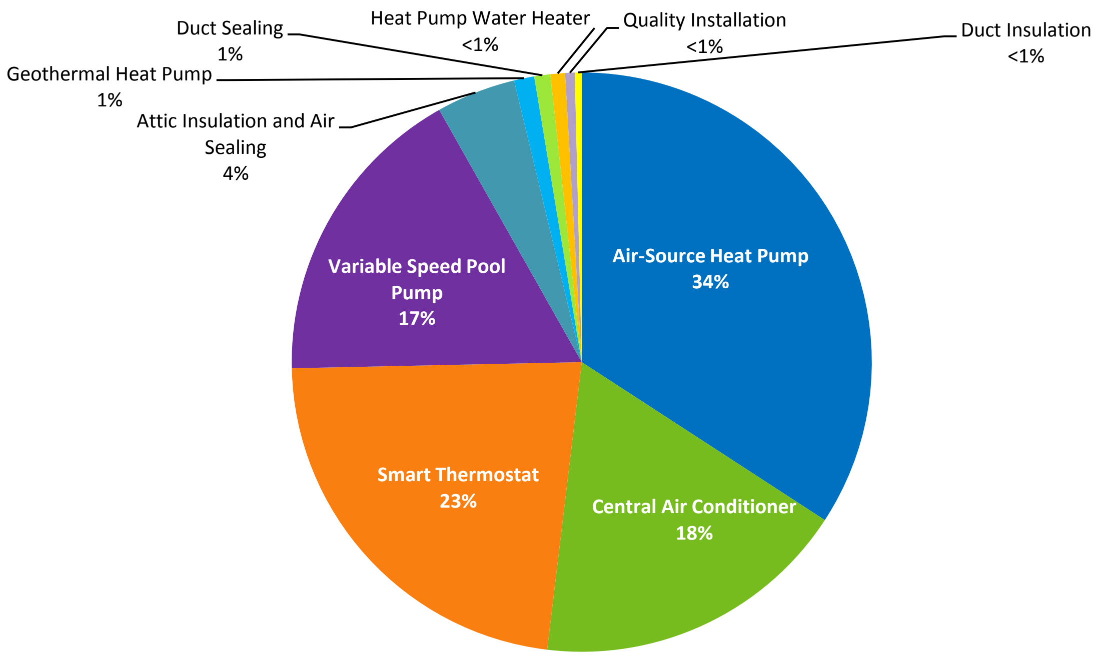


Table 1-2 presents per unit verified gross energy and demand savings with the calculated net-to-gross ratio for each rebated measure.

Table 1-2: Program Verified Impacts by Measure

Measure	Reported Energy Savings per unit (kWh)	Realization Rate	Verified Gross Energy Savings per unit (kWh)	Reported Summer Coincident Demand Savings per unit (kW)	Realization Rate	Verified Gross Summer Coincident Demand per unit (kW)	Reported Winter Coincident Demand Savings per unit (kW)	Realization Rate	Verified Gross Winter Coincident Demand per unit (kW)	Net to Gross Ratio
Central Air Conditioner*	320	70.2%	225	0.195	63.0%	0.123	0.161	103.5%	0.167	66.9%
Heat Pump**	416	117.7%	490	0.139	107.5%	0.149	0.122	174.3%	0.213	
Quality Install	376	3.5%	13	0.133	3.8%	0.005	0.084	5.0%	0.004	
Smart Thermostat	377	106.2%	400	0.000	100.0%	0.000	0.000	100.0%	0.000	
Attic Insulation and Air Sealing	1,163	70.9%	824	0.184	120.1%	0.221	0.194	205.8%	0.399	
Variable Speed Pool Pump	2,342	103.8%	2,430	0..590	89.3%	0.527	0.000	100.0%	0.000	
Heat Pump Water Heater	1,616	100.0%	1,616	0.124	100.0%	0.124	0.000	100.0%	0.000	
Duct Sealing	350	125.1%	438	0.291	55.5%	0.162	0.000	100.0%	0.153	
Duct Insulation	688	92.1%	634	0.573	40.9%	0.234	0.000	100.0%	0.222	

*All values are a weighted average of Tiers 1, 2, and 3. Per unit verified savings for each Tier is provided in Section 3.
** All values are a weighted average of Tiers 1, 2, and 3 with air source heat pumps combined with geothermal heat pumps. The evaluation team assessed savings separately for each technology type and tier and presents these findings in Section 3. References to "heat pump" in subsequent tables and figures in this evaluation report reflect the combined findings for air source and geothermal heat pumps unless otherwise noted.

1.2.2 Process Evaluation

This process evaluation assessed why and how rebated energy saving measures were implemented through Smart $aver and identified ways to improve the program design and implementation. To answer these research questions, the evaluation team interviewed program and implementer staff (n=2) and "high volume" trade allies (n=5), and surveyed stratified random samples of trade allies (n=58) and participants (n=73).[1]

Program Successes

The DEC Smart $aver Program found success in the following areas.

Overall, participants are highly satisfied with Smart $aver. Participants were especially satisfied with their contractors, their upgrade project, and the program overall.

Smart $aver influences energy efficiency contracting services in DEC service territory. Trade allies reported that participating in Smart $aver influenced them to recommend and implement qualifying measures and has increased their knowledge of energy efficient technologies.

Trade allies are Smart $aver's most successful marketing channel. Participant surveys demonstrated that trade allies are the primary source of program awareness (Table 1-3) and are the most influential factor on the customer's decision to implement rebated measures.

Table 1-3: Source of Program Awareness (Multiple Responses Allowed; n=73)

Source of Program Awareness	Percent
Trade ally	77%
Online	11%
Mailer	8%
Other	3%
Don't know	6%

Program Challenges

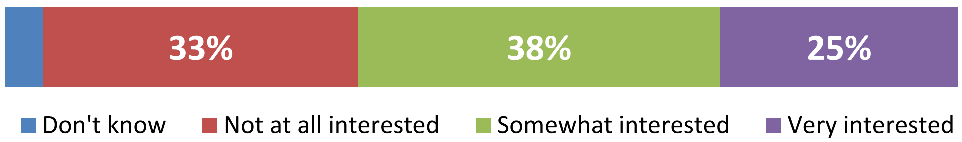
The following concerns were highlighted by trade allies and participants.

Smart $aver is not a strong gateway program. About one-third (29%) of participants reported awareness of other DEC programs, and 41% of those participated (12% of total sample). Since receiving Smart Saver rebates, 30% of participants reported purchasing other products or services to help save energy in their homes. However, very little of this resulted in attributable spillover savings as most (16 of 22) said Smart $aver had no influence on their subsequent energy upgrades.

[1] High volume trade allies are companies in the top 20% of trade allies in terms of number of rebated measures, for a given campaign, in 2016.

Trade allies could benefit from additional sales training. Most trade allies expressed interest in training to help them sell qualified measures (Figure 1-3).

Figure 1-3: Trade Ally Interest in Sales Training (n=58)



The transition to the online portal has been challenging for trade allies. The portal was the biggest sticking point for trade allies, with 71% reporting problems or frustrations with the new rebate application process. Trade allies most commonly reported the following issues:

- data entry and form upload problems (which causes them to resubmit forms)
- reasons for rebate rejections are vague or unknown
- the application process takes too much time
- resolving application issues tend to be an onerous task

However, nearly three-fourths of trade allies said portal issues have gotten at least somewhat better over time.

Quality installation has caused dissatisfaction among many trade allies. While most trade allies said they were already doing all of the techniques on the quality install checklist, only one mentioned all of the primary components of the checklist when asked to list the specific techniques. When asked if they had any suggestions for improving quality install, many trade allies noted their frustration with and criticism of the measure. Trade allies were most dissatisfied with the cumbersome process of the quality installation checklist and many either suggested eliminating the requirement or compensating the trade ally for their time completing the quality installation.

1.3 Evaluation Conclusions and Recommendations

Based on evaluation findings, the evaluation team concluded the following and provides several recommendations for program improvement.

Conclusion 1: Trade allies are the driving force of the program, but there may be opportunities to improve their program experience and effectiveness. Trade allies are the primary mechanism for bringing participants into the program, as they often upsell energy efficient systems to customers who have no prior awareness of the program during a time of immediate heating or cooling needs. However, trade ally satisfaction with certain program elements is relatively low, particularly: the application process and portal, program training, and the quality installation process and requirements.

- **Recommendation: Look for ways to increase trade ally satisfaction and rebate volumes.** Trade allies are vital to the program's success, DEC should work with Blackhawk Engagement Solutions, the program implementer, to improve the trade ally experience and look for ways to increase trade ally effectiveness in the field.
- Potential strategies for increasing trade ally effectiveness (and simultaneously increasing trade ally satisfaction):
  - Provide marketing materials to trade allies, such as co-op marketing
  - Attempt to increase trade ally participation in training events. Potential strategies:
    - Align training offerings with trade ally content requests, particularly: sales, quality install, portal/application process, and program changes
    - Ensure training sessions occur during convenient periods during the year (i.e., non-peak seasons) and convenient times (breakfast meetings can be particularly successful).
- Potential strategies for improving Trade Ally (TA) satisfaction:
  - Continue improving portal system and simplifying the application process
  - Consider splitting incentives with TAs to compensate TAs for their time spent on Duke Energy processes. Shifting a small portion of the incentive to the trade ally is unlikely to negatively impact participation levels, as participants were only marginally influenced by the rebate and were instead mainly influenced by their contractor's recommendation (a finding which underscores the need to retain a strong trade ally network).

Conclusion 2: Approximately 60% of sampled quality install sheets included issues. Trade allies complete quality install sheets detailing system measurements taken while on site. Upon review of a sample of quality install sheets, the evaluation team found several issues including:

- Math errors
- Calculated capacities below program requirement
- Rule of thumb CFM estimates instead of actual measurements
- Testing in sub-optimal conditions

These issues compromise the validity of the impact of quality installation and therefore the associated energy and demand savings cannot be verified.

- **Recommendations:**
  - Establish additional internal QA/QC processes when reviewing submitted quality install sheets.
  - Work with trade allies to better understand issues encountered with the quality install sheets and to improve quality install reporting.

Conclusion 3: The quality installation measure may have experienced some growing pains in its infancy. Many trade allies expressed frustration with the 'complex and time consuming' quality install form, especially since they receive no compensation for completing it. These concerns may have limited the initial growth of the new measure:

- Tier 1 (which requires QI) was the least installed HVAC tier, amounting to about one-tenth of all HVAC units in the program.
- Less than one-third of Tier 2 and Tier 3 HVAC units received a QI rebate.
  - **Recommendation: As DEC matures the quality installation measure, look for ways to retain, expand, and improve trade ally quality install practices.**
  - Potential strategies for retaining and expanding trade ally quality installation practices:
    - <u>Shift the quality install rebate to trade allies</u>: trade ally dissatisfaction with the process may be mitigated by compensation.
    - <u>Hold a round table meeting with trade allies to collaborate on a revised quality install process that better serves the needs of both parties:</u> for DEC to generate cost-effective savings from the measure, the process must be minimally burdensome for trade allies so that they actively and accurately complete it

Conclusion 4: New HVAC rebates and requirements are generating additional energy savings that would not have occurred naturally. The new HVAC program components have resulted in increased trade ally sales of high SEER HVAC units and smart thermostats. Although comparatively less successful, quality installation rebates and requirements have encouraged a minority of trade allies to adopt new quality install techniques.

- **Recommendation 1:** <u>Continue offering the new incentives</u>:
  - tiered HVAC incentives
  - smart thermostats incentives
  - QI incentives (however, shift the rebate to trade allies)
- **Recommendation 2:** <u>Continue looking for new program offerings that could generate additional savings</u>.

2 Introduction and Program Description

2.1 Program Description

The Smart $aver program offers Duke Energy Carolinas ("Duke" or "DEC") existing and new construction residential customers incentives for improving their home's energy efficiency through the installation of energy efficient heating, ventilating, and air conditioning (HVAC) units, smart thermostats, water heating equipment, pool pump, duct sealing and insulation, and attic insulation with air sealing[1]. A tiered incentive structure offers larger rebates for higher efficiency units. Quality install and smart thermostat incentives are not offered as standalone incentives; customers must receive a rebate for a new HVAC system to be eligible for these additional incentives.

The program is provided through independent prequalified contractors – called "trade allies" – who install the eligible energy efficiency measures consistent with the program standards and guidelines, and submit the rebate application documentation on behalf of the customer. Trade allies receive no monetary incentives for measures they install in existing buildings, but builders are eligible to receive rebates for qualified HVAC equipment installed in residential new construction projects.

2.1.1 Energy Efficiency Measures

Energy efficiency measures included in the Smart $aver program are summarized in Table 2-1.

[1] HVAC tune-ups were also included in the program offering; however, there was no participation for this service during the evaluation timeframe.

Table 2-1: Smart $aver Measures and Incentives

Measures		Rebate Amount	Details
Central Air Conditioner		Tier 1: $250 Tier 2: $250 Tier 3: $300	Tier 1: 14 SEER, ECM fan on indoor unit, quality installation required Tier 2: 15 and 16 SEER, with ECM Tier 3: 17 SEER or greater, with ECM
Heat Pump*	*Air Source*	Tier 1: $250 Tier 2: $250 Tier 3: $300	Tier 1: 14 SEER, ECM fan on indoor unit, quality installation required Tier 2: 15 and 16 SEER, with ECM Tier 3: 17 SEER or greater, with ECM
	Geothermal	Tier 3: $300	Tier 3: 19 SEER or greater, with ECM
Smart Thermostat		$100	Add-on incentive for HVAC participants
Quality Installation		$60	Required on Tier 1 HVAC (no add-on incentive provided), add-on incentive for Tier 2 and Tier 3 HVAC participants
Attic Insulation & Air Seal		$250	R-19 or below to R-30 or greater; decrease home air leakage by 5% or more
Variable Speed Pool Pump		$300	Equipment must be an ENERGY STAR® qualified variable-speed pool pump for use with main filtration of in-ground residential swimming pool; applications for motor replacements only are not eligible.
Heat Pump Water Heater		$350	ENERGY STAR® qualified units. Must have an EF ≥ 2
Duct Sealing		$100/duct system	Decrease air duct leakage by 12% or more
Duct insulation*		$75/duct system	For unconditioned attic: R-4.2 to R-19 or greater; for unconditioned crawl space or basement: R-0 to R-6 or greater

*The Smart$aver program filing stipulates heat pumps as a certified measure. However, because the program rebated both air source and geothermal heat pumps during the evaluation period, the evaluation team assessed savings separately for each technology type. References to “heat pump” in subsequent tables and figures in this evaluation report reflect the combined findings for air source and geothermal heat pumps unless otherwise noted.

2.2 Program Implementation

The Smart $aver program is chiefly implemented by Blackhawk Engagement Solutions (BES). BES manages the trade ally registration process, incentive application submission and fulfillment, the trade ally online portal, and the program call center. As part of the prequalification process, all contractors who wish to participate are required to enter into a Letter of Agreement or Prequalified Contractor Participation Agreement for participation in the program. Contractors who meet program requirements are included in a prequalified contractor listing on the program website. Prequalified contractors have permission to promote Smart $aver program measures and identify themselves as a program contractor.

Upon selection by the customer, contractors will complete the requested installation in accordance with all Smart $aver Program standards and guidelines, and all applicable building codes. Contractors use the online portal to submit incentive applications. Paper format incentive applications are also accepted, but discouraged. Prequalified contractors provide itemized invoices with sufficient detail describing what was installed.

Upon receipt of the application, BES verifies that the application is complete and accurate, and will follow up with customers or contractors to resolve any discrepancies. DEC staff conduct quality control inspections on a small share of installed measures.[2] Inspections are to be shared across all contractors, with new contractors and those who have had quality issues being inspected at a higher rate. Upon approval of applications, incentives are issued to participating customers (and, when applicable, builders or trade allies) for the incentive value.

DEC provides marketing through several channels, including: direct mail campaigns, utility website, participating contractor outreach and advertising, and contractor associations. DEC also performs trade ally outreach and training services.

Eligibility

DEC residential account holders residing in DEC electric service territory are eligible for the Smart $aver rebates. All customers participating in the program must be on a DEC residential electric rate. The program is open to existing residential electric service customers living in single-family homes, condominiums, mobile homes, townhomes and duplexes. Builders may also apply for HVAC rebates for their residential new construction projects.

2.3 Key Research Objectives

Over-arching project goals will follow the definition of impact evaluation established in the “Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency,” November 2007:

[2] DEC staff inspects the first five projects completed by new trade allies. Further, DEC staff randomly inspects 10% of projects for each measure category.

"Evaluation is the process of determining and documenting the results, benefits, and lessons learned from an energy-efficiency program. Evaluation results can be used in planning future programs and determining the value and potential of a portfolio of energy-efficiency programs in an integrated resource planning process. It can also be used in retrospectively determining the performance (and resulting payments, incentives, or penalties) of contractors and administrators responsible for implementing efficiency programs."

Evaluation has two key objectives:

1) To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.
2) To help understand why those effects occurred and identify ways to improve.

2.3.1 Impact

Over-arching project impact evaluation processes followed standard industry protocols and definitions, where applicable, and include the Department of Energy Uniform Methods Protocol, as an example. As part of evaluation planning, the evaluation team outlined the following activities for this program evaluation:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for energy efficient measures and equipment implemented in participants' homes;
- Assess the rate of free riders from customer and contractor perspective and determine spillover effects;
- Benchmark verified measure level energy impacts to applicable technical reference manuals (TRMs) and other Duke-similar programs in other jurisdictions;
- Consider and verify that measure installation vintage aligns with measure baseline definitions, i.e. early replacement, burnout on failure, etc.; and,
- To the extent possible for the purposes of program planning, the evaluation team will seek to provide estimated per-unit savings by measure.

2.3.2 Process

The process evaluation was designed to support organizational learning and program adaptation. To this end, the evaluation team sought to research several elements of the program delivery and customer experience as outlined below:

- **Awareness and Engagement:** How aware are customers of the Smart $aver program? What are the primary sources of information (e.g., trade allies, program website, bill inserts) that customers use to learn more about the program? How do customers typically learn about energy efficient technologies? How are trade allies engaged in the Smart $aver program, and what is the most effective engagement source (e.g., implementer, program website). Is there a need to conduct any additional marketing of the program and/or provide marketing support to trade allies?

- **Program Satisfaction:** How satisfied are participants with the overall program experience, their contractor and the quality of the installation, incentive turnaround, energy savings after the work was performed, and Duke Energy? How satisfied are trade allies with the program?
- **Program Influence:** Does the program influence participants to engage in other Duke Energy energy-efficiency programs? Does the program increase contractor's knowledge of energy-efficient technologies? Does the program increase how often participating contractors promote energy-efficient equipment and services to their customers?
- **Challenges and opportunities for improvement:** Are there any inefficiencies or challenges with the application, incentive turnaround, or trade allies? What training opportunities could be offered to trade allies to help them more effectively sell rebated equipment? How engaged are trade allies in using the implementer web portal or other program resources?
- **Participant characteristics and potential:** What are the demographic characteristics of those participating in the program? Are there segments of the population that are not participating but have high participation potential and should be reached?
- **Code Changes:** New Seasonal Energy Efficiency Ratio (SEER) standards were enforced for heat pumps and air conditioners manufactured or distributed on or after January 1, 2015. What are trade ally perspectives on how this change will affect the market and the program?

2.4 Evaluation Overview

The evaluation team divided the approach into key tasks to meet the goals outlined:

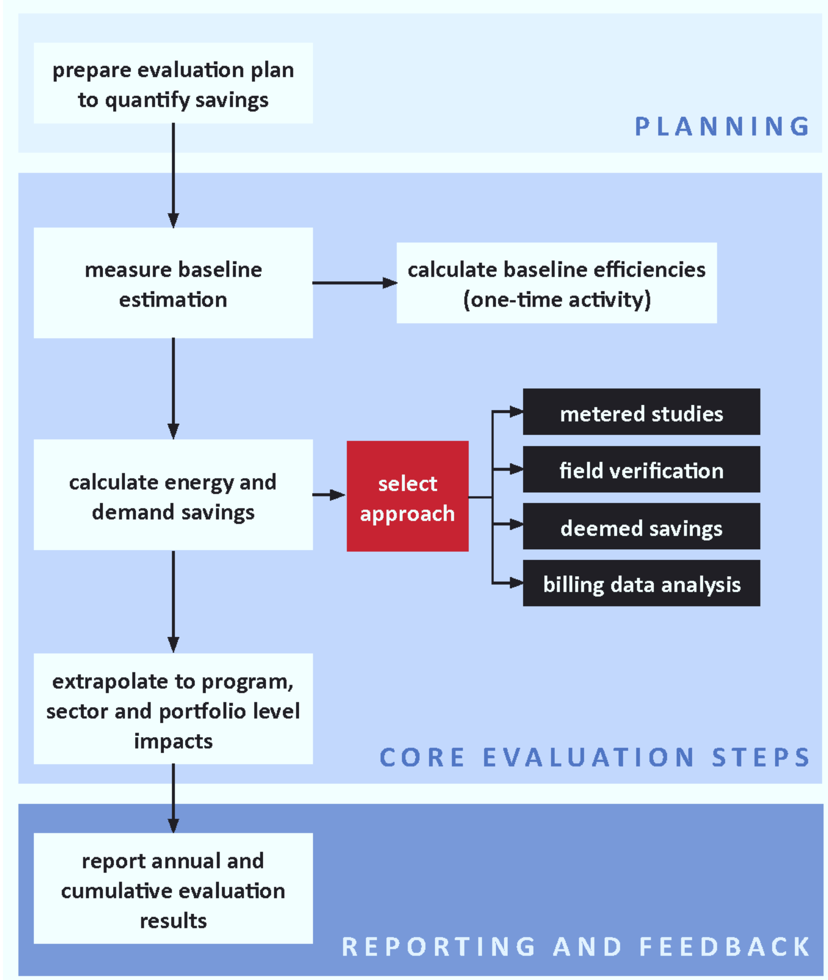
- **Task 1 –** Develop and manage evaluation plan to describe the processes that will be followed to complete the evaluation tasks outlined in this project;
- **Task 2 –** Conduct a process review to determine how successfully the program is being delivered to market and identify opportunities for improvement;
- **Task 3 –** Verify gross and net energy and peak demand savings resulting from the Smart $aver program through on-site measurements and verification activities of a sample of program participants and projects.

2.4.1 Impact Evaluation

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct our evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, include on-site inspections and measurements, telephone surveys, database review, best practice review, and interviews with implementation staff, trade allies, and program participants.

Figure 2-1 demonstrates the principle evaluation steps organized through planning, core evaluation activities, and final reporting.

Figure 2-1: Impact Evaluation Process



The evaluation team targeted sample sizes for on-site activities based upon the evaluation team's understanding of the expected significance (or magnitude) of expected participation, the level of certainty of savings, and the variety of measures.

The evaluation generally comprised the following steps, which are described in further detail throughout this report:

- **Design the Sample for Measurement and Verification (M&V):** The review, measurement, and verification of all implemented projects is not plausible or cost-effective given the size of this program. Consequently, a sample of projects was established for M&V. In order to provide the most cost-effective sample, the evaluation team employed a Value of Information (VOI) approach. VOI is used to balance cost and rigor and follows a process to allocate the bulk of the evaluation funds to programs and projects with high impact and high uncertainty.
- **Develop Measure-Specific M&V Plans**: Upon review of the program documents, a unique M&V plan was developed for each program and measure, including a metering protocol, as applicable. M&V methods were developed with adherence to

the International Performance Measurement and Verification Protocol (IPMVP) and other well-established engineering analysis procedures.

- **Participant Surveys and On-site Inspections:** The database review provided the necessary information to design a sample of projects to review. All sampled projects received a telephone survey with the participant. Additionally, a portion of the sampled projects received on-site measurement and verification to further detail the information obtained during the database review and ultimately used to calculate energy savings. Table 2-2, in Section 2.4.3 below summarizes the number of surveys and on-site inspections completed. The samples were drawn to meet a 90% confidence and 10% precision at the program level.
- **Calculate Impacts and Analyze Load Shapes:** Data collected via the on-site visits, database reviews and telephone surveys enabled the evaluation team to calculate gross verified energy and demand savings for each project or measure. Hourly load shapes are important in calculating system on-peak demand savings, especially when the measures installed have daily and seasonal variations in the operating schedule.
- **Estimate Net Savings**: Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and incentives. The evaluation team estimated free-ridership and spillover for each project in the impact sample utilizing self-report methods through surveys with program participants. The ratio of net verified savings to gross verified savings is the net-to-gross ratio as an applied scaling factor to the reported savings.

2.4.2 Process Evaluation

Process evaluation tells the qualitative story behind the quantitative impact evaluation by understanding the program in its unique context. The goal of process evaluation is to perform a systematic assessment of an energy efficiency program by generating feedback that achieves the following outcomes:

- Document program operations
- Recommend improvements to increase the program's efficiency and effectiveness
- Assess stakeholder satisfaction

These outcomes can inform program planning, existing program implementation, or efforts to redesign a program. Process evaluations typically cover all aspects of a program including its design, implementation, marketing and outreach, data tracking, quality assurance, customer and stakeholder feedback, and market conditions. By evaluating the broad context in which a program operates, evaluators can recommend realistic improvements. Evaluators typically examine program aspects through the following mechanisms:

- Database and document review
- Interviews with program staff and key stakeholders, such as trade allies
- Surveys with customers

- Benchmarking research
- Marketing review

Information gathered from participating customers and trade allies through process evaluation activities can be measured and analyzed to form the basis of a NTG ratio. For example, participant surveys used to assess participant satisfaction also provide opportunity to ask participants about their motivations for participating and the influence of the program on their decisions, both of which are key components of a free ridership calculation. Similarly, the participant surveys are used to assess whether participants installed additional energy savings measures, which could be attributed to spillover.

2.4.3 Summary of Activities

Techniques we utilized to conduct the evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, included field inspection and metering, telephone surveys with program participants, program database reviews and in-depth interviews (IDI) with utility staff, implementer, and trade allies. Table 2-2 provides a summary of the activities Nexant conducted as part of the Smart $aver program process and impact evaluation for the period of May 1, 2016 – April 30, 2017.

Table 2-2: Summary of Evaluation Activities

Target Group	Population	Sample	Method
Central Air Conditioner and Air Source Heat Pump	11,976	46	Field inspection and metering
Participants (rebated measures)	9,841	73	Telephone Survey
Duke Energy Program Staff	N/A	1	In-depth interview (IDI)
Implementer Staff	N/A	1	IDI
Most Active Trade Allies	~20	5	IDI
Trade Allies	624	58	Telephone survey

2.5 Sample and Estimation

The gross and net verified energy and demand savings estimates presented for the majority of the Smart $aver program participation were generally determined through the observation of key measure parameters among a sample of program participants. A census evaluation would involve surveying, measuring, or otherwise evaluating the entire population of projects within a population. Although a census approach would eliminate the sampling uncertainty for an entire program, the reality is that M&V takes many resources both on the part of the evaluation team and the program participants who agree to be surveyed or have site inspections conducted in their home. When a sample of projects is selected and analyzed, the sample statistics can be extrapolated to provide a reasonable estimate of the population parameters. Therefore, when used effectively, sampling can improve the overall quality of an evaluation study but at a lower cost. By limiting resource-intensive data collection and analysis to a random sample of all projects, more attention can be devoted to each project surveyed.

The nuances and tradeoffs considered by the evaluation team when developing sampling approaches varied by measure across the program and are discussed in more detail in Section 3 and Section 4. However, several common objectives were shared across measures and research objectives. The most important sampling objective was representativeness – that is that the projects selected in the evaluation were representative of the population they were selected from and would produce unbiased estimates of population parameters. A second key sampling objective was to consider the value of information being collected and align sample allocations accordingly. This effort generally involves considering the size (contribution to program savings) and uncertainty associated with the measure being studied and making a determination about the appropriate level of evaluation resources to allocate.

The evaluation team relied primarily on mean-per-unit estimation for the Smart $aver program and separated the program population into a series of homogenous measure categories. This approach works well for residential programs that include a large number of rebates for similar equipment types where the evaluation objective is to determine an average kWh savings per rebated measure. With mean-per-unit estimation, the average kWh savings and NTG ratio observed within the sample is applied to all projects in the population. For several measures the characteristics observed within the evaluation sample were supplemented with parameter values that were available for all members of the population in the program database. For example, the program database stores the capacity (BTU/hour) for every rebated air source heat pump so the evaluation team used the population mean capacity when calculating average per-unit energy savings rather than the sample mean.

2.5.1 Stratification

The evaluation team used sample stratification for the gross impact, net impact, and process evaluation sampling. Stratification is a departure from simple random sampling, where each sampling unit (customer/project/rebate/measure) has an identical likelihood of being selected in the sample. Stratified random sampling refers to the designation of two or more sub-groups (strata) from within a program population prior to the selection process. The evaluation team felt that stratification was advantageous and utilized this approach in the sample design for a variety of reasons across the program, including:

- Increased precision of the within-stratum variability was expected to be small compared to the variability of the population as a whole. Stratification in this case allows for increased precision or smaller total sample sizes, which lowered evaluation costs.
- Ensured a minimum number of units within a particular stratum will be verified. For example, Smart $aver participation in the defined evaluation period was dominated by air source heat pump and central air conditioner installations. A simple random sample would have likely returned zero heat pump water heaters or pool pump

samples. The evaluation team felt it was important to develop primary research results for less common offerings; therefore, separate strata were created.

- Allowed for a value-of-information approach to be implemented through which the largest measures are sampled at a much higher rate than smaller projects by creating size-based strata.

2.5.2 Presentation of Uncertainty

There is an inherent risk, or uncertainty, that accompanies sampling, because the projects selected in the evaluation sample may not be representative of the program population as a whole with respect to the parameters of interest. As the proportion of projects in the program population that are sampled increases, the amount of sampling uncertainty in the findings decreases. The amount of variability in the sample also affects the amount of uncertainty introduced by sampling. A small sample drawn from a homogeneous population will provide a more reliable estimate of the true population characteristics than a small sample drawn from a heterogeneous population. Variability is expressed using the coefficient of variation (C_v) for programs that use simple random sampling, and an error ratio for programs that use ratio estimation. The C_v of a population is equal to the standard deviation (σ) divided by the mean (μ) as shown in Equation 2-1.

Equation 2-1: Coefficient of Variation

$$C_v = \frac{\sigma}{\mu}$$

Equation 2-2 shows the formula used to calculate the required sample size for each evaluation sample, based on the desired level of confidence and precision. Notice that the C_v term is in the numerator, so the required sample size will increase as the level of variability increases. For programs that rely on ratio estimation error ratio replaces the C_v term in Equation 2-2. Results of the previous Duke Energy evaluations and Nexant evaluations from other jurisdictions were the primary source of error ratio and C_v assumptions for the 2016 Smart $aver evaluation.

Equation 2-2: Required Sample Size

$$n_0 = (\frac{z * C_v}{D})^2$$

Where:

n_0	=	*The required sample size before adjusting for the size of the population*
Z	=	*A constant based on the desired level of confidence (equal to 1.645 for 90% confidence two-tailed test)*
C_v	=	*Coefficient of variation (error ratio for ratio estimation)*
D	=	*Desired relative precision*

The sample size formula shown in Equation 2-2 assumes that the population of the program is infinite and that the sample being drawn is reasonably large. In practice, this assumption is not always met. For sampling purposes, any population greater than approximately 7,000 may be considered infinite for the purposes of sampling. For smaller, or finite, populations, the use of a finite population correction factor (FPC) is warranted. This adjustment accounts for the extra precision that is gained when the sampled projects make up more than about 5% of the program savings. Multiplying the results of Equation 2-2 by the FPC formula shown in Equation 2-3 will produce the required sample size for a finite population.

Equation 2-3: Finite Population Correction Factor

$$fpc = \sqrt{\frac{N - n_0}{N - 1}}$$

Where:

N = *Size of the population*

n_0 = *The required sample size before adjusting for the size of the population*

The required sample size (*n*) after adjusting for the size of the population is given by Equation 2-4.

Equation 2-4: Application of the Finite Population Correction Factor

$$n = n_0 * fpc$$

Verified savings estimates always represent the point estimate of total savings, or the midpoint of the confidence interval around the verified savings estimate for the program. Equation 2-5 shows the formula used to calculate the margin of error for a parameter estimate.

Equation 2-5: Error Bound of the Savings Estimate

$$Error\ Bound = se * (z - statistic)$$

Where:

se = *The standard error of the population parameter of interest (proportion of customers installing a measure, realization rate, total energy savings, etc.) This formula will differ according to the sampling technique utilized.*

$z - statistic$ = *Calculated based on the desired confidence level and the standard normal distribution.*

The 90% confidence level is a widely accepted industry standard for reporting program-level uncertainty in evaluation findings. The z-statistic associated with 90% confidence is 1.645.

When evaluators or regulators use the term “90/10”, the 10 refers to the relative precision of the estimate. The formula for relative precision shown in Equation 2-6:

Equation 2-6: Relative Precision of the Savings Estimate

$$Relative\ Precision_{Verified\ Savings} = \frac{Error\ Bound_{(kWh\ or\ kW)}}{Verified\ Impact_{(kWh\ or\ kW)}}$$

An important attribute of relative precision to consider when reviewing achieved precision values is that it is “relative” to the impact estimate. Therefore measures with low realization rates are likely to have larger relative precision values because the error bound (in kWh or kW) is being divided by a smaller number. This means two measures with exactly the same reported savings and sampling error in absolute terms, will have very different relative precision values, as shown in Table 2-3.

Table 2-3: Relative Precision Example

Program	Reported kWh	Realization Rate	Error Bound (kWh)	Verified kWh	Relative Precision (90%)
Measure #1	4,000,000	0.5	400,000	2,000,000	± 20%
Measure #2	4,000,000	1.0	400,000	4,000,000	± 10%

To calculate a Smart $aver program-level savings estimate requires summation of the verified savings estimates from several strata. In order to calculate the relative precision for these program-level savings estimates, the Evaluation Team used Equation 2-7 to estimate the error bound for the program as a whole from the stratum-level error bounds.

Equation 2-7: Combining Error Bounds across Strata

$$Error\ Bound_{Program} = \sqrt{Error\ Bound^2_{Stratum1} + Error\ Bound^2_{Stratum2} + Error\ Bound^2_{Stratum3}}$$

Using this methodology, the evaluation team developed verified savings estimates for the program and an error bound for that estimate. The relative precision of the verified savings for the program is then calculated by dividing the error bound by the verified savings estimate.

3 Impact Evaluation

3.1 Methodology

An impact evaluation was performed to evaluate energy and demand savings attributable to the Smart $aver program. The evaluation was divided into two research areas; determining gross and net savings (or impacts). Gross impacts are energy and demand savings found at a participant's home that are the direct result of a measure installed and rebated through the program. Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and funds. The evaluation team verified energy and demand savings attributable to the Smart $aver program by conducting the following impact evaluation activities:

- Database and ex ante savings review.
- Sampling of participating measures.
- Performing on-site metering for air source heat pump and central air conditioner replacements to estimate hours of operation and associated amperage.
- Estimating gross verified savings using data collected in previous tasks.
- Comparing the DEC ex ante savings to gross-verified savings to determine program- and measure-level realization rates.
- Applying attribution surveys to estimate net-to-gross ratios and net-verified savings at the program level.

The impact evaluation activities result in the calculation of an adjustment factor called a realization rate, which is applied to the reported savings documented in the program tracking records. The realization rate is the ratio of the savings determined from the site inspections, M&V activities, or engineering calculations to the program-reported savings. The adjusted savings obtained by multiplying the realization rate by the program-reported savings are termed the verified gross savings and they reflect the direct energy and demand impact of the program's operations.

3.2 Database and Ex Ante Review

Review of the program database provided details that informed all evaluation activities. The scope of the evaluation was oriented based on information referenced from the program database, including; the rebate count for each measure and measure specific installation details. These data were considered when designing approaches and methods to evaluate the program. For example, the database included baseline efficiencies for existing equipment; however, it did not include details regarding the working condition of that equipment. Therefore, the participant survey included questions to understand the condition of participants' original equipment to inform the type of baseline the evaluation should use when calculating savings (i.e., early replacement or burnout).

The evaluation team also conducted a review of ex ante savings values, i.e., program reported savings, for each measure rebated during the evaluation period. This review consisted of benchmarking the ex ante value against other evaluation results of similar programs from nearby Duke Energy jurisdictions as well as against regional technical reference manuals (TRMs). This review allowed the evaluation team to understand if the program's assumed savings values are or are not in line with expectations. The details of the ex ante review are referenced in Table 3-1.

This benchmarking exercise exposed concerns regarding the program's two most active measures: central air conditioners and air source heat pumps. Both of these measures had significantly larger ex ante values for Tier 1 efficiencies when compared to each TRM as well as a recently completed evaluation for a very similar HVAC program in Duke Energy Progress. Tiers 2 and 3 ex ante values for central air conditioners and air source heat pumps, however, were more aligned with the benchmarked values. Due to this variation, additional emphasis was placed these measures during the evaluation.

Table 3-1: Comparison of DEC Smart $aver Energy Savings Estimates to Peer Group Estimates

Measure	DEC Smart $aver 2016 PY Deemed Savings (kWh)	DEP HEIP 2014 PY Evaluation (kWh)	Georgia Power 2014 Evaluation (kWh)[1]	Ohio 2010 TRM (kWh)[2]	Texas 2017 TRM (kWh)[3]	Mid-Atlantic 2016 TRM (kWh)[4]
Attic Insulation & Air Seal	1,163	364	461	100/2,183*	443/2,045*	187/2,086*
Central Air Conditioner	-	299	525	-	-	-
Tier 1	464[5]	n/a	-	181	156	195
Tier 2	283	n/a	-	328	299	304
Tier 3	404	n/a	-	485	894	444
Air Source Heat Pump	-	865	875	-	-	-
Tier 1	702[5]	n/a	-	279	394	210
Tier 2	350	n/a	-	764	686	553
Tier 3	496	n/a	-	1,497	1,757	1,074
Ground Source Heat Pump	n/a	1,725	2,744	2,744	1,836	2,698
Smart Thermostat	377	n/a	n/a	n/a	n/a	n/a
Quality Installation	376	n/a	n/a	n/a	n/a	n/a
Variable Speed Pool Pump	2,342	n/a	n/a	1,170	n/a	594
Duct Sealing	350	336	353	68	205/383*	248/592*
Heat Pump Water Heater	1,616	1,978	1,477	2,076/1,297*	1,737	1,511/1,362*

* Values separated by a slash show the estimated savings for homes with AC and gas heating and those with Air Source Heat Pumps. Central AC homes are shown first with Heat Pump homes shown second

1 July 2015 Evaluation Report Public Filing

2 State of Ohio Energy Efficiency Technical Reference Manual. August 6, 2010; Dayton location chosen for weather dependent measures

3 Texas Technical Reference Manual, version 4.0, Volume 2 Residential Measures. November 1, 2016. Amarillo location chosen for weather dependent measures

4 Mid-Atlantic Technical Reference Manual, version 6.0, May 2016. Washington DC location chosen for weather dependent measures

5 Tier 1 Central Air Conditioner and Air Source Heat Pump Savings include savings from mandatory Quality Installation and ECM

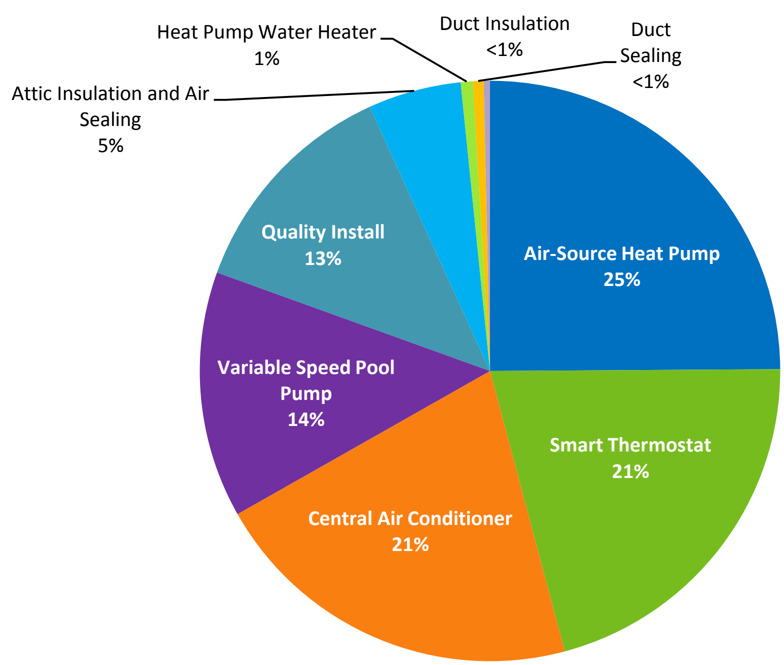
3.3 Sampling Plan and Achievement

To provide representative results, and meet program evaluation goals, a sampling plan was created to guide all evaluation activity. A random sample was created to target 90/10 confidence and precision at the program-level, assuming a coefficient of variation (C_v) equal to 0.5.

For the evaluation period of May 1, 2016 – April 30, 2017, rebated air source heat pumps and central air conditioners were the largest measure contributors for both reported energy and demand savings. Therefore, these measures received the largest share of research activities and the highest level of rigor with on-site equipment measurement.

The evaluation team requested a participation database extract of 2016 and 2017 program results, which included counts and details on installed measures. The distribution of ex ante energy savings based on measure counts from the participation database, shown in Figure 3-1, provided insight to measures with greater influence on total program savings.

Figure 3-1: Reported Energy Savings



Central air conditioners, heat pumps, and bundled measures (smart thermostat, quality install) accounted for 80% of reported energy savings. The sampling plan designed for the evaluation period is included in Table 3-2.

Table 3-2: Impact Sampling Plan

Measure	Metering and/or Verification Sites		Phone Survey	
	Achieved	Targeted	Achieved	Targeted
Central Air Conditioner				
Tier 1	1	1	3	2
Tier 2	23	16	24	24
Tier 3	4	4	6	6
Air Source Heat Pump				
Tier 1	3	3	3	3
Tier 2	11	14	20	20
Tier 3	4	4	6	5
Geothermal Heat Pump	n/a	n/a	1	1
Smart Thermostat*	n/a	n/a	31	29
Quality Install*	n/a	n/a	27	31
Attic Insulation & Air Seal	n/a	n/a	3	2
Variable Speed Pool Pump	n/a	n/a	4	4
Duct Sealing	n/a	n/a	1	1
Duct Insulation	n/a	n/a	1	1
Heat Pump Water Heater	n/a	n/a	1	1
Total	**46**	**42**	**73***	**70***

*Targeted and achieved phone sample size counts for Smart Thermostat and Quality Install are imbedded within phone sample size counts for Central Air Conditioner and Air Source Heat Pump.

3.4 Description of Analysis

The evaluation team applied varying analysis techniques depending on the measure, the measure's prominence within the program, and the availability of data on baseline and retrofit savings. A database of program participation provided useful information about measures installed, participants, as well as additional inputs that varied by measure and informed the analysis. Table 3-3 shows the type of analysis applied to each measure.

Table 3-3: Analysis Approach

Measure	Achieved
Central Air Conditioner	Metering study and desk analysis
Air Source Heat Pump	Metering study and desk analysis
Geothermal Heat Pump	Desk analysis
Smart Thermostat	Desk analysis and secondary research
Quality Install	Metering study and desk analysis
Attic Insulation & Air Seal	Desk analysis
Variable Speed Pool Pump	Desk analysis
Duct Sealing	Desk analysis
Heat Pump Water Heater	Deemed

*Energy savings for the Quality Install measure were based on metering data collected for the EFLH Study

3.4.1 Metering study

Given that a large share of overall program savings is derived from air source heat pumps and central air conditioners, an end-use metering approach was applied for the analysis of these two measures. There are three primary inputs needed to calculate residential HVAC savings. The units' heating/cooling efficiencies and capacities were provided by the program database. The third input, hours of operation, has the highest level of uncertainty and the metering study enabled us to estimate cooling and heating Equivalent Full Load Hours (EFLH) for the program. The methodology used for the metering study follows the Uniform Methods Project (UMP) and most closely resembles IPMVP Option A: Partial Retrofit Isolation/Metered Equipment.

3.4.1.1 Data Collection

To complete the metering study, field engineers were dispatched to the homes of Smart $aver participants who received a rebate for an air source heat pump or central air conditioner replacement. Participants who took part in the metering study were provided a $75 incentive divided across two visits to their home. Forty-six sites were metered across all the DEC territory. Two data sets were dropped due to data quality and ultimately 44 sites, including 28 central air conditioners and 16 air source heat pumps, were used in the analysis. All meters were installed in February 2017 and collected in July 2017 ensuring that ample data was available during both the cooling and heating seasons.

During site visits, field engineers performed various data collection activities. Voltage, amperage, and power factor spot measurements were taken on each unit while in operation. Unit specifications, including capacity, were obtained from each system's nameplate information. Finally, a HOBO CTV-A current transducer (CT) was connected on the conductors supplying electricity to the condensing unit located on the exterior of the home to record electrical current measurements. The CT was paired with a U12-006 data logger that stored current data at 10 minute intervals. The result was a trended data log of electrical current between February and July.

Data collected during the metering study was used in a regression analysis that supplied an estimated EFLH for both cooling and heating periods.

3.4.2 Analysis, Regression, EFLH Calculation

Three primary inputs are required to estimate annual cooling and heating savings for air source heat pumps and central air conditioners:

1. Capacity - the size (kBtuh) of the efficient unit
2. Efficiency - the SEER or Heating Seasonal Performance Factor (HSPF) value of the efficient unit
3. Equivalent Full Load Hours (EFLH) - how often the unit is in operation at full capacity

EFLH is an effective measure for estimating the cooling and heating requirement for a specific region and provides a comparison of energy use between regions and equipment types. The general form for the EFLH term is shown in Equation 3-1.

Equation 3-1: Effective Full Load Hours

$$EFLH_{cool} = \sum_{h=1}^{8760} \frac{Estimated\ Hourly\ Load\ (kW)}{Connected\ Load\ (kW)}$$

Where:

Estimated Hourly Load = Electric demand of the unit in hour h
Connected Load = Electric demand draw of the unit when operating at full power

The evaluation team assigned a connected load to each unit in the sample using nameplate size, efficiency, and spot measurements of voltage and power factor collected on-site. Hourly load was obtained from the logger data and was divided by the connected load to calculate the unit's runtime for each hour in the evaluated period.

The evaluation team collected hourly weather records for the full metering period (February 2017 through July 2017) from six weather stations in North and South Carolina, and assigned each sampled customer to one of six weather stations based on proximity, in order to develop a relationship between observed HVAC system usage runtimes and outdoor temperature. In addition, the evaluation team obtained data for typical meteorological year (TMY3) weather for each location and applied the observed relationship between runtimes and weather to the TMY3 data to estimate annual $EFLH_{heat}$ and $EFLH_{cool}$ for a typical year.

The evaluation team originally intended to utilize the program database to segment the sample based on customer tier levels and estimate EFLH separately for each tier group. However, due to an unbalanced sample, as well as restrictions related to small sample sizes within a segmented dataset, we were not able to confidently estimate EFLH separately by tier. Instead, the evaluation team used an aggregated EFLH value across all tiers. The assumption that EFLH is consistent across different tiers is based on the fact that the heating or cooling load for a home is independent of the efficiency of the HVAC system that conditions the space. A higher efficiency air conditioner may run additional hours during the day, but it does so by consuming energy at a level below full load and removing heat from the home at a slower rate. This system saves energy by operating below full load for longer periods of time but the EFLH, a product of hours operating at given power level, remains constant.

As mentioned above, units were metered from February through July 2017. Because the metering period covered both cooling, heating, and shoulder seasons, and the regression analysis was performed twice to estimate annual $EFLH_{cool}$ and annual $EFLH_{heat}$ separately. The evaluation team split the meter data into two separate datasets. The first dataset contained only observations where average daily temperatures exceeded the base temperature of 65°F, or where temperatures indicated cooling. The second dataset contained observations where average daily temperatures fell below the base temperature of 65°F, or where outdoor temperatures indicated heating.

The evaluation team developed weather-normalized estimates of $EFLH_{cool}$ for each unit in the sample using a linear regression model of observed runtimes as a function of the observed cooling degree days (base 65°F) during the cooling season. Figure 3-2 shows the relationship between average daily runtimes (hours) and cooling degree days. Each blue + represents the average air conditioning runtime in hours for each day in the cooling dataset, i.e. each day with an average temperature exceeding 65°F.

Figure 3-2: Cooling Runtime as a Function of Temperature

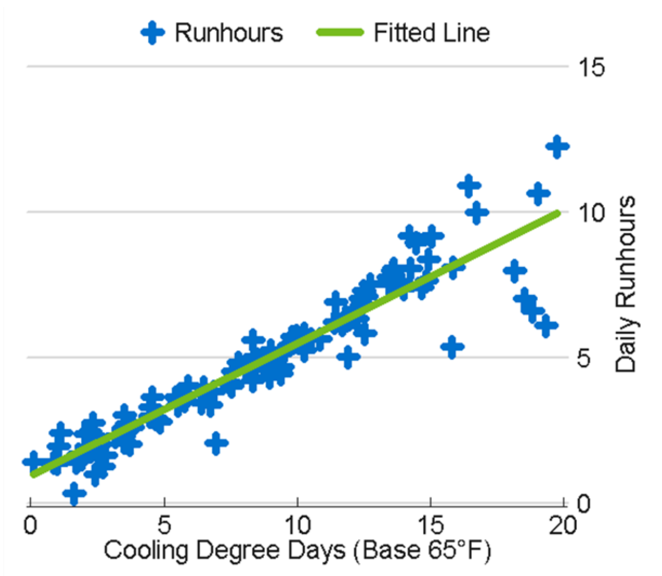


Table 3-4 shows the regression output for the relationship described in Figure 3-2. The key value to consider is the Cooling Degree Day (CDD) coefficient of 0.54. This term indicates that DEC customers use an average of 0.54 hours, or approximately 33 minutes, of additional cooling per CDD.

Table 3-4: $EFLH_{cool}$ Regression Output

Model Term	Coefficient	Std. Err.	t-stat	P-value	[90% Confidence Interval]
CDD	0.54	0.005	104.71	0.000	± 1.6%

The evaluation team ran a similar linear regression model to develop weather-normalized estimates of $EFLH_{heat}$ for each air source heat pump unit. The key difference is that instead of CDD, the model estimated runtimes as a function of observed Heating Degree Days (HDD) during the heating season.

Figure 3-3 shows the relationship between average daily runtimes and heating degree days. Each blue + represents the average air source heat pump runtime in hours for each day in the heating dataset, i.e. each day with an average daily temperature below 65°F.

Figure 3-3: Heating Runtime as a Function of Temperature

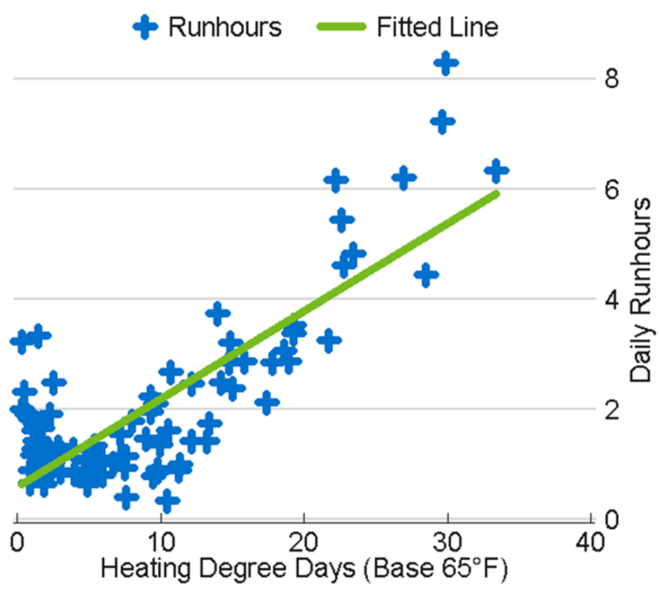


Table 3-5 shows the regression output for the relationship described in Figure 3-3. The coefficient term 0.19 indicates that DEC customers use an average of 0.19 hours, or approximately 12 minutes, of additional heating per HDD.

Table 3-5: $EFLH_{heat}$ Regression Output

Model Term	Coefficient	Std. Err.	t-stat	P-value	[90% Confidence Interval]
HDD	0.19	0.006	33.70	0.000	± 4.9%

The evaluation team utilized hourly TMY3 data for Carolina weather stations to calculate annual CDD and HDD and used those values to estimate $EFLH_{cool}$ and $EFLH_{heat}$ for each customer region. Table 3-6 shows regression coefficients, annual CDD, annual HDD, and estimated EFLH values for each season. $EFLH_{cool}$ and $EFLH_{heat}$ were calculated by multiplying each term's regression coefficient by the average CDD and HDD values determined by TMY3 data.

Table 3-6: EFLH Calculations

Term	Regression Coefficient	Annual CDD (Base 64°F)	Annual HDD (Base 65°F)	$EFLH_{cool}$ (hours)	$EFLH_{heat}$ (hours)
CDD	0.54	1,393	-	752	-
HDD	0.19	-	3,674		698

The field data collected by Nexant also provided the peak summer cooling demand coincidence factor (CF_{summer}). Just as EFLH is a necessary component of the annual energy savings calculation, peak coincidence factor is a necessary component of the peak demand savings calculation. Peak demand coincidence factor is defined here as the probability that the cooling equipment is operating during system peak hours. The basic form for the CF term is a ratio of hourly load to full load during a given hour of the day, and is shown in Equation 3-2.

Equation 3-2: Coincidence Factor

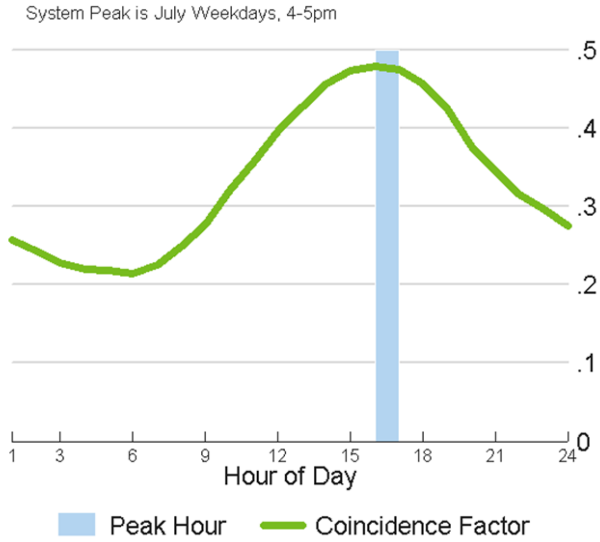
$$CF_h = \frac{Hourly\ Load_h\ (kW)}{Full\ Load\ (kW)}$$

Where:

Hourly Load = *Electric demand of the unit at hour h*
Full Load = *Electric demand draw of the unit when operating at full power*

The evaluation team calculated the peak demand coincidence factor to estimate peak demand savings for the sample. A system's peak demand period refers to the period during which the highest level of power is needed to satisfy its electric demand requirement. DEC defines its summer peak period as July weekdays between 4:00pm and 5:00pm (hour ending 17). Figure 3-4 shows the average CF_{summer} load curve for each weekday of July 2017 for the metered sample. The system's peak period is highlighted in light blue. The CF_{summer} during the system peak is 0.47.

Figure 3-4: Summer Peak Demand Coincidence Factor



A winter peak coincidence factor (CF_{winter}) was not able to be estimated through the metering study because the metering period did not coincide with the timeframe during which DEC's winter peak is defined. DEC defines its winter peak period as January weekdays between 7:00am and 8:00am (hour ending 8). However, due to the evaluation schedule, loggers were installed in early February and we were unable to collect January usage information to estimate winter demand coincidence factor for the Carolinas territory. Since we were unable to estimate a program specific winter demand CF, the evaluation team applied the estimated CF_{winter} found through a similar 2016 metering study performed in DEP territory in order to calculate winter demand (kW) savings. Although the Duke Energy Progress (DEP) and Carolinas service territories boarder each other, differences in geography like mountains or coastal regions result in varying HVAC needs across the two territories. Applying the CF_{winter} found in the DEP evaluation is a strong approximation of performance in DEC, but the uncertainty is increased due to variations in program participants and their location.

3.4.2.1 Central Air Conditioner and Air Source Heat Pump Savings Calculation

Energy and demand savings for central air conditioners and air source heat pumps were determined by engineering algorithms shown in Table 3-7 using the inputs provided in Table 3-8 and Table 3-12.

Table 3-7: Algorithms for HVAC Energy and Demand Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right)$
Summer Cooling Demand Savings	$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times CF_{cool}$
Winter Heating Energy Savings	$\Delta kWh_{heat} = EFLH_{heat} \times Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right)$
Winter Heating Demand Savings	$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) \times CF_{heat}$
Algorithm Reference	Mid-Atlantic TRM, v6.0, May 2016

Table 3-8: Inputs for Central AC Energy and Demand Savings

Input	Units	Tier	Value	Source
$EFLH_{cool}$	Hours	All	752	Metering study
$Capacity_{cool}$	kBtuh	1	33.8	Population average
		2	32.0	
		3	32.8	
$SEER_{base}$	SEER	All	14[1]	Code minimum
$SEER_{ee}$	SEER	1	14.2	Population average
		2	15.7	
		3	18.1	
CF_{summer}	n/a	All	0.475	Metering study
CF_{winter}	n/a	All	0.588	Metering study

Electrically Commutated Motor Savings

For participants who received an electrically commutated motor (ECM) as part of their central air conditioner replacement, the evaluation team estimated the savings impacts resulting from the fan operation in conjunction with a furnace during the heating season. To estimate this impact, we leveraged primary ECM metered data collected previously by the evaluation team in Duke Energy's Progress territory as well as secondary research to establish baseline conditions. The ECM metered data provided five minute amperage intervals which we used in combination with recorded voltage and power factor measurements to estimate the average power draw of an

[1] The results of the participant survey found no existing central air conditioners were in good working condition when replaced. Therefore, an early replacement adjustment was not applicable.

ECM in operating mode. Our secondary research[2] found that ECMs use half the energy of a standard fan motor when used in residential furnace applications. This insight was applied to estimate baseline fan usage.

To calculate savings, we applied an estimated annual effective full load hours (EFLH) for furnaces to our estimated baseline and ECM power draw. The evaluation team calculated the ECM savings as the difference in consumption between the baseline and ECM fans. We further adjusted the estimated ECM savings by applying the percentage of customers in the program who received an ECM with their new system (86%) as well as by the saturation of residential customers with central air conditioners and forced air furnaces (52%) based on Duke Energy's 2013 residential appliance saturation study (RASS). The algorithm applied to estimate ECM fan savings during the heating season (Table 3-9) along with DEC centric inputs (Table 3-10) are included below.

Table 3-9: Algorithm for ECM Fan Energy and Demand Savings

Calculation	Equation
ECM Fan, furnace, energy savings	$\Delta kWh_{furnace} = EFLH_{furnace} \times Power_{ECM} \times System\ Type\ Adj \times Program\ ECM\ Adj$

Table 3-10: Inputs for Central AC Energy and Demand Savings

Input	Units	Tier	Value	Source
$EFLH_{furnace}$	Hours	All	359	Metering study
$Power_{ECM}$	kW	All	0.191	DEP metering study
System Type Adj	%	All	52%[3]	2013 Duke RASS
Program ECM Adj	%	All	86%[4]	DEC Program Database

Energy and demand savings for central air conditioners are presented in Table 3-11.

[2] Pigg, Scott and Talerico, Tom. 2004. "Electricity Savings from Variable-Speed Furnaces in Cold Climates" in *ACEEE 2004 Summer Study on Energy Efficiency in Buildings*, *Panel 1, Paper 23*, http://aceee.org/files/proceedings/2004/data/papers/SS04_Panel1_Paper23.pdf

[3] Penetration of central AC systems paired with forced air furnaces in Duke Progress territory per the 2013 RASS

[4] Accounts for participants who only replaced the central AC condensing unit and cooling coil without improving the blower section of the HVAC system

Table 3-11: Central AC Gross Verified Savings

Season	Tier	Energy Savings (kWh)*	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	1	36[5]	0.022[3]	0
	2	182	0.115	
	3	395	0.250	
Heating	All	31	0	0.167
Total	**1**	**66[3]**	**0.022[3]**	**0.167**
	2	**212**	**0.115**	
	3	**426**	**0.250**	

*Rounding error present

Savings for air source heat pumps (Table 3-12 and Table 3-14) apply a split baseline, based on participant responses to the process survey. For this evaluation 6.9% of air source heat pump participants stated their systems were “in good working order” and “not old”, and received early replacement energy savings based on a 10 SEER and 6.8 HSPF baseline heat pump.

5 Tier 1 energy and demand savings include savings associated with program-required quality installation.

Table 3-12: Inputs for Air Source Heat Pump Energy and Demand Savings

Input	Units	Tier	Value	Source
$EFLH_{cool}$	Hours	All	752	Metering study
$EFLH_{heat}$	Hours	All	698	Metering study
$Capacity_{cool\ and\ heat}$	kBtuh	1	29.7	Population average
		2	30.2	
		3	32.8	
Early Replacement (ER%)	%	All	6.9%	Process Survey
$SEER_{base\ ,early\ replacement}$	SEER	All	10[6]	Mid-Atlantic TRM
$SEER_{base,replace\ on\ failure}$	SEER	All	14	Code minimum
$SEER_{ee}$	SEER	1	14.2	Population average
		2	15.5	
		3	18.3	
$HSPF_{base}$	HSPF	All	6.8/8.2[4]	Code minimum
$HSPF_{ee}$	HSPF	1	8.4	Population average
		2	8.8	
		3	9.7	
CF_{summer}	n/a	All	0.475	Metering study
CF_{winter}	n/a	All	0.588	Metering study

Calculation of savings related to spilt baselines considers each scenario (early replacement and replace on failure) separately, and then calculates a spilt baseline by multiplying each component by the percentage of units that meet the conditions of a given scenario (Table 3-13).

[6] The results of the participant survey found 6.9% of Air Source Heat Pump Replacement participants considered their previous system was “in good working order”. An early replacement baseline of 10 SEER and 6.8 HSPF was applied to 6.9% of the population to reflect this finding.

Table 3-13: Algorithm for Split Baseline Savings

Calculation	Equation
Early Replacement, Cooling Energy Savings	$\Delta kWh_{cool,ER} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base,ER}} - \frac{1}{SEER_{ee}}\right)$
Replace on Failure, Cooling Energy Savings	$\Delta kWh_{cool,ROF} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base,ROF}} - \frac{1}{SEER_{ee}}\right)$
Heat Pump, Cooling Energy Savings	$\Delta kWh_{cool,\ split\ baseline} = \Delta kWh_{cool,ER} \times ER\% + \Delta kWh_{cool,ROF} \times (1 - ER\%)$

Table 3-14: Air Source Heat Pump Gross Verified Savings

Season	Tier	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	1	73[7]	0.046[5]	0
	2	199	0.126	
	3	463	0.293	
Heating	1	98[5]	0	0.082[5]
	2	216		0.182
	3	463		0.390
Total	**1**	**171**[5]	0.046[5]	0.082[5]
	2	**415**	0.126	0.182
	3	**926**	0.293	0.390

3.4.2.2 Geothermal Heat Pump Savings Calculation

Geothermal heat pumps make use of constant ground temperature to provide heating and cooling and operate at higher efficiency levels than air source heat pumps. The Smart $aver Program provides incentives for these systems to encourage participants to install higher efficiency HVAC systems in their homes. Geothermal heat pumps were excluded from the EFLH metering study; however, the evaluation team estimated savings based on the assumption that heating and cooling EFLH for a geothermal heat pump are equivalent to an air source heat pump.

[7] Tier 1 energy and demand savings include savings associated with program required quality installation

Table 3-15: Algorithms for Geothermal Heat Pump Energy and Demand Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right)$
Summer Cooling Demand Savings	$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times CF_{cool}$
Winter Heating Energy Savings	$\Delta kWh_{heat} = EFLH_{heat} \times Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{COP_{retrofit} \times 3.412}\right)$
Winter Heating Demand Savings	$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{COP_{retrofit} \times 3.412}\right) \times CF_{heat}$
Algorithm Reference	Mid-Atlantic TRM, v6.0, May 2016

Table 3-16: Inputs for Geothermal Heat Pump Gross Verified Savings

Input	Units	Value	Source
$EFLH_{cool}$	Hours	752	Metering study
$EFLH_{heat}$	Hours	698	Metering study
$Capacity_{cool\ and\ heat}$	kBtuh	49.6	Population average
$SEER_{base}$	SEER	14	Program minimum
$SEER_{ee}$	SEER	24.2	Population average
$HSPF_{base}$	HSPF	8.2	Program minimum
$COP_{retrofit}$	COP	3.7	Assumed
CF_{cool}	N/A	0.475	Metering study
CF_{heat}	N/A	0.588	Metering study

Table 3-17: Geothermal Heat Pump Gross Verified Savings

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	1,124	0.710	1.274
Heating	1,513		
Total	**2,637**		

3.4.2.3 Quality Installation Energy Savings

The Quality Installation (QI) measure provides HVAC technicians a process to ensure that new equipment is properly tuned and operating at a high efficiency level when installed. The QI process includes:

- Measuring the sub-cool or superheat charge of the condenser
  - System must be allowed to run for at least 15 minutes prior to measuring charge
- Measuring the liquid and suction line pressures
- Completing a return and supply enthalpy conversion
- Measuring static pressure in the return and supply ducts
- Measuring the system level airflow.

The HVAC technician uses these measurements to calculate a cooling capacity for the unit while in operation. The QI requires that the system performance achieve at least 90% of the net capacity as rated by the Air-conditioning, Heating, & Refrigeration Institute (AHRI).

QI is required for all Tier 1 HVAC units rebated through the Smart $aver Program. For Tiers 2 and 3, an additional incentive is offered if the contractor completed the QI process.

The evaluation team based its verification of QI energy and demand savings estimates on a review of contractor submitted QI data collection sheets and metering data from the Duke Energy Carolinas EFLH study. Along with the program specific steps, secondary research was completed to provide an industry estimate for the level of energy savings expected when a QI process is implemented during the installation of new residential HVAC equipment.

The evaluation team completed a review of 210 QI data collection sheets from the program (70 each from the tier) provided by DEC. These sheets tracked the inputs and calculations completed by HVAC technicians as they installed a participant's new HVAC system and progressed through the QI process. The evaluation focused on the accuracy of the inputs and calculations on the QI data collection sheets to determine if the process was properly applied. Based on the review of these QI data sheets, 60% contained one or more of the following issues:

- Failure to achieve a calculated operational cooling capacity inside the 90%-110% range
- Application of an industry rule of thumb (airflow = 400 cfm/tom) instead of directly measuring the parameter
- Measurements taken below 60° F ambient air temperature on standard QI data collection forms

Based on this review the evaluation de-rated savings from the measure by 60% to reflect the issues discovered (Table 3-18).

Table 3-18: Summary of Quality Installation De-rate Components

Quality Installation Measurement	Count
Cooling Capacity Outside of 90-110%	71
Airflow Rule of Thumb Applied	65
QI Performed Below 60 °F	48
Total QI Sheets with Issues	122[8]
QI Data Sheets for Comparison	202
Savings De-rate Percentage	**60%**

Additionally, the evaluation team found 11% of the QIs were completed as 'Cold Weather Quality Installations' which is a simplified QI data collection process applied when ambient temperatures are below 70° F. Because the accuracy of charge readings of HVAC systems decreases as the ambient temperature falls below 70° F, the HVAC technician is not able to collect the charge data to needed to calculate the operating capacity of the system. Therefore, systems installed in these weather conditions cannot qualify for the program's QI process. Ultimately the evaluation team determined 11% of QIs were completed in these conditions. This finding did not influence the per unit energy and demand savings for QI measure, but the evaluation team did reduce the reported count of QI participants by 11% to reflect systems installed during cold weather (Table 3-19).

Table 3-19: Summary of Quality Installation Cold Weather Installs

Quality Installation Data Type	Count
Cold Weather Sheets Removed	25
Total QI Data Sheet Reviewed	227
QI Participation Reduction	**11%**

The evaluation team based the verification of savings attributable to the QI measure on meter data collected during the Duke Energy Carolinas EFLH study. We estimated and compared the efficiency level (based on the ratio of kW/ton) of systems with and without QI and calculated improvements in efficiency from systems that received QI were attributed to the measure. This analysis found a SEER efficiency improvement of 1.37%, which when reduced by 60% (based on issues discovered on the QI data collection forms) provided a measure-level savings estimate of 0.54%. To quantify the impact this increased efficiency had on energy and demand savings, the evaluation team defined a QI efficiency level by increasing the program-level SEER and HSPF values by 0.54% and calculated the savings impact relative to the non-QI SEER and HSPF as detailed in Table 3-20 below.

[8] Some Quality Install data sheets included multiple issues so the values above do not sum to 122

Table 3-20: Algorithms for Quality Installation Energy and Demand Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{ee}} - \frac{1}{(1+ESF_{QI}) \times SEER_{ee}}\right)$
Summer Cooling Demand Savings	$\Delta kW_{cool} = Cap_{cool} \times \left(\frac{1}{SEER_{ee}} - \frac{1}{(1+ESF_{QI}) \times SEER_{ee}}\right) \times CF_{cool}$
Winter Heating Energy Savings	$\Delta kWh_{heat} = EFLH_{heat} \times Cap_{heat} \times \left(\frac{1}{HSPF_{ee}} - \frac{1}{(1+ESF_{QI}) \times HSPF_{ee}}\right)$
Winter Heating Demand Savings	$\Delta kW_{heat} = Cap_{heat} \times \left(\frac{1}{HSPF_{ee}} - \frac{1}{(1+ESF_{QI}) \times HSPF_{ee}}\right) \times CF_{heat}$
Algorithm Reference	Modified from Mid-Atlantic TRM, v6.0, May 2016

Table 3-21: Inputs for Quality Installation Energy and Demand Savings

Input	Units	Tier	Value	Source
$EFLH_{cool}$	Hours	All	752	Metering study
$EFLH_{heat}$	Hours	All	698	Metering study
ESF_{QI}	%	All	0.54%	Metering study
$Capacity_{cool\ and\ heat}$	kBtuh	1	29.7	Population average
		2	30.2	
		3	32.8	
$SEER_{base}$	SEER	All	14	Code minimum
$SEER_{ee}$	SEER	1	14.2	Population average
		2	15.5	
		3	18.3	
$HSPF_{base}$	HSPF	All	8.2	Code minimum
$HSPF_{ee}$	HSPF	1	8.4	Population average
		2	8.8	
		3	9.7	
CF_{summer}	n/a	All	0.475	Metering study
CF_{winter}	n/a	All	0.588	Metering study

Table 3-22: Quality Installation Verified Savings

System	Tier	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Central Air Conditioner	1	10	0.006	0.000
	2 and 3	8	0.005	0.000
Heat Pump	1[9]	13	0.005	0.011
	2 and 3	21	0.005	0.011

3.4.2.4 Smart Thermostat Energy Savings

Customers who installed an eligible central air conditioner or heat pump had the opportunity to receive a rebate for a qualifying smart thermostat. Because the thermostats were included only in conjunction with a rebated HVAC system, the evaluation team opted to analyze the energy savings impacts for thermostats based on an engineering algorithm informed by the metering analysis and secondary data. The evaluation developed its savings analysis based on estimating the cooling and heating consumption of the retrofitted HVAC system and applying an estimated energy savings factor (ESF) that accounts for the amount of reduced consumption caused by the smart thermostat. This same method and algorithm is provided in the 2015 Indiana TRM (see Table 3-23). The evaluation team did review the Mid-Atlantic TRM; however, that resource specified deemed savings rather than an algorithm that could leverage the primary data collected from the metering study.

Table 3-23: Algorithms for Smart Thermostat Energy Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{ee}}\right) \times ESF_{cool}$
Winter Heating Energy Savings	$\Delta kWh_{heat} = EFLH_{heat} \times Cap_{heat} \times \left(\frac{1}{HSPF_{ee}}\right) \times ESF_{heat}$
Algorithm Reference	Indiana TRM version 2.1, July 2015

As detailed in Table 3-24, the evaluation team applied system capacities, SEER and HSPF values, and EFLH based on the data collected from the metering study as well as from the participant database. The ESF was sourced from the 2015 Indiana TRM. The evaluation team consulted the 2017 Arkansas TRM due to its similar climate zone to the DEC territory; however, the sources used to calculate savings in the Arkansas TRM ultimately rely on similar sources cited in the Indiana TRM. Moreover, the evaluation team felt the savings algorithm suggested in the Indiana TRM was more robust and allowed us to leverage more participant data in calculating the estimated impact. Therefore, we chose that document to estimate the verified impacts for smart thermostats. Based on these assumptions, we estimated the savings impact of the smart thermostats as illustrated in Table 3-25.

Table 3-24: Inputs for Smart Thermostat Savings

Input	Units	Tier	Value	Source
$EFLH_{cool}$	Hours	All	752	Metering study
$EFLH_{heat}$	Hours	All	698	Metering study
ESF_{cool}	%	All	13.9%	2015 Indiana TRM
ESF_{heat}	%	All	12.5%	2015 Indiana TRM
$Capacity_{cool\ and\ heat}$	kBtuh	1	29.7	Population average
		2	30.2	
		3	32.8	
$SEER_{ee}$	SEER	1	14.2	Population average
		2	15.5	
		3	18.3	
$HSPF_{ee}$	HSPF	1	8.4	Population average
		2	8.8	
		3	9.7	

Table 3-25: Smart Thermostat Verified Savings

System	Tier	Energy Savings (kWh)	Weighted Average Energy Savings (kWh)
Smart Thermostat - Central Air Conditioner	1	248	211
	2	214	
	3	190	
Smart Thermostat - Heat Pump	1	530	499
	2	503	
	3	483	

3.4.3 Engineering Analysis

3.4.3.1 Attic Insulation and Air Sealing

The evaluation considered attic insulation and air sealing data provided by the program database to inform savings calculations. Inputs for the insulation component of the measure included baseline and retrofit insulation R-values and attic area. HVAC system efficiency was assumed to be either SEER 13 or 10 and was modeled using a split baseline, determined by data in the 2016 Duke Energy RASS, to approximate system age across the DEC service area and apply a lower efficiency rating for older units. Validation of the estimated square footage data point showed many input that were inconsistent with the available attic area for a given home. This data appears to be inconsistently provided and for many projects the total home square footage is listed instead of attic insulation area. In order to adjust for this issue potential attic area was verified through the review of publically available housing information.

Adjustments were made by dividing the total home area by the number of stories and reducing attic area by a measure level adjustment factor.

To estimate the impacts of the attic insulation component of this measure, the evaluation team reviewed the savings algorithm from the Mid-Atlantic TRM; however, we found the stipulated algorithm provided lower results that are inconsistent with our expectations of savings from this measure. The evaluation team instead applied the algorithm provided by the Illinois TRM with weather data based on typical meteorological year (TMY3) in Charlotte, NC.

Table 3-26: Algorithms for Attic Insulation Energy and Demand Savings

Calculation	Equation
Cooling Energy Savings	$\Delta kWh_{cool} = CDD \times 24 \times Area \times DUA \times (1 - FramingFactor_{attic}) \times \left(\frac{1}{Rvalue_{base}} - \frac{1}{Rvalue_{retrofit}}\right) \times \frac{1}{\eta_{cool} \times 1000}$
Heating Energy Savings	$\Delta kWh_{heat} = HDD \times 24 \times Area \times (1 - FramingFactor_{attic}) \times ADJ_{attic} \times \left(\frac{1}{Rvalue_{base}} - \frac{1}{Rvalue_{retrofit}}\right) \times \frac{1}{COP \times 3412} \times Ratio_{ASHP}$
Summer Demand Savings	$\Delta kW_{summer} = \frac{\Delta kWh_{cool}}{EFLH_{cool}} \times CF_{summer}$
Winter Demand Savings	$\Delta kW_{winter} = \frac{\Delta kWh_{heat}}{EFLH_{heat}} \times CF_{winter}$
Algorithm Reference	Illinois TRM, v5.0, June 2016

Table 3-27: Inputs for Attic Insulation Energy and Demand Savings

Input	Units	Value	Source
R_{base}	R-value	12.5	Program database average
$R_{retrofit}$	R-value	40.1	Program database average
Area	ft^2	1,268	Program database average; secondary research
CDD	CDD	1,765	TMY3 data
HDD	HDD	2,389	TMY3 data
η_{cool}	SEER	10/13	TRM
COP	COP	1.7/1.9	TRM
HVAC Age Ratio, >10 years	%	32%	Duke Energy Carolinas 2016 RASS
HVAC Age Ratio, <=10 years	%	68%	Duke Energy Carolinas 2016 RASS
ADJ_{attic}	%	80%	TRM
DUA	%	75%	TRM
Framing Factor	%	7%	TRM
air source heat pump Ratio	%	47.8%	DEC program database ratio
CF_{summer}	N/A	0.475	Metering study
CF_{winter}	N/A	0.588	Metering study

Table 3-28: Attic Insulation Gross Verified Savings

Season	Energy Savings(kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	179	0.221	0.399
Heating	251		
Total	**430**		

All participants who installed attic insulation were also required to air seal the attic plane to reduce air leakage from conditioned areas of the home. Savings for this component of the measure are separated from the insulation improvement and calculated using pre- and post-retrofit blower door results provided by the program database. Overall the program achieved an average air leakage reduction of 21% (Table 3-31) in-line with other Duke Energy territories (DEO – 24%, DEI – 21%). Air sealing improvements typically exhibit energy savings greater than the attic insulation portion of the measure, but that's not to the result for this evaluation. Given similar blower door inputs the variation is due to differences in energy savings algorithms provided by the regional TRM applied in each jurisdiction.

Table 3-29: Algorithms for Air Sealing Energy and Demand Savings

Calculation	Equation
Cooling Energy Savings	$\Delta kWh_{cool} = CDH \times DUA \times 60 \times 0.018 \times LM \times \frac{CFM50_{base} - CFM50_{retrofit}}{n - Factor} \times \frac{1}{\eta_{cool} \times 1000}$
Heating Energy Savings	$\Delta kWh_{heat} = HDD \times 60 \times 24 \times 0.018 \times (CFM50_{base} - CFM50_{retrofit}) \times \frac{1}{COP \times 3412} \times Ratio_{ASHP} \times \frac{1}{n - Factor}$
Summer Demand Savings	$\Delta kW_{summer} = \frac{\Delta kWh_{cool}}{EFLH_{cool}} \times CF_{summer}$
Winter Demand Savings	$\Delta kW_{winter} = \frac{\Delta kWh_{heat}}{EFLH_{heat}} \times CF_{winter}$
Algorithm Reference	Mid-Atlantic TRM, v6.0, May 2016

Table 3-30: Inputs for Air Sealing Energy and Demand Savings

Input	Units	Value	Source
CFM_{base}	CFM_{50}	3,733	Program database average
$CFM_{retrofit}$	CFM_{50}	2,941	Program database average
n-Factor	N/A	16.7	Secondary research
CDH	CDH	12,948	TMY3 data
HDD	HDD	2,389	TMY3 data
DUA	Unitless	0.75	Mid-Atlantic TRM
η_{cool}	SEER	10/13	Code minimum
COP	COP	1.7/1.9	Mid-Atlantic TRM
HVAC Age Ratio, >10 years	%	32%	Duke Energy Carolinas 2016 RASS
HVAC Age Ratio, <=10 years	%	68%	Duke Energy Carolinas 2016 RASS
Air source heat pump Ratio	%	47.8%	DEC program database ratio
CF_{summer}	N/A	0.475	Metering study
CF_{winter}	N/A	0.588	Metering study

Table 3-31: Air Sealing Gross Verified Savings

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	172	0.108	0.188
Heating	223		
Total	**395**		

Table 3-32: Combined Attic Insulation and Air Sealing Gross Verified Savings

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	350	0.221	0.399
Heating	474		
Total	**824**		

3.4.3.2 Variable Speed Pool Pumps

Variable speed pool pumps save the participant energy by reducing flow rates through a pump and achieving significant energy savings. Reducing pump flow by 50% is expected to save 87% of the energy needed to operate the system. The algorithm use by the evaluation team and the associated parameters are presented in Table 3-33 and Table 3-34. Final verified gross savings are provided in Table 3-35.

While the Mid-Atlantic TRM provides deemed savings values for the variable speed pool pump measure, the evaluation team chose to apply data provided by the Duke Energy Carolinas Smart $aver Program database to reduce the assumptions used and provide more accurate, program specific savings results. To apply this primary program data, we used the algorithm provided by the 2015 Indiana TRM estimates the consumption of a standard single speed pool pump, which applies an energy savings factor (ESF) based on expected usage of a variable speed motor.

Table 3-33: Algorithms for Variable Speed Pool Pump Energy and Demand Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh = \frac{HP \times LF \times 0.746}{\eta_{pump}} \times \frac{Hrs}{Day} \times \frac{Days}{Year} \times ESF$
Summer Demand Savings	$\Delta kW_{summer} = \frac{\Delta kWh}{\frac{Hrs}{Day} \times \frac{Days}{Year}} \times CF_{summer}$
Algorithm Reference	Indiana TRM v2.1, July 15, 2015

Table 3-34: Inputs for Variable Speed Pool Pump Gross Verified Savings

Input	Units	Value	Source
HP	Horsepower	2.02	Program database average
Load Factor	%	66%	IN TRM
Pump Efficiency (ηpump)	%	33%	IN TRM
Hours of Use per Day, single speed pump	Hours	6.0	IN TRM
Days of Use per Year	Days	154	Survey responses
Energy Savings Factor	%	91%	IN TRM
CF_{summer}	N/A	0.20	IN TRM

Table 3-35: Variable Speed Pool Pump Gross Verified Savings

Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
2,430	0.53	0.000

3.4.3.3 Duct Sealing

Duct sealing improves the distribution efficiency of a heating or cooling system by patching any openings in the duct system that prevent conditioned air from reaching its intended destination. This results in savings from an HVAC system that can operate less often and still maintain the consistent, comfortable temperature desired by the homeowner. The algorithms used by the evaluation team and the associated parameters are presented in Table 3-36 and Table 3-37. Final verified gross savings are provided in Table 3-38.

Table 3-36: Algorithms for Duct Sealing Energy and Demand Savings

Calculation	Equation
Summer Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times Cap_{cool} \times \frac{\Delta CFM25_{DL}}{System\ CFM} \times \frac{1}{\eta_{cool}}$
Summer Cooling Demand Savings	$\Delta kWh_{heat} = EFLH_{heat} \times Cap_{heat} \times \frac{\Delta CFM25_{DL}}{System\ CFM} \times \frac{1}{COP \times 3{,}412} \times Ratio_{ASHP}$
Winter Heating Energy Savings	$\Delta kW_{summer} = \frac{\Delta kWh_{cool}}{EFLH_{cool}} \times CF_{summer}$
Winter Heating Demand Savings	$\Delta kW_{winter} = \frac{\Delta kWh_{heat}}{EFLH_{heat}} \times CF_{winter}$
Algorithm Reference	Mid-Atlantic TRM, v6.0, May 2016

Table 3-37: Inputs for Duct Sealing Gross Verified Savings

Input	Units	Value	Source
ΔCFM_{25}	CFM_{25}	134.6	Program database
System CFM	CFM	1,063	Program database
$EFLH_{cool}$	Hours	752	Metering study
$EFLH_{heat}$	Hours	698	Metering study
$Capacity_{cool\ and\ heat}$	kBtuh	31.9	Program database
SEER	SEER	10/13	Mid-Atlantic TRM
COP	COP	2.0/2.3	Mid-Atlantic TRM
HVAC Age Ratio, >10 years	%	32%	Duke Energy Carolinas 2016 RASS
HVAC Age Ratio, <=10 years	%	68%	Duke Energy Carolinas 2016 RASS
CF_{cool}	N/A	0.475	Metering study
CF_{heat}	N/A	0.588	Metering study

Table 3-38: Duct Sealing Gross Verified Savings

Season	Energy Savings (kWh)	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	256	0.162	0.153
Heating	182		
Total	**438**		

3.4.3.4 Duct Insulation

Duct insulation reduces the thermal transfer of energy between the conditioned air in the duct system and the surrounding conditions, and reduces HVAC system operation. All the duct insulation measures are considered to be in the attic, outside conditioned space, where all heat transferred into or away from the conditioned air is considered outside the thermal envelope of the home. The algorithms used by the evaluation team and the associated parameters are presented in Table 3-39 and Table 3-40. Final verified gross savings are provided in Table 3-41.

Table 3-39: Algorithms for Duct Insulation Energy and Demand Savings

Calculation	Equation
Cooling Energy Savings	$\Delta kWh_{cool} = EFLH_{cool} \times \text{Capacity} \times Area \times \left(\frac{1}{Rvalue_{base}} - \frac{1}{Rvalue_{retrofit}}\right) \times \frac{1}{\eta_{cool} \times 1000}$
Heating Energy Savings	$\Delta kWh_{heat} = EFLH_{heat} \times \text{Capacity} \times Area \times \left(\frac{1}{Rvalue_{base}} - \frac{1}{Rvalue_{retrofit}}\right) \times \frac{1}{COP \times 3412} \times Ratio_{ASHP}$
Summer Demand Savings	$\Delta kW_{summer} = \frac{\Delta kWh_{cool}}{EFLH_{cool}} \times CF_{summer}$
Winter Demand Savings	$\Delta kW_{winter} = \frac{\Delta kWh_{heat}}{EFLH_{heat}} \times CF_{winter}$
Algorithm Reference	Mid-Atlantic TRM, v6.0, May 2016

Table 3-40: Inputs for Duct Insulation Gross Verified Savings

Input	Units	Value	Source
R_{base}	R-value	1	Program database average
$R_{retrofit}$	R-value	8	Program database average
Duct Diameter	ft	0.667	Engineering assumption
Duct Length	ft	100	Engineering assumption
Area	ft^2	209	Calculated
Capacitycool and heat	kBtuh	31.9	Program database
$EFLH_{cool}$	hours	752	Metering study
$EFLH_{heat}$	hours	698	Metering study
η_{cool}	SEER	10/13	Mid-Atlantic TRM
COP	COP	2.0/2.3	Mid-Atlantic TRM
HVAC Age Ratio, >10 years	%	32%	Duke Energy Carolinas 2016 RASS
HVAC Age Ratio, <=10 years	%	68%	Duke Energy Carolinas 2016 RASS
air source heat pump Ratio	%	47.8%	DEC program database ratio
CF_{summer}	N/A	0.475	Metering study
CF_{winter}	N/A	0.588	Metering study

Table 3-41: Duct Insulation Gross Verified Savings

Season	Energy Savings (kWh)*	Summer Demand Savings (kW)	Winter Demand Savings (kW)
Cooling	370	0.234	0.222
Heating	263		
Total	**634**		

*rounding error present

3.4.4 Deemed Analysis

Due to low uncertainty on measure savings and low program participation the evaluation team applied deemed savings from the previous evaluation for the heat pump water heater.

3.4.4.1 Heat Pump Water Heater

Energy and demand savings for heat pump water heaters are provided in Table 3-42.

Table 3-42: Heat Pump Water Heater Gross Verified Savings

Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
1,616	0.124	0.178

3.5 Targeted and Achieved Confidence and Precision

The Smart $aver evaluation plan was developed with the goal of achieving a target goal of 10% relative precision at the 90% confidence interval for the program as a whole. As the program is composed of different measures, and the energy savings estimation approach varies by measure, the evaluation team assigned sampling, verification, and impact estimate effort among the program measures in accordance with the measures' contribution to total reported Smart $aver savings. The evaluation team calculated the relative precision for each of these samples and combined the error bound to calculate a program-level relative precision. As presented in Table 3-43, the evaluation team reported confidence and precision for the program is +/- 9.6% at the 90% confidence level.

Table 3-43: Targeted and Achieved Confidence and Precision

Program	Targeted Confidence/Precision	Achieved Confidence/Precision
Smart $aver	90/10.0	90/9.6

3.6 Results

Measure level, per unit energy savings values are detailed in Figure 3-5, Figure 3-6, Figure 3-7, and Table 3-44. The program's two most active measures in terms of participation, central air conditioners and air source heat pumps, realized a substantially lower per unit savings compared to the reported values. Also, the program did not provide a reported savings estimate for ground source heat pumps. Therefore, the evaluation team deemed a 100% realization rate for this measure.

Figure 3-5: HVAC Replacement Per Unit Energy Savings

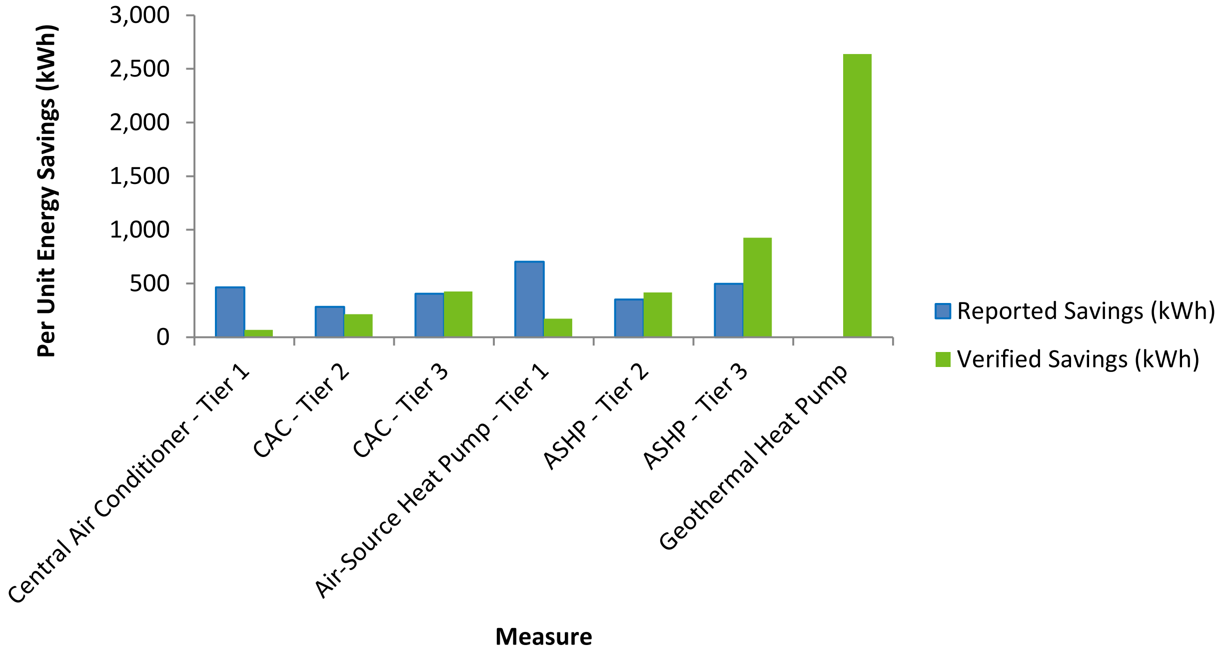


Figure 3-6: HVAC Add-on Per Unit Energy Savings

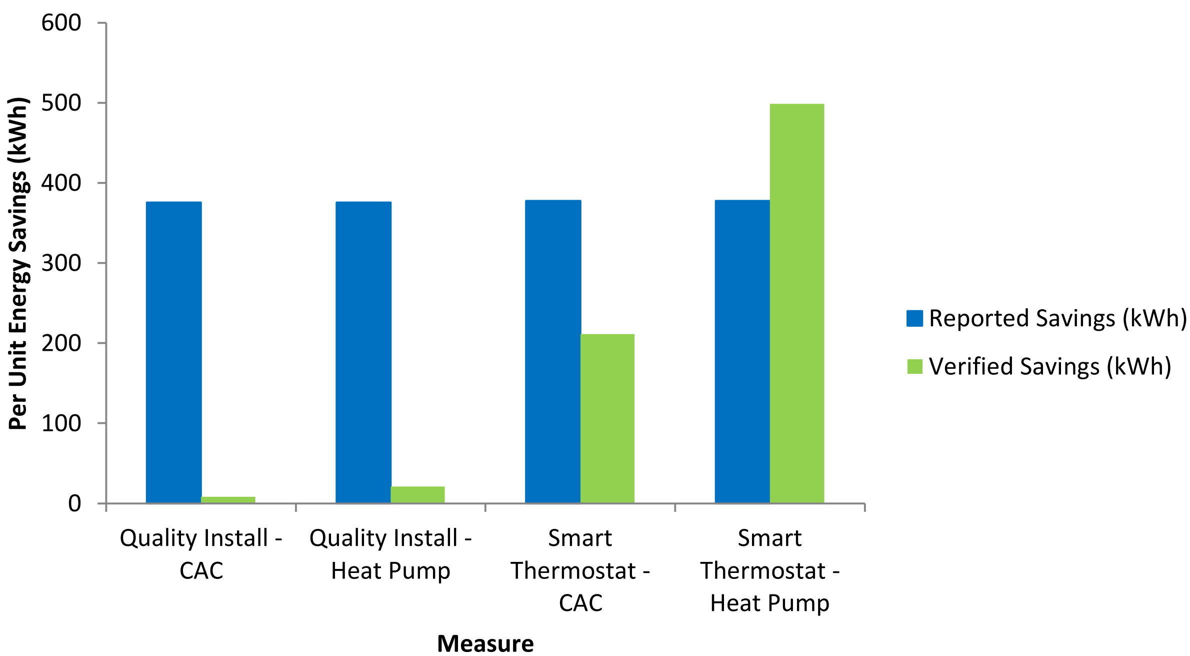


Figure 3-7: Other Measures Per Unit Energy Savings

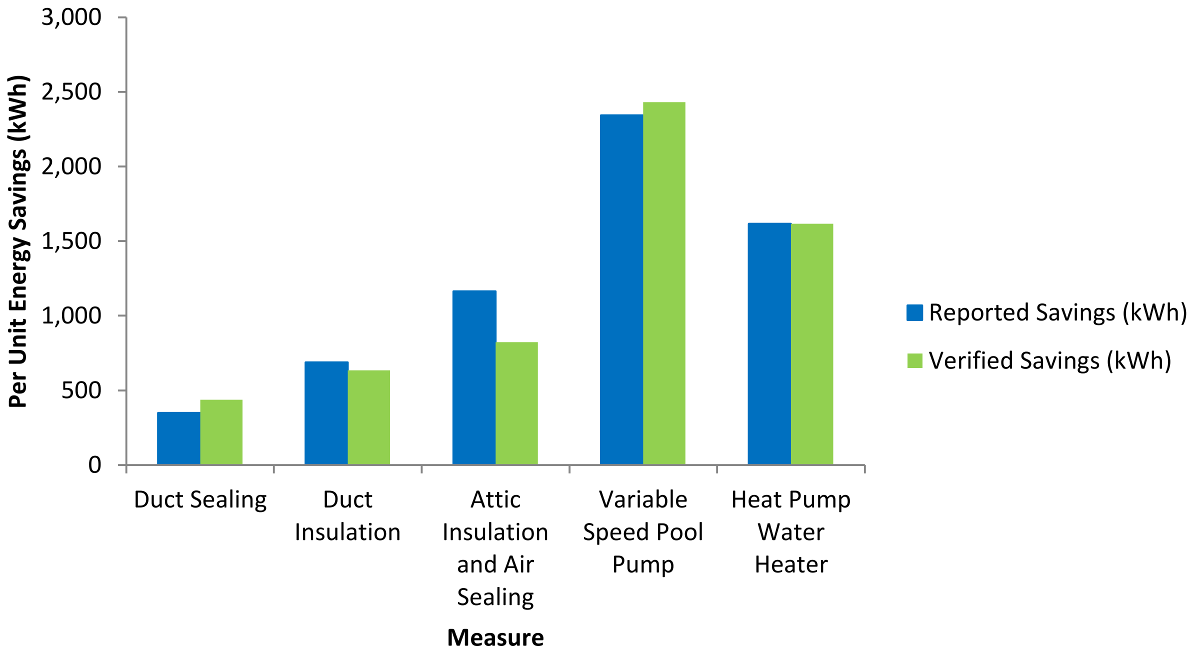


Table 3-44: Measure-Level Reported and Verified Gross Energy Savings

Measure	Tier	Rebated Measures	Reported Energy Savings, per unit (kWh)	Realization Rate	Gross Verified Energy Savings, per unit (kWh)	Total Gross Verified Energy Savings (MWh)
Central Air Conditioner	1	723	464	14.3%	66	47,900
	2	4,679	283	75.1%	212	993,420
	3	867	404	105.5%	426	369,470
Air Source Heat Pump	1	692	702	24.3%	171	118,164
	2	3,996	350	118.8%	415	1,659,605
	3	1,019	496	186.6%	926*	943,158
Geothermal Heat Pump	n/a	34	0	100.0%	2,637*	89,659
Quality Install - CAC	2 and 3	1,989	376	2.2%	8	16,189
Quality Install - Heat Pump	2 and 3	1,251	376	5.6%	21	26,268
Smart Thermostat - CAC	n/a	2,938	377	56.0%	211	620,751
Smart Thermostat - ASHP	n/a	2,388	377	132.1%	499	1,194,014
Variable Speed Pool Pump	n/a	562	2,342	103.8%	2,430	1,365,841
Attic Insulation & Air Seal	n/a	428	1,163	70.9%	824	352,838
Duct Sealing	n/a	163	350	125.1%	438	71,367
Duct Insulation	n/a	48	688	92.1%	634	30,420
Heat Pump Water Heater	n/a	40	1,616	100.0%	1,616	64,640
Total		**21,817**		**83.0%**		**7,960,401**

*The Smart $aver program rebates geothermal heat pumps under Tier 3 HP. As a result, the planning kWh value for Tier 3 HP also includes savings from the Geothermal HP measure; calculated as the total kWh for Tier 3 HP + Total kWh for Geothermal HP divided by the total Tier 3 participation + total Geothermal HP participation = 980.8 kWh

The program realization rate of 83% is driven by a substantial reduction in savings for the quality installation measure. This issue also impacted the Tier 1 central air conditioners and Tier 1 air source heat pumps which include quality installation savings in their reported values and verified savings.

Table 3-45 and Table 3-46 provide the per unit and total verified gross demand savings for the summer and winter seasons. The program realization rates for summer and winter were 70.5% and 196.8%, respectively.

Table 3-45: Measure-Level Reported and Verified Summer Demand Gross Savings[9]

Measure	Tier	Rebated Measures	Reported Summer Demand Savings, per unit (kW)	Realization Rate	Gross Verified Summer Demand Savings, per unit (kW)	Total Gross Verified Summer Demand Savings (MW)
Central Air Conditioner	1	723	0.248	9.0%	0.022	16.25
	2	4,679	0.172	66.7%	0.115	537.02
	3	867	0.274	91.2%	0.250	216.66
Air Source Heat Pump	1	692	0.216	21.4%	0.046	31.96
	2	3,996	0.117	107.5%	0.126	502.57
	3	1,019	0.176	165.8%	0.293*	298.06
Geothermal Heat Pump	n/a	34	0.000	100.0%	0.710*	24.16
Quality Install - CAC	2 and 3	1,989	0.133	3.9%	0.005	10.23
Quality Install - Heat Pump	2 and 3	1,251	0.133	3.8%	0.005	6.31
Smart Thermostat - CAC	n/a	2,938	0.000	100.0%	0.000	0.00
Smart Thermostat - ASHP	n/a	2,388	0.000	100.0%	0.000	0.00
Variable Speed Pool Pump	n/a	562	0.590	89.3%	0.527	296.21
Attic Insulation & Air Seal	n/a	428	0.194	114.0%	0.221	94.74
Duct Sealing	n/a	163	0.291	55.5%	0.162	26.36
Duct Insulation	n/a	48	0.573	40.9%	0.234	11.24
Heat Pump Water Heater	n/a	40	0.124	100.0%	0.124	4.96
Total		**21,817**		**70.5%**		**2,076.7**

*The Smart $aver program rebates geothermal heat pumps under Tier 3 HP. As a result, the planning Summer kW value for Tier 3 HP also includes savings from the Geothermal HP measure; calculated as the total Summer kW for Tier 3 HP + Total Summer kW for Geothermal HP divided by the total Tier 3 participation + total Geothermal HP participation = 0.306 kW

[9] Summer demand savings for all HVAC dependent measures are based on the summer coincident peak determined by the EFLH study.

Table 3-46: Measure-Level Reported and Verified Winter Demand Gross Savings

Measure	Tier	Rebated Measures	Reported Winter Demand Savings, per unit (kW)	Realization Rate	Gross Verified Winter Demand Savings, per unit (kW)	Total Gross Verified Winter Demand Savings (MW)
Central Air Conditioner	1	723	0.046	362.1%	0.167	120.44
	2	4,679	0.038	438.4%	0.167	779.47
	3	867	-0.010	n/a	0.167	144.43
Air Source Heat Pump	1	692	0.251	32.8%	0.082	56.93
	2	3,996	0.144	126.4%	0.182	728.09
	3	1,019	-0.046	n/a	0.390*	397.18
Geothermal Heat Pump	n/a	34	0.000	100.0%	1.274*	43.33
Quality Install - CAC	2 and 3	1,989	0.084	0.0%	0.000	0.00
Quality Install - Heat Pump	2 and 3	1,251	0.084	13.0%	0.011	13.71
Smart Thermostat - CAC	n/a	2,938	0.000	100.0%	0.000	0.00
Smart Thermostat - ASHP	n/a	2,388	0.000	100.0%	0.000	0.00
Variable Speed Pool Pump	n/a	562	n/a	100.0%	0.000	0.00
Attic Insulation & Air Seal	n/a	428	0.194	205.8%	0.399	170.94
Duct Sealing	n/a	163	0.000	100.0%	0.153	24.98
Duct Insulation	n/a	48	0.000	100.0%	0.222	10.65
Heat Pump Water Heater	n/a	40	0.178	100.0%	0.178	7.12
Total		**21,817**		**196.8%**		**2,497.1**

*The Smart $aver program rebates geothermal heat pumps under Tier 3 HP. As a result, the planning Winter kW value for Tier 3 HP also includes savings from the Geothermal HP measure; calculated as the total Winter kW for Tier 3 HP + Total Winter kW for Geothermal HP divided by the total Tier 3 participation + total Geothermal HP participation = 0.418 kW

Table 3-47 and Table 3-48 present the reported and verified energy and demand savings for 2016.

Table 3-47: 2016 Program Level Energy Savings

Measures Installed	Reported Energy (kWh)	Realization Rate	Gross Verified Energy (kWh)	Net-to-Gross Ratio	Net Verified Energy (kWh)
21,817	9,598,932	83.0%	7,960,401	66.9%	5,324,635

Table 3-48: 2016 Program Level Demand Savings

Measurement	Reported Demand (MW)	Realization Rate	Gross Verified Demand (MW)	Net-to-Gross Ratio	Net Verified Demand (MW)
Summer Demand	2.60	70.5%	2.08	66.9%	1.39
Winter Demand	2.07	196.8%	2.50		1.67

4 Net-to-Gross Methodology and Results

The evaluation team calculated the net savings, which are the amount of savings that occurred as a direct result of influence attributable to the program, by applying net-to-gross (NTG) adjustments to the gross savings. The evaluation team determined the NTG adjustment value via data collected from participant and trade ally surveys.

To calculate net savings, a NTG ratio must first be established. NTG consists of free ridership (FR) and spillover (SO). Free ridership refers to the portion of energy savings that participants would have achieved in the absence of the program through their own initiatives and expenditures (U.S. DOE, 2014).[1] Spillover refers to the program-induced adoption of measures by non-participants and participants who did not receive financial incentives or technical assistance for installations of measures supported by the program (U.S. DOE, 2014). The evaluation team used the following formula to calculate a NTG ratio:

$$NTG = 1 - FR + SO$$

Once the NTG ratio is established, the evaluation team used the following formula to calculate net savings:

$$Net\ Savings = Gross\ Savings * NTG$$

The evaluation team estimated nonparticipant spillover and quality install free ridership from trade ally survey data and estimated participant free ridership and spillover from participant surveys. The following sections describe how the evaluation team estimated participant free ridership and spillover values.

4.1 Free Ridership

Free ridership estimates how much the program influenced participants to make the energy saving improvements that the program incents, which is then used to adjust gross savings by the level of attribution the program is able to claim. Free ridership ranges from 0 to 1, with 0 being no free ridership (or, total program attribution), 1 being total free ridership (or, no program attribution) and values in between represent varying degrees of partial free ridership. The evaluation team used participant and trade ally survey data to inform free ridership estimates. Since an individual's free ridership may differ between different measure types, free ridership was first calculated individually for each measure associated with each participant survey respondent. Free ridership for the quality install measure was calculated in a similar respondent-level manner for trade allies. The evaluation team then used the respondent-measure-level free ridership values to derive a program-level free ridership estimate. This chapter describes this process.

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1 The U.S. Department of Energy (DOE) (2014). *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 23: Estimating Net Savings: Common Practices.* Retrieved August 29, 2016 from http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf

4.1.1 Participant-Measure-Level Free Ridership

Participant-measure-level free ridership consists of two components – change (FRC) and influence (FRI) – which both range from 0 to .5.[2] The following formula uses these two components to calculate participant-measure-level free ridership:

$$FR = FRC + FRI$$

4.1.1.1 Free Ridership Change

Free ridership change demonstrates what the participant would have likely done if the program had not provided an incentive for their energy upgrade. To determine this, the evaluation team asked participant survey respondents FRC questions specific to the measures they installed. The generic example below exemplifies how the evaluation team collected FRC data (see Appendix C for the measure-specific FRC questions in the participant survey).

Q1. If you had not received a Duke Energy incentive for your [PIPE IN INCENTED MEASURE], which of the following is most likely: Would you have…? [READ ALL, SELECT ONE]

1. *Not purchased a [PIPE IN INCENTED MEASURE]*
2. *Delayed purchasing a new [PIPE IN INCENTED MEASURE] for at least a year*
3. *Purchased a new [PIPE IN INCENTED MEASURE] but a less efficient or less expensive model*
4. *Bought the exact same [PIPE IN INCENTED MEASURE] anyway, and paid the full cost yourself*
5. *Or done something else, specify:_______*

98. *Don't know*
99. *Refused*

[2] Since most quality install rebate participants were unaware of the quality installation rebates, we used trade ally survey data to estimate free ridership for the measure. See section 4.1.1.3 for quality install free ridership estimation methods.

For insulation[3] and replacement equipment with less efficient options,[4] the evaluation team asked a follow up question to respondents that reported the third response option above (purchased a less efficient or less expensive measure), as exemplified below:

Q2. [ASK IF Q1=3] You said you would have bought a [PIPE IN INCENTED MEASURE] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy. Do you think it is more likely that you would have bought equipment that was…?

1. *Almost as efficient as the one you bought, or*
2. *Significantly less efficient than the one you bought*

98. *Don't know*
99. *Refused*

The evaluation team then assigned the following FRC values to each respondent for each rebated measure, based on their response to the questions above, as shown in the Table 4-1.

Table 4-1: Free Ridership Change Values

<table>
<tr><th>Q1 Response</th><th>Q2 Response</th><th>FRC Value</th></tr>
<tr><td>Not purchased a [MEASURE]</td><td></td><td>0.0</td></tr>
<tr><td>Delayed purchasing a new [MEASURE] for at least a year</td><td></td><td>0.0</td></tr>
<tr><td rowspan="3">Purchased a new [MEASURE] but a less efficient or less expensive model</td><td>Almost as efficient as the one you bought</td><td>0.375*</td></tr>
<tr><td>Significantly less efficient than the one you bought</td><td>0.125*</td></tr>
<tr><td>Don't know / Refused</td><td>0.25*</td></tr>
<tr><td>Bought the exact same [MEASURE] anyway, and paid the full cost yourself</td><td></td><td>0.50</td></tr>
<tr><td>Or done something else</td><td></td><td>FRC values assigned on a case by case basis, depending on which pre-coded response item they most resemble</td></tr>
<tr><td>Don't know / Refused</td><td></td><td>Measure average</td></tr>
</table>

* Since the less efficient version would be a standard efficiency model (which serves as the baseline from which savings are claimed), these values are set to 0 for smart thermostats and pool pumps. Additionally, the values vary for ASHPs and CACs, based on replacement condition and incentive tier (Table 4-2).

3 Respondents that report they would have installed less insulation will then be asked to report how much less insulation they would have purchased in a percentage format (e.g.: 50% less). This reported value will be subtracted from 100% and then divided in half; the result will serve as their FRC value.

4 Since duct sealing is a service measure, as compared to an equipment measure, there is no less efficient version. Thus, the counterfactual for service measures would be to either: 1) not purchase the service, 2) wait a year or more to purchase the service, or 3) purchase the service without the assistance of a rebate. Accordingly, FRC values for service measures are either 0 (would have not purchased or would have waited a year or more to purchase) or .5 (would have purchased without assistance of a rebate). Also, since the less efficient/expensive version of pool pumps and wi-fi thermostats would be the baseline, 'purchased a different unit' responses result in a FRC value of 0.

Participants who replaced a broken HVAC system pose a particular challenge to NTG (or FRC, specifically): because there is an immediate space heating or cooling need, it is possible that free ridership could be higher for some in this group, as "replacement upon burnout" participants may be less likely to report they would not purchase or would delay purchasing a replacement measure (which are responses that traditionally garner FRC scores of 0). These issues expose the possibility of higher free ridership scores for "replacement upon burnout" participants when using the algorithm in Table 4-1. Since the counterfactual of taking no action is not a realistic scenario for "replacement upon burnout" participants, we used a special FRC algorithm for air source heat pump and central air conditioner participants that assigns FRC scores of 0 to certain "replacement upon burnout" participants that indicated they would bought a less expensive or less energy efficient heating or cooling system as their counterfactual response (Table 4-2). This is the most prudent approach since:

1) Tier 1 incentives are effectively ECM incentives, since Tier 1 only requires the code minimum for SEER standards.

2) Savings are calculated based on a code SEER level baseline assumption.

3) For "replacement upon burnout" participants, the most realistic counterfactual that would result in the least efficient outcome is installing a less efficient unit than the one they installed through the program – which would be a code unit in certain counterfactual scenarios.

As seen in Table 4-2, this unique FRC algorithm takes SEER level of the incented unit into account. "Replacement upon burnout" participants who installed units exceeding minimum program requirements that said they would have installed an "almost as efficient" unit reveal that the program did not motivate them to purchase a unit above code in the first place, but rather motivated them purchase an even more efficient unit than they would have otherwise. Thus, these "replacement upon burnout" participants are partial free riders (given that their counterfactual outcome would likely still be above code) and garner a FRC value of 0.375.

Table 4-2: FRC Follow Up Values for Air-Source Heat Pumps and Central Air Conditioners

Follow Up Response	Incentive Tier	Replacement Upon Burnout*	FRC Value
Almost as efficient as the one you bought	1	Yes	0
		No	0.375
	2 or 3	Yes or No	0.375
Significantly less efficient than the one you bought	All	Yes	0
		No	0.125
Don't know / Refused	1	Yes	0
	2 or 3	Yes or No	0.25

* Replacement upon burnout represents respondents who indicated they replaced an "old" or "broken" unit.

The following tables show the count of respondents for each measure that chose each option in Table 4-1 or Table 4-2, as well as the resulting mean FRC value for each measure.

Table 4-3: Free Ridership Change Values: Geothermal Heat Pump (n=1)

Q1 Response	Q2 Response	FRC Value	Count Choosing Option
Not purchased a geothermal heat pump		0.0	0
Delayed purchase for at least one year		0.0	0
Bought a less expensive or less energy efficient heating and cooling system	Almost as efficient as the one you bought	0.375	0
	Significantly less efficient than the one you bought	0.125	0
	Don’t know / Refused	0.25	0
Bought the exact same geothermal heat pump anyway, and paid the full cost yourself		0.50	1
Or done something else		Assigned on a case by case basis	0
Don’t know / Refused		Measure average	0
Mean FRC value: geothermal heat pump		**0.50**	

Table 4-4: Free Ridership Change Values: Air Source Heat Pump (n=29)

Q1 Response	Q2 Response	Incentive Tier	Replacement Upon Burnout	FRC Value	Count Choosing Option
Not purchased an air source heat pump	N/A	N/A	Yes or No	0.0	0
Delayed purchase for at least a year	N/A	N/A	Yes or No	0.0	4
Bought a less expensive or less energy efficient heating and cooling system	Almost as efficient as the one you bought	1	Yes	0.0	1
			No	0.375	0
		2 or 3	Yes or No	0.375	2
	Significantly less efficient than the one you bought	All	Yes	0.0	0
			No	0.125	1
	Don’t know / Refused	1	Yes	0.0	0
		2 or 3	Yes or No	0.25	0
Bought the exact same air source heat pump anyway, and paid the full cost yourself	N/A	N/A	Yes or No	0.50	21

Q1 Response	Q2 Response	Incentive Tier	Replacement Upon Burnout	FRC Value	Count Choosing Option
Or done something else	N/A	N/A	Yes or No	Assigned on a case by case basis	0
Don't know / Refused	N/A	N/A	Yes or No	Measure average	0
Mean FRC value: air source heat pump				**0.39**	

Table 4-5: Free Ridership Change Values: Central Air Conditioner (n=33)

Q1 Response	Q2 Response	Incentive Tier	Replacement Upon Burnout	FRC Value	Count Choosing Option
Not purchased a central air conditioner	N/A	N/A	Yes or No	0.0	0
Delayed purchase for at least a year	N/A	N/A	Yes or No	0.0	2
Bought a less expensive or less energy efficient cooling system	Almost as efficient as the one you bought	1	Yes	0.0	1
			No	0.375	0
		2 or 3	Yes or No	0.375	2
	Significantly less efficient than the one you bought	All	Yes	0.0	1
			No	0.125	0
	Don't know / Refused	1	Yes	0.0	0
		2 or 3	Yes or No	0.25	0
Bought the exact same central air conditioner anyway, and paid the full cost yourself	N/A	N/A	Yes or No	0.50	23
Or done something else	N/A	N/A	Yes or No	Assigned on a case by case basis	1
Don't know / Refused	N/A	N/A	Yes or No	Measure average	3
Mean FRC value: central air conditioner				**0.42**	

Table 4-6: Free Ridership Change Values: Heat Pump Water Heater (n=1)

Q1 Response	Q2 Response	FRC Value	Count Choosing Option
Not installed a heat pump water heater		0.0	0
Postponed the purchase for at least one year		0.0	0
Purchased a new heat pump water heater, but a less efficient or less expensive model	Almost as efficient as the one you bought	0.375	0
	Significantly less efficient than the one you bought	0.125	0
	Don't know / Refused	0.25	0
Bought the exact heat pump water heater anyway, and paid the full cost yourself		0.50	1
Or done something else		Assigned on a case by case basis	0
Don't know / Refused		Measure average	0
Mean FRC value: heat pump water heater		**0.50**	

Table 4-7: Free Ridership Change Values: Attic Insulation (n=5)

Q1 Response	Q2 Response	FRC Value	Count Choosing Option
Would not have done the attic insulation		0.0	0
Postponed attic insulation for at least one year		0.0	3
Would have added less insulation	% less they would have added	reported value subtracted from 100% and then divided in half	0
Done the exact same upgrade, and paid the full cost yourself		0.50	2
Or done something else		Assigned on a case by case basis	0
Don't know / Refused		Measure average	0
Mean FRC value: attic insulation		**0.20**	

Table 4-8: Free Ridership Change Values: Duct Sealing (n=1)

Q1 Response	FRC Value	Count Choosing Option
Would not have done the duct sealing project	0.0	0
Postponed duct sealing project for at least one year	0.0	1
Done the exact same upgrade, and paid the full cost yourself	0.50	0
Or done something else	Assigned on a case by case basis	0
Don't know / Refused	Measure average	0
Mean FRC value: duct sealing	**0.00**	

Table 4-9: Free Ridership Change Values: Pool Pump (n=4)

Q1 Response	FRC Value	Count Choosing Option
Not installed/replaced a pool pump	0.0	0
Postponed the purchase for at least one year	0.0	0
Would have bought a less expensive or less energy efficient pool pump	0.0	2
Bought the exact pool pump anyway, and paid the full cost yourself	0.50	2
Or done something else	Assigned on a case by case basis	0
Don't know / Refused	Measure average	0
Mean FRC value: pool pump	**0.25**	

Table 4-10: Free Ridership Change Values: Smart Thermostat (n=32)

Q1 Response	FRC Value	Count Choosing Option
Not purchased wi-fi thermostat	0.0	3
Postponed the purchase for at least one year	0.0	0
Would have bought a different type of thermostat	0.0	12
Bought the exact wi-fi thermostat anyway, and paid the full cost yourself	0.50	14
Or done something else	Assigned on a case by case basis	2
Don't know / Refused	Measure average	1
Mean FRC value: pool pump	**0.24**	

4.1.1.2 Free Ridership Influence

Free ridership influence demonstrates how much influence the program had on a participant's decision to perform the incented energy upgrade. To determine this, the evaluation team asked participant survey respondents the following question, repeating this battery for each unique rebated measure associated with the respondent:

I'm going to read a list of factors that might have influenced your decision to make the energy saving improvements to your property we have been talking about. For each factor, please indicate how influential it was in your decision, using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential."

[INTERVIEWER NOTE: IF RESPONDENT SAYS 'NOT APPLICABLE; I DIDN'T GET/USE THAT,' THEN FOLLOW UP WITH: "So would you say it was "not at all influential?" AND PROBE TO CODE]

[PROGRAMMER: For each factor below input 0-10 scale and don't know and refused options.]

- a. *The rebate received*
- b. *Information or advertisements from Duke Energy, including their website*
- c. *Recommendation from your contractor*
- d. *Did anything else influence you? If so, please specify: _______________ [INTERVIEWER: PROBE IF UNCLEAR. RECORD VERBATIM RESPONSE]*

The evaluation team then selected the highest rated program-attributable item for each respondent and assigned the following FRI scores, depending on their high score value (Table 4-11).

Table 4-11: Free Ridership Influence Values

Max Influence Rating	FRI Value
0	0.5
1	0.45
2	0.4
3	0.35
4	0.3
5	0.25
6	0.2
7	0.15
8	0.1
9	0.05
10	0
Don’t know / Refused	Measure average

Table 4-12 shows the count of respondents for each measure associated with each max influence rating and FRI value in Table 4 11, as well as the resulting mean max influence and FRI values for each measure.

Table 4-12: Free Ridership Influence Values, by Measure

Max Influence Rating	FRI Value	Count with Max Influence Rating/FRI Value							
		Heat Pump (Air Source) (n=29)	Attic Insulation and Air Sealing (n=5)	Central Air Conditioner (n=33)	Duct Sealing (n=1)	Heat Pump (Geothermal) (n=1)	Heat Pump Water Heater (n=1)	Pool Pump (n=4)	Smart Thermostat (n=32)
0	0.5	0	0	0	0	0	0	0	1
1	0.45	0	0	0	0	0	0	0	0
2	0.4	0	0	0	0	0	0	0	0
3	0.35	0	0	0	0	0	0	0	0
4	0.3	0	0	0	0	0	0	0	0
5	0.25	0	0	0	0	0	0	0	2
6	0.2	1	0	0	0	0	1	0	1
7	0.15	2	1	4	0	0	0	0	0
8	0.1	6	1	7	0	0	0	2	8
9	0.05	5	0	6	0	0	0	0	5
10	0	15	3	16	1	1	0	2	15
Don't know / Refused	Measure average	0	0	0	0	0	0	0	0
Mean max influence		**9**	**9**	**9**	**10**	**10**	**6**	**9**	**9**
Mean FRI score		**0.05**	**0.05**	**0.05**	**0.00**	**0.00**	**0.20**	**0.05**	**0.07**

4.1.1.3 Quality Install Free Ridership

As seen in the Process Evaluation Findings chapter, participants were largely unaware of that they received a rebate for the quality installation service. Given this finding and the measure's goal of influencing trade ally installation practices (as compared to consumer purchasing decisions), we used trade ally surveys to estimate free ridership for quality install. To inform free ridership estimates, we asked trade allies that performed quality installations the following questions:

[Base: IF PERFORMED QUALITY INSTALLS]

Q15. As you may know, Duke Energy recently added "quality install" requirements for installations of heat pumps and air conditioners? Were you already doing all the techniques on the quality install check list prior to Duke requiring them?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF Q15=1]

Q16. Prior to using Duke's quality install checklist, did you have a system in place to document that your installers were following these same quality install techniques?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF Q15=1]

Q17. Prior to using Duke's quality install checklist, what specific quality install techniques were you using? Please be as specific as possible.

[Multiple response, do not read]

1. System capacity
2. Airflow / static pressure
3. System CFM (cubic feet per minute)
4. Condenser measurements
5. Enthalpy conversion
6. Blower door tests
7. Duct blaster tests
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Much like the participant-based free ridership algorithm, we used a two-component approach to estimate free ridership for quality install. Respondent-level free ridership is the result of summing FR_A and FR_B, both of which range from 0 to .5 (Figure 4-1). Trade allies that did not indicate they were using all the Duke Energy quality install techniques prior to the introduction of the Smart $aver quality install measure (Q15) received scores of 0 for both FR_A and FR_B, resulting in 0% free ridership for the measure. Trade allies that said yes to Q15 were scored as partial to full free riders, depending on their answers to Q16-Q17.

Figure 4-1: Quality Installation Free Ridership Algorithm

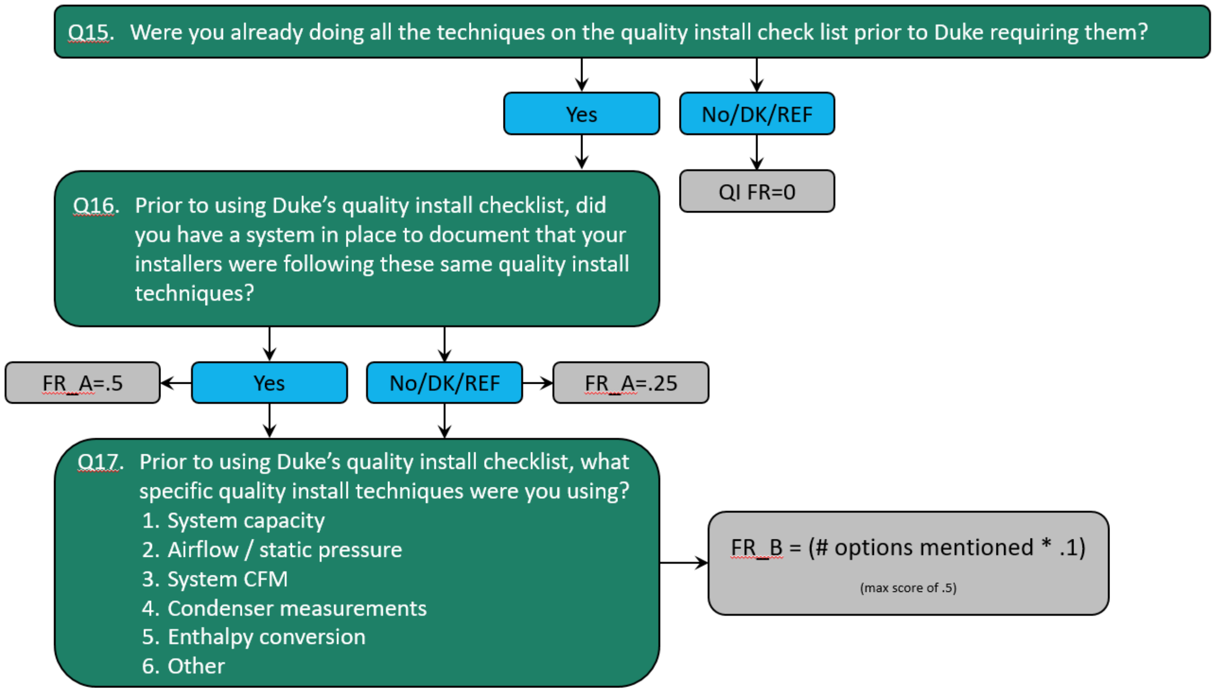


Table 4-13 shows the count of respondents associated with each FR_A score in Figure 4-1, as well as the resulting mean FR_A value for Quality Installation.

Table 4-13: Quality Install FR_A Values (n=28)

Q15 Response	Q16 Response	FR_A Value	Count Choosing Option
No		0.0	5
Don't know / Refused		0.0	1
Yes	Yes	0.5	19
	No	0.25	3
	Don't know / Refused	0.25	0
Mean QI FR_A value		**0.37**	

Table 4-14 shows the count of respondents associated with each FR_B score in Figure 4-1, as well as the resulting mean FR_B value for Quality Installation.

Table 4-14: Quality Install FR_B Values (n=28)

Q17 Response	FR_B Value	Count Choosing Option
System capacity	+.1	4
Airflow / static pressure	+.1	8
System CFM (cubic feet per minute)	+.1	1
Condenser measurements	+.1	4
Enthalpy conversion	+.1	3
Other	+.1	8
Q15=No / Don't know / Refused	0	6
Mean QI FR_B value	**0.10**	

The algorithm seen in Figure 4-1 resulted in free ridership scores for each trade ally that performed the quality installation measure. We then calculated a weighted average of the respondent-level scores to inform free ridership at the program level. We weighted respondent scores by the number of quality installation jobs each trade ally performed during the evaluation timeframe, resulting in a 0.63 FR score for the Quality Installation measure.

4.1.2 Measure-Level Free Ridership

To provide additional insight and transparency into the free ridership analysis, the evaluation team summed the measure-specific FRC and FRI scores for each respondent resulting in participant-measure-level free ridership (FR) scores. The evaluation team used the participant-measure-level FR scores to calculate an average FR score for each measure type. Table 4-15 exhibits the resulting mean measure-level FR scores, and the number of respondents associated with each mean FR score.

While the measure-level FR scores provide additional detail behind the free ridership analysis, we note that the evaluation was not designed to provide statistically significant measure-level results but rather provide a program-level FR score based on data collected on all program measures (see section 4.1.3 below). Therefore, the measure-level FR scores presented in Table 4-15 should be interpreted as potentially indicative of the rate of FR present but with the caveat of large error bounds due to the low sample sizes. This is particularly applicable to geothermal heat pumps, attic insulation and air sealing, variable speed pool pumps, heat pump water heaters, and duct sealing. These measures comprised a very small percentage of overall program participation and savings and consequently fewer evaluation resources were dedicated to data collection for these measures. As these measures continue to mature in the program and increase their overall share to the impact of the program, additional evaluation resources should be dedicated to assessing the level of free ridership.

Table 4-15: Measure-Level Free Ridership Scores

Measure		Count of respondents with measure	Mean FRC Score	Mean FRI Score	Mean FR Score
Central air conditioner		33	0.42	0.05	0.47
Heat pump	*Air Source*	29	0.39	0.05	0.43
	Geothermal	1	0.50	0.00	0.50
Attic insulation and air sealing		5	0.20	0.05	0.25
Variable speed pool pump		4	0.25	0.05	0.30
Heat pump water heater		1	0.50	0.20	0.70
Duct sealing		1	0.00	0.00	0.00
Smart Thermostat		32	0.24	0.07	0.31
Quality Install*		28	0.37	0.10	0.63

* Unlike other measures that report count of participants with the measure, Quality Install denotes Trade Ally sample size. Quality Install FR_A is reported in the FRC column and FR_B is reported in the FRI column. Note that FR_A and FR_B are unweighted, whereas the mean FR score is weighted by number of QI rebates. Thus, the simple sum of FR_A and FR_B does not equal the mean FR score for the measure.

4.1.3 Program-Level Free Ridership

Next, the evaluation team combined the measure-level FR scores into a program-level FR score. Table 4-16 shows the savings weights used to calculate the program-level FR score. Savings weights were calculated as follows:

$$Savings\ Weight = \frac{Population\ N * Verified\ Savings}{Gross\ Program\ Savings}$$

Table 4-16: Measure-Level Free Ridership Scores and Savings Weights

Measure		Population N	Verified Savings (kWh)	Savings Share (weight)	Mean FR Score
Central air conditioner		6,269	225	20%	0.47
Heat pump	*Air Source*	5,707	477	39%	0.43
	Geothermal	34	2637	1%	0.50
Attic insulation and air sealing		428	824	5%	0.25
Variable speed pool pump		562	1581	13%	0.30
Heat pump water heater		40	1616	1%	0.70
Duct sealing		163	438	1%	0.00
Smart Thermostat		5,326	243	19%	0.31
Quality Install*		3,240	13	1%	0.63

The resulting program-level free ridership is 0.39. Given that the sampling strategy aimed to achieve a representative sample with 90/10 confidence/precision at the program level, the program-level free ridership score was applied to each measure.

4.2 Spillover

Spillover estimates energy savings from non-rebated energy improvements made outside of the program that are influenced by the program, and is used to adjust gross savings by the additional energy savings garnered and the level of attribution the program is able to claim for these non-rebated measures. Spillover ranges from 0 to infinity, with 0 being no spillover and values greater than 0 demonstrating the existence and magnitude of spillover.[1] The evaluation team used participant survey data and trade ally interview and survey data to estimate spillover: participants to inform participant spillover (PSO) and trade allies to inform nonparticipant spillover (NPSO). These two estimates are summed to calculate total program spillover (SO):

$$SO = PSO + NPSO$$

4.2.1 Participant Spillover

The evaluation team asked participant survey respondents to indicate what energy saving measures or services they had implemented since participating in the program to identify potential spillover (see the Participant Survey in Appendix C for the spillover battery). The evaluation team then asked participants to use a 1 to 10 scale, where 1 means "not at all influential" and 10 means "extremely influential," to indicate how much influence Smart $aver had on their decision to purchase these energy saving measures. This question was repeated for each non-rebated measure category a respondent reported implementing. Table 4-17 exhibits how much program influence, ranging from 0% to 100%, is associated with each scale response to the spillover influence question.

Table 4-17: Participant Spillover Program Influence Values

Reported Smart $aver Influence	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.00
Don't know / Refused	0.00

[1] Spillover values can be interpreted as percentages, where 1=100%. Thus, a spillover value of .5 demonstrates a savings value of 50% of gross program savings.

The evaluation team used the measure-specific influence value to calculate the participant measure spillover (PMSO) for each measure that each participant reported. Participant measure spillover is calculated as follows:[2]

$$PMSO = Deemed\ Measure\ Savings * Number\ Installed * Influence\ Value$$

The evaluation team then summed all PMSO values and divided them by the participant sample's gross program savings to calculate the participant spillover estimate:

$$Participant\ SO = \frac{\sum PMSO}{Participant\ Sample\ Gross\ Program\ Savings}$$

This calculation resulted in a Participant SO (PSO) value of 0.02.

4.2.2 Nonparticipant Spillover

Nonparticipant spillover refers to non-rebated program measures implemented by nonparticipants that were directly or indirectly influenced by the program. The evaluation team surveyed 58 trade allies to identify and measure nonparticipant spillover. The evaluation team asked trade allies how many non-rebated measures that they installed in program territory since August. The program savings attributed to these non-rebated measures were discounted by the trade ally's reported level of program influence on their practice of recommending these measures (Table 4-18), and the proportion of their clients with non-rebated measures that were not influenced by their recommendations. Nonparticipant spillover was calculated individually for each of the top three program-qualified measures that each surveyed trade ally installed during the evaluation timeframe.

Table 4-18: Trade Ally Influence Values

Program Influence Rating	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0
Don't know / Refused	Measure level average

[2]Deemed savings for non-program spillover measures were referenced from the 2016 Mid-AtlanticTRM.

Thus, nonparticipant measure spillover is calculated as follows:[3]

$$NP\ Measure\ SO = Number\ of\ unrebated\ units\ installed * Program\ Influence * (1 - \%\ of\ respondents\ not\ influenced\ by\ TA\ recommendation)$$

The evaluation team then summed all nonparticipant measure spillover values and divided them by the trade ally sample's gross program savings to calculate the program-level nonparticipant spillover estimate:

$$NPSO = \frac{\sum NP\ Measure\ SO}{Sample\ Program\ Savings}$$

This calculation resulted in a NPSO value of 0.03.

4.2.3 Program-Level Spillover

The evaluation team summed the PSO and NPSO values to calculate the program-level SO value. This calculation resulted in program-level SO of 0.05.

4.3 Net-to-Gross

After combining all FR and SO estimates, NTG for the program is 0.67 (Table 4-19). The evaluation team applied the NTG ratio of 0.67 to program-wide verified gross savings to calculate DEC Smart $aver net savings.

Table 4-19: Net-to-Gross Results

Free Ridership	Spillover	NTG
0.38	0.05	66.9%

[3] NP Measure SO = nonparticipant spillover for a given measure type for a given trade ally. NRMC = non-rebated measure count installed in DEC territory since August 2016. %NRM = percent of non-rebated measures.

5 Process Evaluation

5.1 Summary of Data Collection Activities

The process evaluation is based on telephone interviews and surveys with program and implementer staff, trade allies, and participants (Table 5-1).

Table 5-1: Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size	Confidence/Precision
Program and implementer staff	Phone in-depth interview	2	N/A
High volume trade allies[a]	Phone in-depth interview	5	N/A
Trade allies (various rebate volumes)	Phone survey	58	90/10.3
Participants	Phone survey	73	90/9.6

[a] High volume trade allies are companies in the top 20% of trade allies in terms of number of rebated measures, for a given campaign.

5.1.1 Program and Implementer Staff

The evaluation team conducted interviews with the Smart $aver Program Manager and a senior manager from the implementation staff in order to understand how the program was working and to capture their insights about the program's operations, challenges, expectations, and interactions with market actors.

5.1.2 Trade Allies

Participating contractors – called "trade allies" – are the primary program delivery channel for Smart $aver. In December of 2016, the evaluation team conducted five in-depth interviews with high volume Smart $aver trade allies. The in-depth interviews primarily served to pre-test some questions designed for the subsequent trade ally surveys and to see if any additional unforeseen topics emerged that warranted inclusion in participant or trade ally surveys. After interviewing five trade allies and making some corresponding adjustments to the survey guide, the evaluation team surveyed 58 trade allies in February 2017, asking them about various program topics such as satisfaction with the program and program-related challenges (Table 5-2).

Table 5-2: Trade Ally Research Objectives

Research Objectives
Assess Trade Ally engagement with the program and how they and their customers heard of the program
Assess program satisfaction
Document Trade Ally program experience, including any challenges and opportunities for improving the program
Document Trade Ally perspective about the code changes and the future of the program
Gather data for Net-to-Gross spillover
Ask about Trade Ally firmographics and customer characteristics
Document program influence

The evaluation team contends that trade ally specializations (such as insulation, for example) can significantly shape trade ally experience with the program. The evaluation team monitored the measures that surveyed trade allies had experience with to ensure that the sample was diverse and representative in terms of measure experience. The distribution of the trade ally sample's measure experience generally reflects that of the larger trade ally population (Table 5-3).

Table 5-3: Trade Ally Experience with Smart $aver Measures in 2016

Measure	Number installed in evaluation timeframe	Number installed by TA survey sample	Number TA installers in survey sample
Central Air Conditioner	6,269	831	44
Air-Source Heat Pump	5,707	753	48
Geothermal Heat Pump	428	11	4
Attic Insulation and Air Sealing	428	72	6
Variable Speed Pool Pump	562	72	5
Heat Pump Water Heater	40	2	2
Duct Sealing	163	9	2
Duct Insulation	48	4	3
Smart Thermostat	5,326	905	42
Quality Install (Tier 2 and 3)	3,240	490	22

5.1.3 Participants

In July of 2017, the evaluation team surveyed 73 Smart $aver participants who received rebates through the program. The purpose of this data collection activity was to obtain a more detailed understanding of the customer experience with the program, identify potential areas for program improvement, and collect data to inform NTG estimates. Table 5-4 documents the specific research objectives of the participant survey.

Table 5-4: Participant Research Objectives

Research Objectives
Assess program outreach and marketing
Document customer experience with the program
Document reasons for participation and program influence
Gather feedback needed to estimate Net-to-Gross ratio
Assess population segments the program is reaching

To ensure the results were applicable to the larger participant population, the evaluation team stratified the sample by measure type, thus ensuring that sampled participants were representative of the measures in the population (Table 5-5). Central air conditioners and air-source heat pumps were the most commonly installed measures, accounting for nearly all (90%) installations in the program. Aside from survey respondents that received add-on HVAC measures (smart thermostat or quality install), only one survey respondent received rebates for more than one measure. This respondent received rebates for attic insulation/air sealing and duct sealing, and was asked measure-specific questions for all measures they received rebates for.

Table 5-5: Measures Installed by Participant Sample

Measure Installed	Sample % (n=73)	Participant Population %
Central Air Conditioner	45%	47%
Air-Source Heat Pump	40%	43%
Attic Insulation & Air Sealing	7%	3%
Pool Pump	6%	4%
Geothermal Heat Pump	1%	<1%
Heat Pump Water Heater	1%	<1%
Duct Sealing	1%	1%
Smart Thermostat	45%	62%
Quality Install	38%	38%

5.2 Process Evaluation Findings

The following subsections describe program successes and challenges as well as opportunities for program improvement.

5.2.1 Trade Ally Perspective

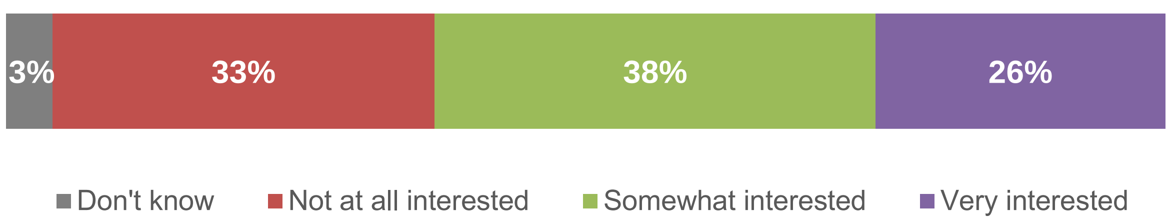
This section reports the results from trade ally surveys regarding their experience participating in the Smart $aver program in the Duke Energy Carolinas jurisdiction.

5.2.1.1 Training

We asked trade allies about their satisfaction with program training, as well as their suggestions for future training opportunities. Overall, trade allies were somewhat dissatisfied with program training opportunities (see Figure 5-10), with trade allies indicating they were dissatisfied because they had not received any program training.

When asked an open-ended question about what other training types they would be interested in, less than half (40%) of surveyed trade allies reported they would be interested in additional training opportunities. Specific training requests varied widely, including training about new rebates and programs offered by Duke Energy and how to fill out required paperwork. When specifically asked to use a 0 to 10 scale to demonstrate their interest in a training course on how to more effectively sell high efficiency equipment, the majority (64%) expressed at least minor interest in sales training (Figure 5-1).

Figure 5-1: Interest in Sales Training (n=58)*

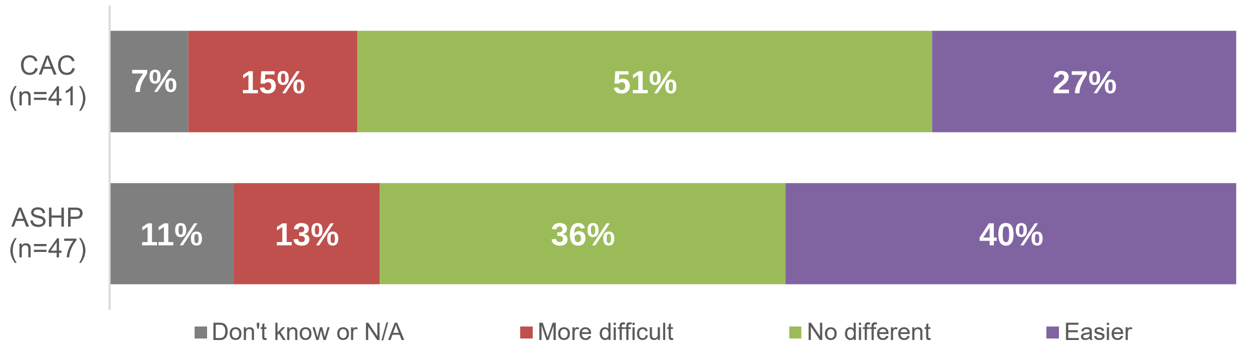


* Respondents used a 0 to 10 scale, where 0 meant "Not at all interested" and 10 meant "Extremely interested." In the figure above, "Not very interested" represents those selecting "0" through "2", "Somewhat interested" represents those selecting "3" through "7," and "Very interested" represents those selecting "8" through "10."

5.2.1.2 Code Changes

The U.S. Department of Energy revised the efficiency standard for air source heat pumps and central air conditioners; the new standard requires split system air source heat pumps and air conditioners to achieve a 14 SEER minimum for systems manufactured after January 1st, 2015. The revised standards for air source heat pumps and central air conditioners appear to have had moderate effect on sales in the region. About half (51%) of trade allies that installed central air conditioners said it is no easier or more difficult to sell 15 SEER central air conditioners following this code change. However, 40% (19 of 47) of surveyed trade allies that installed air source heat pumps through the program said that it is at least somewhat easier to sell 15 SEER air source heat pumps following the increases in minimum standards (Figure 5-2).

Figure 5-2: Difference in Ease or Difficulty in Selling 15 SEER Central Air Conditioners & Air-Source Heat Pumps Since Code Change*

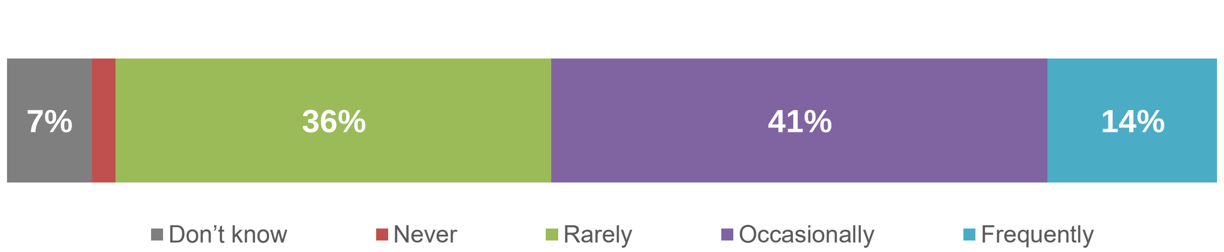


* Excluded respondents who don't sell SEER 15.

5.2.1.3 Recruiting Customers into Smart $aver

Trade ally survey data – which is further corroborated by participant survey data (see section 5.2.2.1) – reveals that trade allies are largely responsible for recruiting customers into the program. While over half of surveyed trade allies (55%) said that their customers "occasionally" or "frequently" ask about Smart $aver rebates, over one-third (38%) said their customers never or rarely ask about the program (Figure 5-3).

Figure 5-3: How Often Customers Ask About Smart $aver Rebates (n=58)

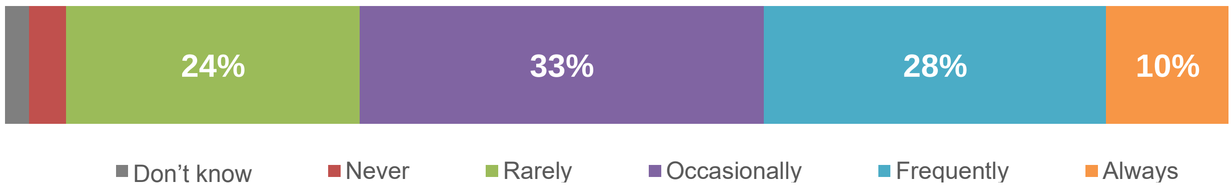


Few trade allies (31%) were highly satisfied with DEC's marketing of the program (see Figure 5-10), with dissatisfied trade allies noting that DEC does not conduct enough Smart $aver marketing. Participant survey results may help corroborate these trade ally reports, as few (6%) surveyed participants explicitly mentioned Duke Energy marketing materials as their source of program awareness. Thus, trade allies often need to educate their customers on the benefits of energy efficiency and the availability of Smart $aver rebates to bring new households into the program.

5.2.1.4 Rebate Application Process

Smart $aver transitioned to an online application system (called the "trade ally portal") in April 2016. We asked trade allies how frequently they have experienced problems or frustrations using the new portal (Figure 5-4). Although most (95%) reported experiencing problems or frustrations with the rebate application process, less than two-fifths (38%) said this was "frequently" or "always."

Figure 5-4: Frequency of Experiencing Problems or Frustrations with Online Rebate Application Process (n=58)



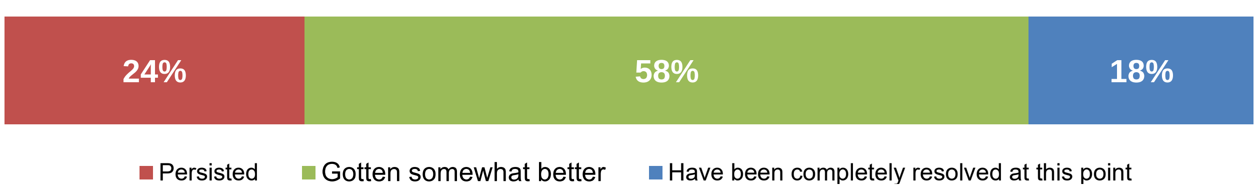
Trade allies that reported experiencing problems or frustrations with the rebate application process (n=55) typically mentioned struggles with uploading to the portal (be it applications or documentation) which can result in needing to resubmit, or indicated that the application process is overly burdensome (Table 5-6).

Table 5-6: Problems and Frustrations with the Rebate Application Process (Multiple Responses Allowed)

Responses	n=55
Data entry and form upload problems / having to resubmit forms	55%
Submission process is difficult, burdensome, or too lengthy	25%
Stringent application requirements	24%
Rebate applications being rejected for unknown or vague reasons	16%
Lack of feedback from Duke regarding rebate status and problems	16%
Resolving application errors is burdensome	13%
Thermostat application issues	11%
Quality Install checklist issues	7%
Rebate tracking issues	5%
Misc. other	40%
Don't know	2%

Echoing the prevalence of these problems and frustrations, the rebate application submission process had the highest level of dissatisfaction in the trade ally satisfaction battery (see Figure 5-10). However, over three-fourths (76%) of trade allies indicated that these problems have gotten at least somewhat better since the rollout of the new portal system (Figure 5-5).

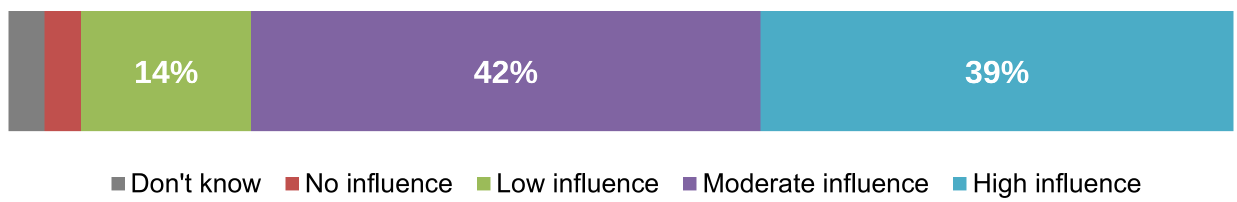
Figure 5-5: Trade Ally Perception of Portal Problems: Persisting vs. Improving (n=55)



5.2.1.5 Program Influence on Trade Allies

Trade ally survey results reveal that the program is influencing energy efficiency contracting services offered by contractors in the trade ally network. Most (62%, or 36 of 58) surveyed trade allies reported their knowledge of energy efficient products and services had increased since they became involved with Smart $aver, 39% of which said the program was highly influential on their increased knowledge (Figure 5-6).

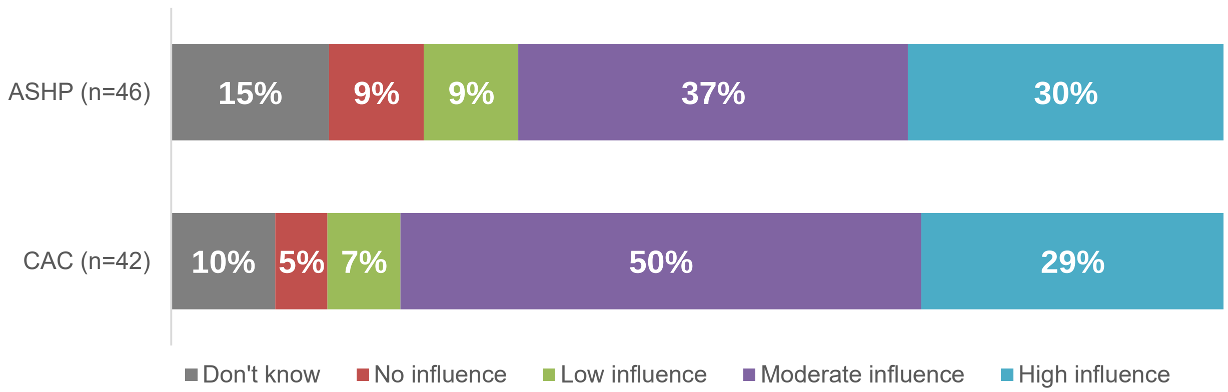
Figure 5-6: Smart $aver Influence on Increased Trade Ally Knowledge of Energy Efficient Products and Services (n=36)*



* Asked on a 0-10 scale, where 0 is "not at all influential" and 10 is "extremely influential." "No influence" represents trade allies that reported "0," low influence represents responses ranging from 1 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10.

Most HVAC trade allies reported that Smart $aver has at least partially influenced their practice of recommending qualifying HVAC measures, with about two-thirds or more – depending on the measure – indicating Smart $aver was moderately or highly influential (Figure 5-7).

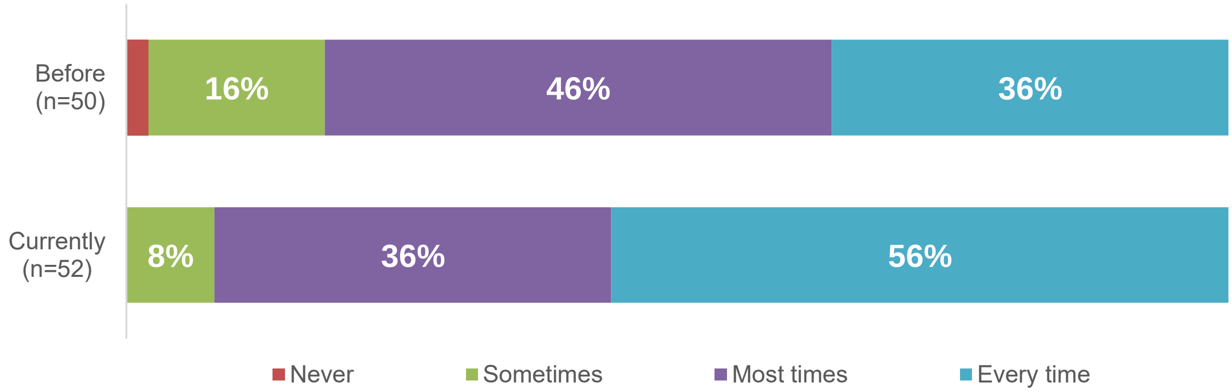
Figure 5-7 Program Influence on Trade Ally Practice of Recommending Program Qualified Measure*



* Asked on a 0-10 scale, where 0 is "not at all influential" and 10 is "extremely influential." "No influence" represents trade allies that reported "0," low influence represents responses ranging from 1 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10. Each row only includes trade allies who had experience with the measure.

Further, survey data reveals that contractors recommend high efficiency equipment more frequently now compared to before they were a participating trade ally in Smart $aver (Figure 5-8). Ultimately, surveyed trade allies revealed that over half of their central air conditioners (57%) or air source heat pumps (60%) installed in 2016 qualified for Smart $aver rebates.

Figure 5-8: Trade Ally Frequency of Recommending High Efficiency Equipment*



* Figure excludes "don't know" and "not applicable" responses. Only trade allies that install equipment measures (HVAC, water heat, and pool pumps) were asked these questions.

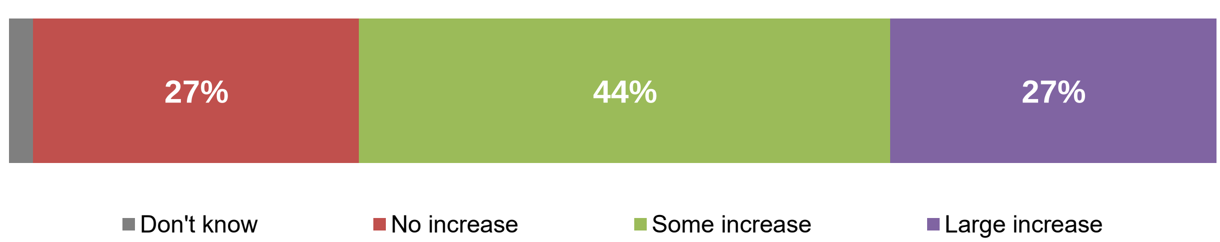
5.2.1.6 New Program Incentives

In April 2016, DEC added several new HVAC incentive offerings to the Smart $aver program:

- Tiered HVAC incentives
- Smart thermostat
- Quality install (QI)

The tiered HVAC rebates increased sales of high SEER units, as almost three-fourths of trade allies that installed CACs (71%) or ASHPs (70%) reported that the higher incentives helped them sell more 15+ SEER units. The smart thermostat incentives also appear to be influential, as almost three-fourths (71%) of HVAC trade allies said they have experienced at least some increase in smart thermostat installations since the introduction of the new incentive offering (Figure 5-9).

Figure 5-9: Smart $aver Effect on Trade Ally Smart Thermostat Installation Volume (n=41)



Almost 80% (22 of 28) of trade allies that performed quality installations reported they were already doing all the techniques on the quality install checklist prior to Duke Energy requiring them. Of these trade allies, most (19 of 22) said they had a system in place to document that their installers were following the same QI techniques. However, when trade allies were asked which specific QI techniques they previously used, only one mentioned all the primary components required in the Duke Energy QI checklist. Trade allies most commonly reported 'airflow and static pressure' as a previously used QI technique (mentioned by 8 of the 22 trade allies that reported previously using quality install techniques) (Table 5-7).

Table 5-7: Previous Quality Install Techniques Used by Trade Allies (Multiple Responses Allowed)

Quality Install Technique	Count (n=22)
Airflow/static pressure*	8
System capacity*	4
Condenser measurements*	4
Blower door tests	4
Enthalpy conversion*	3
System CFM*	1
Other	8
Don't know	8

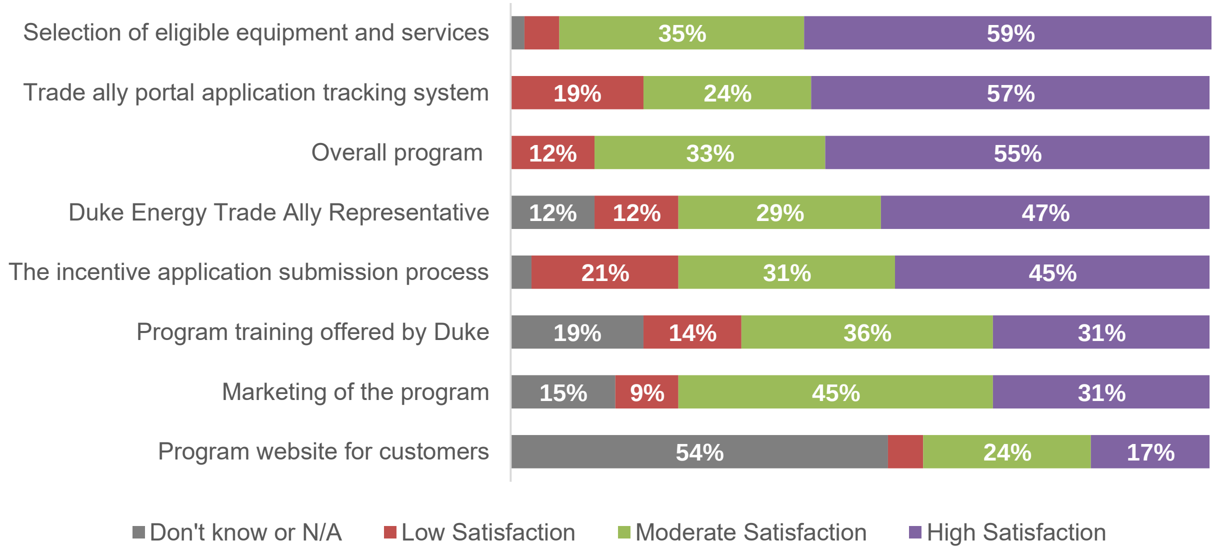
*Primary components of the Duke Energy Quality Install checklist

When completing the quality installation checklist on Tier 2 and Tier 3 HVAC jobs, almost all (91%) trade allies reported they do not charge their customers extra on the invoice for the quality install process. Open-ended comments reveal trade allies are considerably frustrated with the quality install measure: almost three-quarters (71%) of trade allies said improvements were needed or offered criticisms about the 'lengthy and burdensome' process. Of those offering suggestions for improvement, common responses included eliminating the Tier 1 HVAC incentives or checklist altogether, reducing paperwork required for the quality install checklist to simplify the process, and compensating the contractors for their time completing the quality installation. Additional analysis revealed that the more experience the trade ally had with the measure, the less likely they were to criticize it. See Appendix C for full verbatim responses.

5.2.1.7 Satisfaction

Surveyed trade allies reported moderate satisfaction with several program elements (Figure 5-10). The incentive submission process and the application tracking system received the most dissatisfied ratings; dissatisfied trade allies elaborated they were dissatisfied with these items because the submission process is burdensome and rebate statuses are often inaccurate. Program training and DEC's marketing of the program also received low satisfaction ratings, with trade allies explaining they were not aware of their presence (that is, they felt program marketing and training opportunities were lacking). However, over half of trade allies reported high satisfaction with the selection of eligible equipment and services and the overall program.

Figure 5-10: Trade Ally Satisfaction with Program Elements* (n=58)



* Asked on a 0-10 scale, where 0 is "very dissatisfied," 5 is "neither satisfied nor dissatisfied," and 10 is "very satisfied." Figure exhibits percent with "high influence" ratings that range from 8 to 10.

5.2.1.8 Suggestions for Improvement

Despite their moderate satisfaction ratings, trade allies had few suggestions for program improvement, including:

- Continue improving and simplifying the online portal and incentive application process. Some trade allies offered specific suggestions to help streamline the process and enhance the accessibility of the portal, such as eliminating highly technical jargon, reducing unnecessary paperwork, and other general usability improvements.
- Simplify or eliminate the quality installation process. Most trade allies offered suggestions for improving the checklist, including: eliminating the Tier 1 QI requirement or checklist altogether, compensating the trade ally for their time completing the checklist, and reducing the amount of paperwork needed to shorten the processing time.
- Improve communication and customer service. Although almost half of trade allies reported high satisfaction with their trade ally representative, over 40% of trade allies reported low to moderate satisfaction due to lack of communication and accessibility.

5.2.2 Participant Experience

In July 2017, the evaluation team surveyed 73 Smart $aver participants who received rebates through the program. Nearly all (95%) reported living at the residence where the work was performed, all of which reported owning their home. Nearly all (89%) reported living in a single-family detached home, followed by 6% living in a row or town house, 3% living in a factory manufactured single-family home, 1% living in a duplex, and 1% living in an apartment or condo building with four or more units (Table 5-8).

Table 5-8: Participant Housing Type

Housing Type	n=73
Single-family detached home	89%
Row house or town house	6%
Factory manufactured single-family home	3%
Duplex	1%
Apartment or condo building with four or more units	1%
Total	**100%**

5.2.2.1 Participant Awareness

Trade allies are the primary way consumers learn about the program, as evidenced by more than three-quarters (77%) of participants citing their contractor as their source of program awareness (Table 5-9). A minority of participants may have heard about Smart $aver via Duke Energy's marketing efforts, as several participants said they learned about the program from the internet (11%) or a mailer (8%).

Table 5-9: Source of $mart Saver Program Awareness (Multiple Responses Allowed)

Source of Program Awareness	n=73
Trade ally	77%
Online	11%
Mailer	8%
Duke Energy mentioned	6%
Don't know	6%
Other	6%

Respondents typically reported learning about energy efficient technologies from the internet, with about half (48%) of surveyed participants reporting going online to search for information regarding energy savings (Table 5-10). However, nearly one-quarter (22%) reported they do not typically search for information on how to save energy in their home.

Table 5-10: Source of Energy Savings Information (Multiple Responses Allowed)

Source of Energy Savings Information	n=73
Online sources	48%
Read utility information on how to save money	29%
Go to utility website	25%
In-store salespeople	1%
Other	5%
Not applicable – do not typically search for information on how to save energy	22%
Don't know	1%

5.2.2.2 Motivation to Participate

The evaluation team asked participants a series of questions to determine why they selected qualifying Smart $aver measures. For those participants who installed equipment measures, the evaluation team asked about the condition of the previous equipment they replaced, and then asked why they chose an energy efficient version of that equipment.

Overall, a slight majority (60%) of participants reported replacing their equipment because it was "getting old" (Table 5-11). More than half (55%) replaced their equipment because it was broken or not working properly, and 3% did so even though it was in good working condition.

Table 5-11: Condition of Previous HVAC Equipment

Condition of Previous System	Geothermal HP participant (n=1)	CAC participant (n=33)	ASHP participant (n=29)	Total (n=63)
Broken & old	0	6	8	14 (22%)
Old & working	0	0	0	0 (0%)
Working [only response]	0	0	2	2 (3%)
Old [only response]	1	19	4	24 (38%)
Broken [only response]	0	8	13	21 (33%)
Other	0	0	2	2 (3%)
No response	0	0	0	0 (0%)

*n=63 includes participants that installed the following: air source heat pump, geothermal heat pump, OR central air conditioner.

The most commonly reported motivation for selecting highly efficient HVAC equipment over standard efficiency equipment was some form of monetary savings (52%), followed by wanting to take advantage of the cost savings and return on investment (26%) and a desire to consume less energy (18%) as summarized in Table 5-12.

Table 5-12: Motivation for Installing Energy Efficient HVAC Equipment (Multiple Responses Allowed)

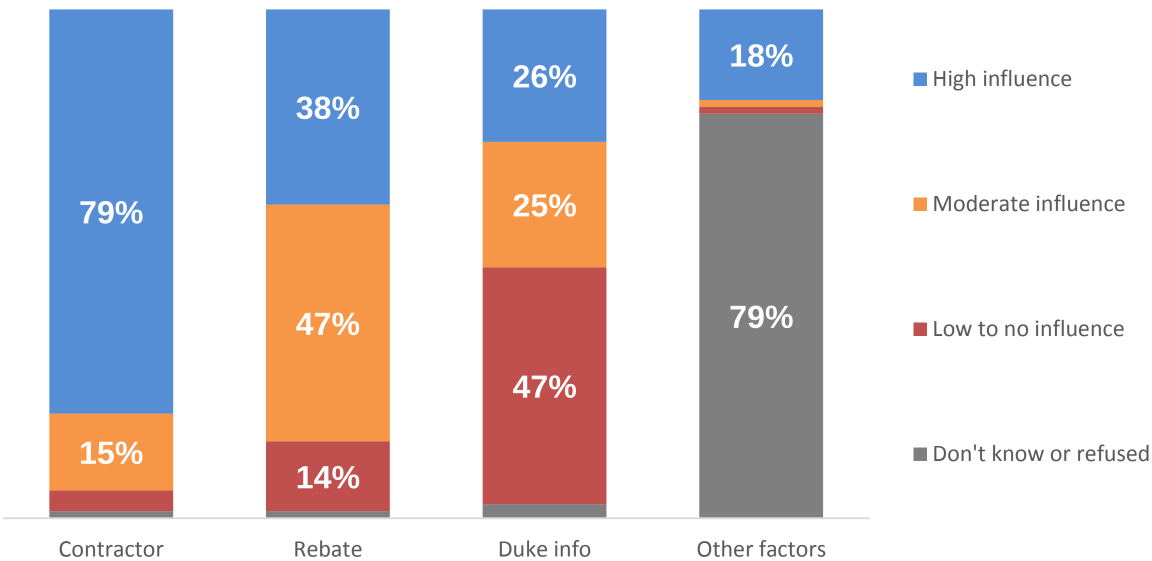
Motivations	n=63
Monetary savings*	52%
ROI & savings on energy bill	26%
To use less energy / make home more energy efficient	18%
To help the environment	8%
Interested in incentive / helped justify increased cost	8%
Wanted a quality system with low maintenance	3%
Contractor recommendation	5%
Other	3%

*Unclear if respondent is citing long term or upfront savings.

5.2.2.3 Program Influence

More than half (55%) of participants who purchased energy efficient equipment reported that recommendations from their contractor were highly influential in their decision to participate in the program (Figure 5-11). Contractors were much more influential than the Smart $aver rebate, information, or advertisements. Other influential factors included recommendations from friends or family, increasing value of home for sale, or federal tax credits.

Figure 5-11: Influential Factors in Decision to Purchase Efficient Measures* (n=73)



* Participants were asked to rate each factor using a 0 to 10 scale where 0 meant "not at all influential," and 10 meant "extremely influential." Low influence represents responses ranging from 0 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10. This only includes influence of these factors on participants' decision to purchase a primary measure, not add-on measures (smart thermostats or quality installation). For more information on influence on add-on measures, see section 5.2.2.5.

Nearly one-third (30%, or 22 of 73) of participants reported being familiar with other DEC energy efficiency programs (Table 5-13). Participants were most aware of the HVAC rebates (6 mentions). Among the 22 respondents that were aware of other DEC rebates, nine reported receiving one or more of them.

Table 5-13: Awareness and Participation in Other Duke Energy Programs (Multiple Responses Allowed)

	Count Aware (n=73)
Familiar with Other Duke Energy Rebates	22
Other Smart $aver Rebates	8
HVAC	*6*
Heat pump water heater	*2*
Pool pump	*2*
Attic insulation and air seal	*1*
Duct sealing and insulation	*1*
Smart Thermostat	*1*
Other Duke Energy Rebates	14
Discounted efficient lighting	*8*
In-home energy audit	*2*
Power manager	*1*
Other	*2*

Around one-third (30%) of participants reported purchasing other products or services to help save energy in their homes. However, very little of this resulted in attributable spillover savings as most (73%) said Smart $aver had no influence on their subsequent energy upgrades.

5.2.2.4 Participant Experience with the Program

About one-sixth (15%, or 11 of 71) of surveyed participants reported they contacted program staff with questions during the course of participating in the program. Of the 11 participants that contacted program staff, most (7 of 11) contacted them just once. Furthermore, of those participants who contacted staff, the majority (10 of 11) reported doing so via phone (Table 5-14).

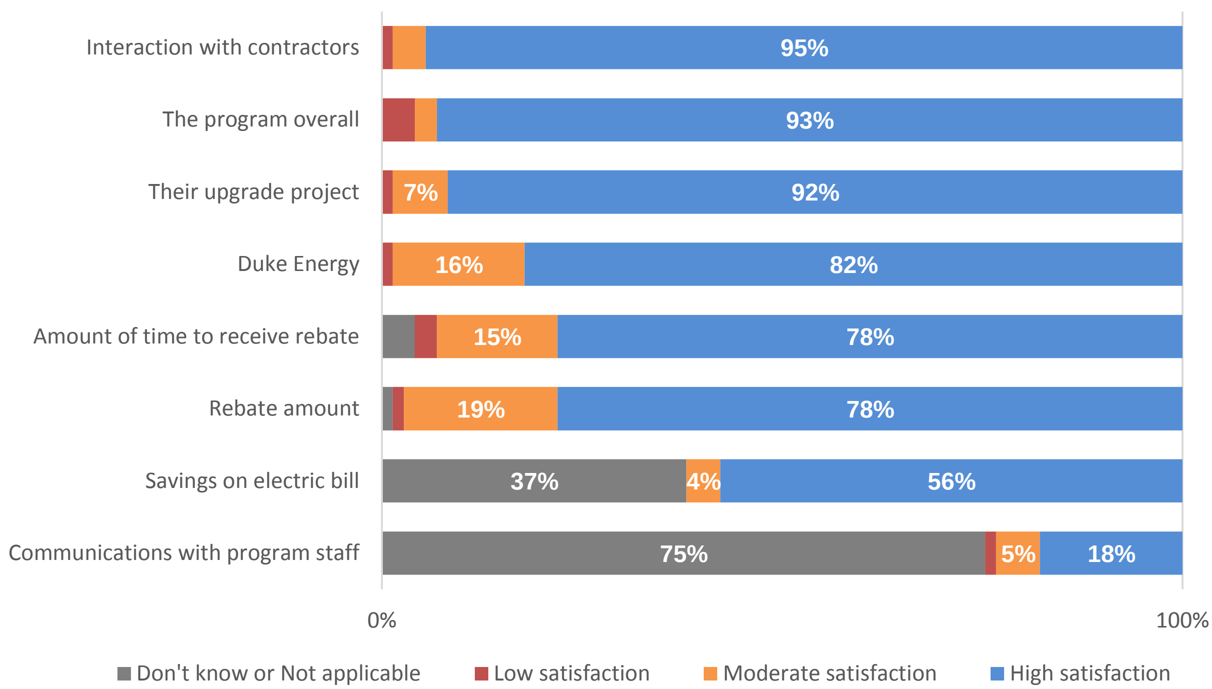
Table 5-14: Contact with Program Staff (n=73)

Contact with Program Staff	Count	Percent
Frequency of Contact		
Never	55	75%
Once	11	15%
Two or three times	6	8%
Four times or more	1	1%
Total	**73**	**100%**
Contact Type (Multiple Responses Allowed; n=18)*		
Phone	18	100%
Email	1	5%

* Includes those that indicated they contacted program staff at least once.

The majority of participants reported high satisfaction levels with most program elements (Figure 5-12). Nearly all (95%) reported being highly satisfied with their interaction with contractor. Furthermore, most participants reported being highly satisfied with their overall experience (93%) and results of their upgrade project (92%). Participants were comparably less satisfied with the rebate amount, and the amount of time to receive their rebate. Few participants noticed savings on their bill or interacted with program staff, but those who did tended to be highly satisfied.

Figure 5-12: Participant Satisfaction with Program Elements* (n=73)



* Participants were asked to rate each factor using a 0 to 10 scale where 0 meant "not at all satisfied," 5 meant "neither satisfied nor dissatisfied," and 10 meant "very satisfied." Low satisfaction represents responses ranging from 0 to 3, moderate satisfaction represents responses ranging from 4 to 7, and high satisfaction represents responses ranging from 8 to 10.

* For this item, participants were asked to rate their overall satisfaction on a five-point scale, from "very dissatisfied" to "very satisfied." The Evaluation Team recoded responses to be comparable with other items in the series.

To further understand Smart $aver's effect on participants attitudes towards Duke Energy, the evaluation team asked whether their participation in the program had a positive, neutral, or negative effect on their overall satisfaction with Duke Energy. Overall, participation was beneficial, with the majority (84%) of respondents reporting a positive effect, and just 1% reporting a negative effect (Table 5-15).

Table 5-15: Effect of $mart Saver Program on Participants Satisfaction with Duke Energy

Effect of Program on Satisfaction with Duke Energy	n=73
Positive effect	84%
No effect	15%
Negative effect	1%
Total	**100%**

Although savings were not a driving factor for participants' program satisfaction, the majority (62%) reported noticing savings on their electric bill since their last project was completed (Table 5-16).

Table 5-16: Resulting Energy Savings on Electric Bill

Experienced Savings on Electric Bill	n=73
Yes, they noticed savings	62%
No - they looked but did not notice any savings	10%
No - they looked but it is too soon to tell	4%
They didn't look	14%
Don't know	11%
Total	**100%**

The evaluation team asked all respondents if they had any suggestions to improve the program. Among the 24 participants who provided a response, around one-quarter (6 of 324) reported wanting more customer outreach to increase awareness of the program (Table 5-17). An additional five respondents suggested improving the program description and instructions around how to receive the rebate.

Table 5-17: Suggestions for Improving $mart Saver Program (Multiple Responses Allowed)

Suggestions for Improving the Program	Count (n=24)
Raise awareness, perform more outreach	6
Improve program description/Instructions on how to get rebate	5
Expand rebates / offerings	5
Improve customer service	1
Use a check for rebates rather than gift card	2
Other	6

5.2.2.5 New HVAC Incentives

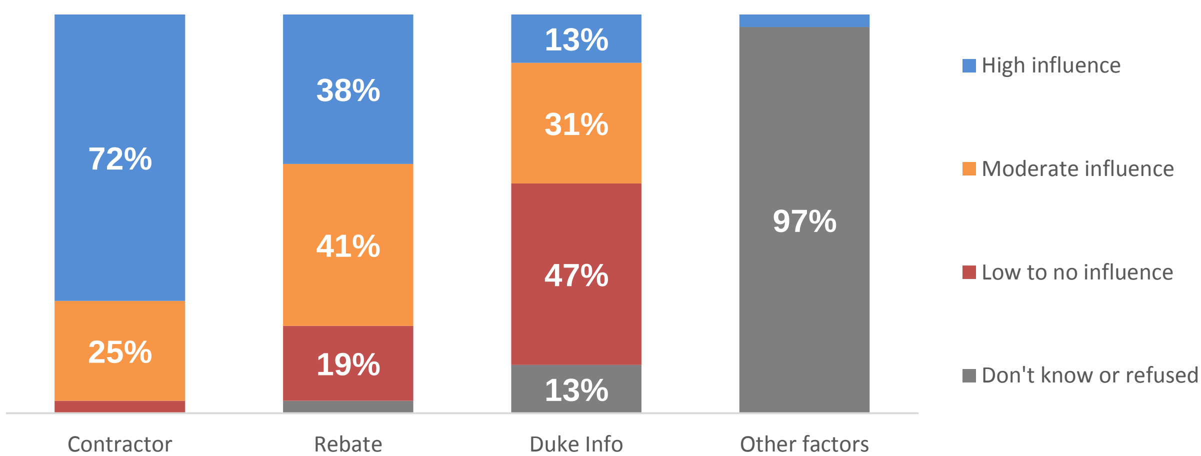
Most (97%) smart thermostat participants replaced non-programmable (50%) or standard programmable (47%) thermostats. Participants were motivated to replace their old thermostats with smart thermostats primarily because it was a 'package deal' and they liked the features (Table 5-18).

Table 5-18: Participant Motivations for Installing Smart Thermostats (Multiple Responses Allowed)

Motivations	(n=32)
Came as a package deal	47%
Thermostat features	38%
Convenience	9%
Rebate	9%
Don't know	6%

Nearly three quarters (72%) of participants that received a smart thermostat reported that recommendations from their contractor were highly influential in their decision to participate in the program (Figure 5-13). Participants rated their contractor as significantly more influential than the Smart $aver rebate or DEC information on their decision to purchase a smart thermostat.

Figure 5-13: Influence on Decision to Purchase a Smart Thermostat (n=32)



Most (75%) quality install rebate recipients were not aware that they had received a rebate for the service. Of those that were aware of the rebate, most (6 of 7) said their contractors gave them a choice between a standard installation and quality installation and most (5 of 7) had heard of quality install before receiving the service. However, the quality install rebate had little influence on participant purchase decisions among those that were aware that they received the rebate for the quality installation service: most (6 of 7) said that if Duke had not offered a rebate for the service, they still would have demanded their contractor provide a quality installation even if they would have had to pay extra for the service.

6 Conclusions and Recommendations

Based on evaluation findings, the evaluation team concluded the following and provides several suggestions on how to improve the program:

Conclusion 1: Trade allies are the driving force of the program, but there may be opportunities to improve their program experience and effectiveness. Trade allies are the primary mechanism for bringing participants into the program, as they often upsell energy efficient systems to customers who have no prior awareness of the program during a time of immediate heating or cooling needs. However, trade ally satisfaction with certain program elements is relatively low, particularly: the application process and portal, program training, and the quality installation process and requirements.

Recommendation: Look for ways to increase trade ally satisfaction and rebate volumes. Trade allies are vital to the program's success. DEC should work with Blackhawk Engagement Solutions, the program implementer, to improve the trade ally experience and look for ways to increase trade ally effectiveness in the field.

- Potential strategies for increasing trade ally effectiveness (and simultaneously increasing trade ally satisfaction):
- <u>Provide marketing materials to trade allies</u>, such as co-op marketing
- <u>Attempt to increase trade ally participation in training events</u>. Potential strategies:
  - Align training offerings with trade ally content requests, particularly: sales, quality install, portal/application process, and program changes
  - Ensure training sessions occur during convenient periods during the year (i.e., non-peak seasons) and convenient times (breakfast meetings can be particularly successful).
- Potential strategies for improving TA (Trade Ally) satisfaction:
  - <u>Continue improving portal system and simplifying the application process</u>
  - <u>Consider splitting incentives with TAs</u> to compensate TAs for their time spent on Duke Energy processes. Shifting a small portion of the incentive to the trade ally is unlikely to negatively impact participation levels, as participants were only marginally influenced by the rebate and were instead mainly influenced by their contractor's recommendation (a finding which underscores the need to retain a strong trade ally network).

Conclusion 2: Approximately 60% of sampled quality install sheets included issues. Trade allies complete quality install sheets detailing system measurements taken while on site. Upon review of a sample of quality install sheets, the evaluation team found several issues including:

- Math errors
- Calculated capacities below program requirement
- Rule of thumb CFM estimates instead of actual measurements
- Testing in sub-optimal conditions

These issues compromise the validity of the impact of quality installation and therefore the associated energy and demand savings cannot be verified.

- **Recommendations:**
  - Establish additional internal QA/QC processes when reviewing submitted quality install sheets.
  - Work with trade allies to better understand issues encountered with the quality install sheets and to improve quality install reporting.

Conclusion 3: The quality installation measure may have experienced some growing pains in its infancy. Many trade allies expressed frustration with the 'complex and time consuming' quality install form, especially since they receive no compensation for completing it. These concerns may have limited the initial growth of the new measure:

- Tier 1 (which requires QI) was the least installed HVAC tier, amounting to about one-tenth of all HVAC units in the program.
- Less than one-third of Tier 2 and Tier 3 HVAC units received a QI rebate.
  - **Recommendation: As DEC matures the quality installation measure, look for ways to retain, expand, and improve trade ally quality install practices.**
  - Potential strategies for retaining and expanding trade ally quality installation practices:
    - <u>Shift the quality install rebate to trade allies</u>: trade ally dissatisfaction with the process may be mitigated by compensation.
    - <u>Hold a round table meeting with trade allies to collaborate on a revised quality install process that better serves the needs of both parties:</u> for DEC to generate cost-effective savings from the measure, the process must be minimally burdensome for trade allies so that they actively and accurately complete it

Conclusion 4: New HVAC rebates and requirements are generating additional energy savings that would not have occurred naturally. The new HVAC program components have resulted in increased trade ally sales of high SEER HVAC units and smart thermostats. Although comparatively less successful, quality installation rebates and requirements have encouraged a minority of trade allies to adopt new quality install techniques.

- **Recommendation 1:** Continue offering the new incentives:
  - tiered HVAC incentives
  - smart thermostats incentives
  - QI incentives (however, shift the rebate to trade allies)
- **Recommendation 2:** Continue looking for new program offerings that could generate additional savings

Appendix A Summary Form

Smart $aver Program

Completed EMV Fact Sheet

Description of program

The Smart $aver program offers Duke Energy existing residential customers incentives for improving their home's energy efficiency through the installation of energy efficient heating, ventilating, and air conditioning (HVAC), quality installation of HVAC units, smart thermostats, pool pump, and water heating equipment replacements, duct sealing, duct insulation, and attic insulation with air sealing.

Date	January 1, 2017 – November 1, 2017	Measure	Verified Net Savings (kWh)
Region(s)	Carolinas	Central Air Conditioner	149
Evaluation Period	May 1, 2016 – April 30, 2017	Air Source Heat Pump	315
Annual kWh Net Savings	5,324,635	Geothermal Heat Pump	1,744
Coincident kW Net Impact - Summer	1,389	Quality Installation	9
Coincident kW Net Impact - Winter	1,670	Smart Thermostat	268
Net-to-Gross Ratio	66.9%	Attic Insulation & Air Seal	545
Process Evaluation	Yes	Variable Speed Pool Pump	1,626
Previous Evaluation(s)	N/A	Heat Pump Water Heater	1,069
		Duct Sealing	290
		Duct Insulation	419

Evaluation Methodology

Impact Evaluation Activities

- *44 on-site metered systems*
- *73 telephone surveys with participants*

Impact Evaluation Findings

- *Realization rate: 83.0%*
- *Net-to-gross: 66.9%*

Process Evaluation Activities

- *Program and implementation staff: interviews with one program staff and one implementation staff*
- *Trade Allies; 5 interviews with high volume contractors, surveys with a representative sample of 58 trade allies*
- *Participants; 73 telephone surveys of participating households.*

Process Evaluation Findings

- *Participants are highly satisfied with Smart $aver.*
- *Smart $aver influences energy efficiency contracting services.*
- *Trade allies are Smart $aver's most successful marketing channel.*
- *Trade ally satisfaction is moderately low, particularly with: portal/application process and quality install process*

Appendix B Measure Impact Results

Table B-1 Program Year 2016 Verified Impacts by Measure

Measure	Gross Energy Savings per unit (kWh)	Gross Summer Coincident Demand per unit (kW)	Gross Winter Coincident Demand per unit (kW)	Free Ridership	Spillover	Net to Gross Ratio	Measure Life
Central Air Conditioner	225	0.123	0.167	0.38	0.05	0.67	15
Heat Pump	490	0.149	0.213	0.38	0.05	0.67	15
Quality Install	13	0.005	0.004	0.38	0.05	0.67	10
Smart Thermostat	244	0.000	0.000	0.38	0.05	0.67	11
Attic Insulation & Air Seal	824	0.221	0.399	0.38	0.05	0.67	20
Variable Speed Pool Pump	1,581	0.527	0.000	0.38	0.05	0.67	10
Heat Pump Water Heater	1,616	0.000	0.000	0.38	0.05	0.67	10
Duct Sealing	438	0.162	0.153	0.38	0.05	0.67	18
Duct Insulation	634	0.234	0.222	0.38	0.05	0.67	20

Appendix C Survey Instruments

C.1 Trade Ally In Depth Interview

Introduction

Hi, I'm ____ calling from Research Into Action on behalf of Duke Energy Carolinas. We are evaluating the SMART $AVER program and we are looking to speak with contractors like yourself who have been particularly active in the program. Our program records indicate that your firm completed several projects this year for which a customer received an incentive from Duke Energy Carolinas SMART $AVER program, is that correct? And are you knowledgeable about those incented projects?

[If "no," ask to speak to someone who is knowledgeable about SMART $AVER work]

Your participation in this study is very important to Duke Energy Carolinas – this is your chance to tell us what is working well, what isn't, and how Duke Energy Carolinas can improve the program to better serve you and your customers. Do you have time to speak on the phone with me today about your experiences in the program?

Great. Rest assured, your answers will be kept strictly confidential and will not be tied to you or your firm. Is it okay if I record our conversation for note keeping purposes? [IF NEEDED: It is just so I can go back and clean up my notes after we are done talking, as to ensure I accurately captured everything you said.]

Background

Q1. My records show your company provides [PIPE IN SERVICES OFFERED: HVAC, plumbing, shell] services through SMART $AVER. Is that correct?

Q2. Have you completed any **new construction** projects that received incentives from the Smart Saver program?

Awareness and Engagement

Q3. How do you explain the value of energy efficiency upgrades to your customers? What are some successful strategies?

Q4. [ASK IF INSTALLED HVAC] Thinking about all customers – including those that do and don't go through the program, what are the primary reasons your customers replace their HVAC equipment?

[ASK IF INSTALLED HPWH] Thinking about all customers – including those that do and don't go through the program, what are the primary reasons your customers replace their water heaters?

[ASK IF INSTALLED POOL PUMPS] Thinking about all customers – including those that do and don't go through the program, what are the primary reasons your customers install ENERGY STAR efficient pool pumps that are equipped with variable speed drives? What proportion of efficient pool pump sales are replacing used pool pumps (as compared to pool pumps that go into newly constructed pools)?

[ASK IF INSTALLED ATTIC/DUCT INSULATION] Thinking about all customers – including those that do and don't go through the program, what are the primary reasons your customers insulate and seal their attics and ducts?

Q5. How did your company learn about the SMART $AVER program?

Q6. About what proportion of your SMART $AVER customers knew about the program prior to you mentioning it? [IF NEEDED: about what proportion of your SMART $AVER customers requested SMART $AVER rebates before you had a chance to mention them?]

Q7. Duke Energy conducts various marketing efforts to promote the SMART $AVER program to your customers. Would you say the program has the right amount, too much, or too little marketing?

Q8. How do you think Duke Energy Carolinas could improve their marketing and outreach efforts?

Q9. What does your company do to market the SMART $AVER program?

Q10. How can Duke better support your SMART $AVER marketing efforts?

Q11. Have you attended any orientations or training events from Duke Energy Carolinas? If yes: What events did you attend? Did the training provide you with information you found useful? Is there anything that you wish had been discussed in the training, but was not?

Q12. Would you like additional training opportunities to help your team more effectively sell rebated equipment? [*Probe: What type of training: sales/marketing training?*]

Q13. Tell me about your thoughts and experiences with the new online application system. (How has it improved or worsened the application process?)

Q14. Do you ever use the program's online portal for contractors for reasons other than submitting rebate applications? If so, for what? Is it helpful? Could it use improvement?

Q15. A new company, Blackhawk Engagement Solutions, is implementing the program now (they take care of rebate application processing, fulfillment and the program call center). How has this affected your experience in the program, if at all?

Q16. How satisfied are you with your Duke Energy Trade Ally Representative? (IF NEEDED: Please explain why you said that)

Trade Ally Program Experience

Q17. What are the challenges you've experienced in the program?

Probes:

- QA audit process (common fails? QA process is cumbersome?)
- Variety of measures offered
- Customer participation rates
- Rebate application process
- Delays
- Communications with Duke Energy and implementer
- Other

Q18. Do you have any suggestions on how to improve the program process?

Program Satisfaction

Q19. What do you like best about the program?

Q20. What do you like least about the program?

Market Changes

Q21. What new energy efficient technologies do you see taking off in the near future? What are your customers asking for? Are there any energy efficient technologies you think would sell better if Duke offered incentives for them? If so, what?

HVAC Offerings [ASK IF HVAC CONTRACTOR]

As you may know, Duke Energy offers additional rebates for HVAC rebate customers who also install smart thermostats that connect to the internet.

Q22. Has this rebate affected the number of smart thermostats you install each year? If so, by how much?

Q23. How, if at all, has the smart thermostat rebate influenced you to recommend smart thermostats to your customers?

Q24. Do you think the smart thermostat rebate has any influence on a consumer's decision to replace their HVAC system?

Duke Energy now offers higher rebates for central air-conditioners and heat pumps that are above SEER 16.

Q25. Thinking of these higher incentives, how, if at all, have they helped you sell more central air-conditioners that are above SEER 16?

Q26. How, if at all, have the higher incentives helped you sell more air-source heat pumps that are above SEER 16?

Q27. Duke Energy also now offers higher rebates for "quality installs" of central air-conditioners and heat pumps. [IF NEEDED: On qualified HVAC replacement, a quality install checklist must be performed to ensure 90 percent net capacity has been achieved at time of installation as rated by AHRI.].

a) Have you done any quality install rebate projects yet?

b) How, if it all, has the "quality install" rebate changed the way you install heat pumps and air conditioners?

c) What kind of metrics were you using previously to verify the system was correctly installed? (static pressure, rated capacity for system, etc.?)

d) How did you all internally document quality installation metrics before the program provided the checklist?

Q28. How, if at all, has the "quality install" rebate changed the way you install air conditioners?

Closing

Q49. Thanks so much for your time today. Are there any other comments you would like to provide?

C.2 Trade Ally Survey

Introduction

Hi, I'm ____ calling from Nexant on behalf of Duke Energy. May I speak with whomever is most knowledgeable about the rebated [MEASURE LIST] that your firm has installed through the Duke Energy Smart Saver rebate program?

[*If needed*:] I need to speak with someone who is knowledgeable about the sales and installation process – which is typically an installer or sales person]

[*Once appropriate contact is one phone*]

We want to get some feedback on how the Smart $aver Duke Energy program is working for your firm - this is your chance to tell us what is working well, what isn't, and how Duke Energy can improve the program to better serve you and your customers. Is this a good time to talk?

[*If needed*:]

- The survey takes about 15 minutes, depending on how much we have to discuss.
- If now isn't a good time, when could I call you back?

Please note that this call may be monitored or recorded for quality assurance purposes. Rest assured, your answers will be confidential and not tied to you or your firm.

Screening [Ask All]

[Base: All respondents]

S1. How many locations does your company have?

1. One
2. Two
3. Three
4. Four
5. Five
6. More than five [*Interviewer, make sure to record the exact number of locations if this option is checked*:] ______________

98. Don't Know
99. Refusal

[ASK IF S1>1]

S2. We would like to talk today about the projects that were sold and installed by the [**PIPE IN ADDRESS**] location. Are you able to speak to the work associated with that location?

1. YES [CONTINUE]
2. NO [*Ask to speak with alternative appropriate person*]

98. Don't know [*Ask to speak with alternative appropriate person*]
99. Refused [*Thank and terminate*]

[*Read preface to all*:] Please note when I mention Duke I am referring only to Duke Energy Carolinas.

S3. Does your firm primarily focus on new construction or existing home projects?

1. New construction projects [*Thank and terminate*]
2. Existing homes
3. Both

98. Don't know [*Ask to speak with alternative appropriate person*]
99. Refused [*Thank and terminate, Record*]

Sources of Program Awareness

[Base: All respondents]

Q1. How did you first hear about Duke Energy Smart $aver rebate offers for HVAC equipment, variable speed pool pumps, insulation, and duct sealing?

1. Word-of-mouth (co-worker, another contractor)
2. Duke Energy website
3. Duke Energy program representative
4. TV/Radio/Newspaper/Billboard Ad
5. Event (home show, workshop, etc.)
6. Other, please specify: _______________
98. Don't know
99. Refused

Nonparticipant Spillover

[*READ PREFACE TO ALL*:]

Next, I will ask you some questions about the work your company did last year in Duke Energy territory, which is separate from Duke Energy Progress territory. When answering these questions, please only consider your work in Duke Energy territory, which includes communities in western North Carolina and the Northwestern parts of South Carolina.

[IF 0>1, DISPLAY:] [*Interviewer read*:] Remember, please only consider projects associated with the [**PIPE IN ADDRESS**] location when answering questions.

[START LOOP – LOOP THROUGH TOP THREE MOST INSTALLED MEASURE TYPES THAT TRADE ALLIES INSTALLED SINCE APRIL OF 2016]

[Base: All respondents]

Q2. Since August of 2016, about what proportion of the [**MEASURE**] jobs that your company did in Duke territory would have qualified for a Duke rebate? [If needed: Your best estimate is fine.] [*Interviewers: Record a number. if they give a range, record a mid-point of that range. For example, if they say 80 to 90%, input 85%.*]

1. [Record response]

[*Do not read*:]

98. Don't Know
99. Refused

[Base: All respondents]

Q3. And since August 2016, what percent of all your Duke rebate qualified [MEASURE] projects did you actually apply for a rebate? [If needed: Your best estimate is fine.] *[Interviewers: Record a number. if they give a range, record a mid-point of that range. For example, if they say 80 to 90%, input 85%.*]

1. [Record response]

[*Do not read*:]

98. Don't Know
99. Refused

Q4. About what proportion of your rebate qualifying [**MEASURE**] customers specifically requested the [**MEASURE**] on their own and were not influenced by your recommendation? [If needed: Your best estimate is fine.]

1. [*Record percent*]

[*Do not read*:]

98. Don't Know
99. Refused

Q5. Using a 0 to 10 scale, where 0 is "not at all influential" and 10 is "extremely influential," how much influence has the Duke program had on your business practice of recommending rebate qualifying [**MEASURE**] to your customers?

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

[END LOOP]

Program Influence and Effects on TAs

[BASE: TRADE ALLIES THAT INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, POOL PUMPS, OR WATER HEATERS]

Q6. Thinking back to before you were involved in the Duke Energy program, how often did you recommend higher efficiency equipment that uses less energy than standard models to your customers? Would you say none of the time, some of the time, most of the time, or every time?

[SINGLE RESPONSE]

1. None of the time
2. Some of the time
3. Most of the time
4. Every time
97. Not applicable – I've been involved with the Duke program since starting in the industry/this company
98. Don't know
99. Refused

[BASE: TRADE ALLIES THAT INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, POOL PUMPS, OR WATER HEATERS]

Q7. And what about now? [*If needed:* Currently, how often do you recommend higher efficiency equipment that uses less energy than standard models to your customers? Would you say none of the time, some of the time, most of the time, or every time?]

[SINGLE RESPONSE. DO NOT READ]

1. None of the time
2. Some of the time
3. Most of the time
4. Every time
98. Don't know
99. Refused

[BASE: ALL RESPONDENTS]

Q8. Would you say your knowledge of energy efficient products and services has increased, decreased, or stayed about the same since you became involved with the program?

[SINGLE RESPONSE]

1. Increased
2. Decreased

3. Stayed about the same
98. Don't know
99. Refused

[ASK IF Q8 =1]

Q9. Using a 0 to 10 scale, where 0 is “not at all influential” and 10 is “extremely influential,” how much influence has Duke Energy program had on your increased knowledge of energy efficient products and services?

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don’t Know
99.	Refused

Code Changes

[READ PREFACE IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS OR AIR SOURCE HEAT PUMPS]

As you may know, a new code for air conditioners and air source heat pumps was enforced in 2015 – the minimum SEER went from 13 to 14.

[Base: IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS]

Q10. How much more difficult or easier is it to sell 15 SEER central air conditioners now that the code is 14 SEER? Would you say it is: [READ FIRST FIVE RESPONSE OPTIONS:]

1. Much more difficult
2. Somewhat more difficult
3. No different
4. Somewhat easier
5. Much easier

[*Do not read*:]

97. Do not sell SEER 15
98. Don't know
99. Refused

[Base: IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS]

Q11. How much more difficult or easier is it to sell 15 SEER HVAC heat pumps now that the code is 14 SEER? Would you say it is:

[*Read*:]

1. Much more difficult
2. Somewhat more difficult
3. No different
4. Somewhat easier
5. Much easier

[*Do not read*:]

97. Do not sell SEER 15
98. Don't know
99. Refused

New Incentives

[Base: IF CONTRACTOR INSTALLED SMART THERMOSTATS]

Q12. As you may know, Duke Energy offers a rebate for smart thermostats. By how much did your installations of smart thermostats increase since Duke began offering smart thermostat rebates? Would you say…

[*Read*:]

1. No increase
2. Some increase
3. A large increase

[*Do not read*:]

98. Don't know
99. Refused

[Base: IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS OR AIR SOURCE HEAT PUMPS]

[*Before asking Q13 and Q14, read*:] As you also may know, Duke Energy started to offer higher rebates for central air-conditioners and heat pumps that are above 14 SEER.

[Base: IF INSTALLED CACS]

Q13. Thinking of these higher incentives, did those help you sell more central air-conditioners that are 15 SEER or higher?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF INSTALLED AIR SOURCE HEAT PUMPS]

Q14. Thinking of these higher incentives, did those help you sell more air-source heat pumps that are 15 SEER or higher?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF PERFORMED QUALITY INSTALLS]

Q15. As you may know, Duke Energy recently added “quality install” requirements for installations of heat pumps and air conditioners? Were you already doing all the techniques on the quality install check list prior to Duke requiring them?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF Q15=1]

Q16. Prior to using Duke’s quality install checklist, did you have a system in place to document that your installers were following these same quality install techniques?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF Q15=1]

Q17. Prior to using Duke’s quality install checklist, what specific quality install techniques were you using? Please be as specific as possible.

[*Multiple response, do not read*:]

1. System capacity
2. Airflow / static pressure
3. System CFM (cubic feet per minute)
4. Condenser measurements
5. Enthalpy conversion
6. Blower door tests
7. Duct blaster tests
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[Base: IF PERFORMED QUALITY INSTALLS ON TIER 2 OR TIER 3 HVAC MEASURES]

Q18. I have a question about your Duke Energy tier 2 and tier 3 HVAC jobs – these are the ones where the quality installation check list is not required, so quality installations get the customer an additional $60 rebate. Do you charge your customers extra on the invoice for completing the quality installation rebate checklist on tier 2 and tier 3 HVAC jobs?

1. Yes
2. No
98. Don't know
99. Refused

[Base: IF PERFORMED QUALITY INSTALLS]

Q19. Do you have any suggestions on how Duke Energy could improve the quality install requirements?

1. [*Record response*]
98. Don't know
99. Refused

Challenges and Suggestions for Improvement

[Base: All respondents]

Q20. What energy efficient products, technologies, or services should be added to the Duke Energy Progress rebate program? [*Do not read: Choose all that apply*.] [MULTIPLE RESPONSE]

1. Modulating furnaces
2. Heat recovery ventilation (HRV) systems
3. Boilers
4. Furnaces equipped with electronically commutated motor (ECM) furnaces

5. Tankless water heaters
6. Humidifiers
7. Air handlers
8. Windows
9. Doors
10. No others should be added
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[Base: All respondents]

Q21. Have you attended any orientations or training events from Duke Energy Carolinas?

1. Yes
2. No
98. Don't know
99. Refused

[BASE: IF Q21=1]

Q22. What topics were covered in the last Duke Energy event you attended?

1. [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[BASE: IF Q21=1]

Q23. On a scale from 0 to 10, where 0 is “not at all helpful” and 10 is “extremely helpful,” how helpful was the last Duke Energy event you attended?

1. Yes
2. No
98. Don't know
99. Refused

[Base: All respondents]

Q24. What types of training, if any, would you be interested in receiving from Duke Energy?

1. [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[Base: All respondents]

Q25. On a scale from 0 to 10, where 0 is “not at all interested” and 10 is “extremely interested,” how interested would you be in a training course on how to more effectively sell high efficiency equipment to your customers if it was offered by the program?

[SINGLE RESPONSE]

0.	0. Not all interested
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely interested
98.	Don’t Know
99.	Refused

[Base: All respondents]

Q26. How often do your customers ask about the Duke Energy rebates before you’ve had the chance to bring them up? Would you say…

[*Read*:]

1. Never
2. Rarely
3. Occasionally
4. Frequently, or
5. Always

[*Do not read*:]

98. Don’t Know
99. Refused

[Base: All respondents]

Q27. Since Duke transitioned to the online application system in April 2016, how frequently have you experienced problems or frustrations with the rebate application process? Would you say…

[*Read*:]

1. Never
2. Rarely
3. Occasionally
4. Frequently, or
5. Always

[*Do not read*:]

98. Don't Know
99. Refusal

[ASK IF Q27=2-5]

Q28. What types of problems or frustrations did you experience?

1. [*Record response*]

[*Do not read*:]

98. Don't Know
99. Refusal

[ASK IF Q27=2-5]

Q29. Overall, have these problems persisted or gotten better over time? Would you say these problems have:

[*Read*:]

1. Persisted
2. Gotten somewhat better, or
3. Have been completely resolved at this point

[*Do not read*:]

98. Don't Know
99. Refusal

[Base: All respondents]

Q30. Do you have any suggestions on how Duke Energy could improve the rebate application process?

1. [*Record response*]
98. Don't Know
99. Refusal

[Base: All respondents]

Q31. Do you have any suggestions on how Duke Energy could improve the project inspection process?

1. [*Record response*]

[*Do not read*:]

98. Don't Know
99. Refusal

Satisfaction

[Preamble:]

Thanks for your feedback so far, next I have some questions about your satisfaction with the program.

[Base: All respondents]

Q32. Please rate the extent to which you are satisfied with the following aspects of the program using a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." How satisfied are you with:

A	Program training offered by Duke Energy
B	Your Duke Energy Trade Ally Representative
C	The program website for customers
D	The trade ally portal application tracking system
E	The marketing of the program
F	The incentive application submission process
G	The selection of eligible equipment and services
H	The overall program

[Single Response on Each A-H Item]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[BASE: ASK IF Q32 < 5]

[**PROGRAMMER'S NOTE:** REPEAT Q33 FOR EACH STATEMENT FROM Q32 WHERE Q32<5]

Q33. Please explain why you were dissatisfied with [**INSERT STATEMENT FROM Q32 A-H**]:

1. [*Record response*]
98. Don't Know
99. Refusal

Closing

[Base: All respondents]

Q34. Thanks so much for your time today. Are there any other comments you would like to provide?

1. [*Record response*]

C.3 Participant Survey

Introduction

[*READ IF CONTACT NAME IS KNOWN:*] Hello, may I speak with _____. [*READ IF NAME IS UNKNOWN*] Hi, my name is ___________from Nexant. I'm calling on behalf of Duke Energy. Our records show that you received a rebate for [**LIST ALL MEASURES**] from the Duke Energy Smart $aver Program.

[*INTERVIEWER – IF PERSON ON PHONE IS UNAWARE OF THE REBATED WORK, ASK TO SPEAK WITH SOMEONE IN THE HOME WHO MIGHT RECALL RECEIVING A REBATE FROM DUKE ENERGY.*

IF PERSON ON PHONE SAYS THEY ARE RENTER (AND/OR THEIR LANDLORD OR PROPERTY MANAGER WAS RESPONSIBLE FOR THE PROJECT), ASK FOR LANDLORD/PROPERTY MANAGER'S NAME AND PHONE NUMBER AND USE THAT AS THE NEW POINT OF CONTACT]

Duke Energy would like your feedback about the work that was done to the home/property through the program as well as feedback on your experience with the program. Is now a good time to talk?

[*IF NEEDED*]*:* The survey will take about 10 to 15 minutes, depending on the details you have for us.

[*IF NEEDED*: *SCHEDULE A TIME TO CALL THEM TO COMPLETE THE SURVEY*]

Please note that this call may be monitored or recorded for quality assurance purposes.

Building Type Confirmation

[ASK ALL]

Q1. I'm going to read a list of building types. Please stop me when I mention the building type that best describes the residence where this work was done. [*READ LIST*]

[SINGLE RESPONSE]

1. Single-family detached home [*IF NEEDED: NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK*]
2. Factory manufactured single family home
3. Row house or town house
4. Duplex
5. Triplex [*IF NEEDED: building with three units*]
6. Apartment or condo building with four or more units
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[PROGRAMMER: IF 0=1-2, BUILDING TYPE=SF. IF 0=3-6, BUILDING TYPE=OTHER. IF 0=96-99, USE PRE-CODED BUILDING TYPE FROM LIST]

Sources of Program Information

[ASK ALL]

Q2. How did you hear about the Duke Energy Smart $aver **rebate(s)** that you received? *[RECORD VERBATIM]*

[ASK ALL]

Q3. Are you familiar with other energy-efficiency rebates that Duke Energy offers, aside from the **[LIST ALL MEASURES THEY RECEIVED FROM SMART $SAVER PROGRAM]** rebate(s)?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF 0= 1 (Yes)]

Q4. Which other rebates are you familiar with? *[Do not read list]* [PROGRAMMER: EXCLUDE THE REBATES THAT THEY RECEIVED FROM THE LIST BELOW]

[MULTIPLE RESPONSE]

1. Heat pump water heater rebate
2. Heating and cooling system rebate
3. Geothermal heat pump rebate
4. Smart Wi-Fi enabled thermostat rebate
5. Attic Insulation and Air Seal rebate
6. Duct sealing and insulation rebate
7. In-home energy audit
8. Pool pump rebate
9. Power Manager bill discounts (for allowing Duke Energy to ramp down air-conditioning during peak usage events)
10. Discounted efficient lighting (CFLs, LEDs, and specialty bulbs)
11. Other – please specify: [OPEN-ENDED RESPONSE]
98. Don’t know
99. Refused

[ASK IF 0= 1 (Yes)]

Q5. Have you received any of these other rebates?

[SINGLE RESPONSE]

1. Yes
2. No

98. Don't know
99. Refused

[ASK IF 0= 1 (Yes) AND Q4 <>98 OR 99 AND MORE THAN ONE ITEM SELECTED IN 0; IF ONLY ONE ITEM SELECTED IN 0 (AND Q4 <>98 OR 99) AND 0=1, AUTOCODE 0 RESPONSE FOR 0]

Q6. Which rebate(s) did you receive? *[Do not read list]*

[MULTIPLE RESPONSE]

1. Heat pump water heater rebate
2. Heating and cooling system rebate
3. Geothermal heat pump rebate
4. Smart Wi-Fi enabled thermostat rebate
5. Attic Insulation and Air Seal rebate
6. Duct sealing/insulation rebate
7. In-home energy audit
8. Pool pump rebate
9. Power Manager bill discounts (for allowing Duke Energy to ramp down air-conditioning during peak usage events)
10. Discounted efficient lighting (CFLs, LEDs, and specialty bulbs)
11. Other – please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Program Influence

[ASK IF 0= 1 (Yes)]

Q7. Did you receive the [**Insert rebated measures from 0**] before or after [**PROJECT #1 LIST**] work was done? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN 0]

[SINGLE RESPONSE]

1. Before
2. After
3. Both before and after
4. At the same time
98. Don't know
99. Refused

[ASK IF 0= 2 or 3 (“After” or “Both before and after”)]

Q8. Using a scale from 0 to 10, where 0 means “Not at all influential” and 10 means “Extremely influential,” how influential was the rebate for [**PROJECT #1 LIST**] in your decision to take advantage of Duke Energy’s [**Insert response from 0**]? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN 0 WHERE RESPONSE TO 0=2 (“After”) OR 0=3 (“Both before and after”)]

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

[ASK IF RESPONDENT HAS A **PROJECT #2 LIST**]

Q9. Using a scale from 0 to 10, where 0 means "Not at all influential" and 10 means "Extremely influential," how influential was the rebate for [**PROJECT #1 LIST**] in your decision to take advantage of additional Duke Energy rebates for [**PROJECT #2 LIST**]?

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

Motivations

We'd like to know what motivated you to complete the work we've been talking about that was rebated through the Duke Energy Smart $aver Program.

[ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED]

Q10. [IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS INSTALLED, READ:] Which of the following best describes the condition of the previous HVAC system that you replaced with a [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]?

[IF CENTRAL AIR CONDITIONER WAS INSTALLED, READ:] Which of the following best describes the condition of the previous air conditioner that you replaced?

[*READ* – MULTIPLE RESPONSE]

1. It was broken or malfunctioning
2. It was getting old, or
3. It was in good working condition

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Q11. [ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED] Approximately, how many years old was the previous HVAC unit that you replaced with your new [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] [*RECORD VERBATIM*]

[ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP, HEAT PUMP WATER HEATER WAS INSTALLED]

Q12. What motivated you to install an **energy efficient** system rather than a less efficient one that would use more energy? [*RECORD VERBATIM*]

Q13. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] I'd like to know how you selected the specific make and model of the [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP] you purchased. Would you say that you chose it…

[READ LIST; SINGLE RESPONSE]

1. Yourself, based entirely on your own research?
2. From a list of options provided by the contractor?
3. Because it was the only option recommended by your contractor?

[*Do not read*:]

96. In some other way, please specify: [RECORD OPEN-ENDED RESPONSE]

98. Don't know
99. Refused

Q14. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] Suppose the contractor that installed your [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] did not offer high efficiency [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**]s that qualify for Duke rebates. Which of the following is most likely what you would have done? [*READ RESPONSE OPTIONS, SINGLE RESPONSE*]

1. You would have installed the cheaper less efficient unit that would not have qualified for rebates if that's all your contractor offered, or
2. You would have looked for a contractor that could install a rebate-qualified high efficiency unit

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q15. Which of the following best describes the old thermostat that you replaced?

[*READ* – SINGLE RESPONSE]

1. Manual non-programmable thermostat,
2. Programmable thermostat that *does not* communicate with your wi-fi network, or
3. Programmable thermostat that communicates with your wi-fi network

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q16. Thinking of your old thermostat, at what temperature was that thermostat typically set in the winter?

1. *Record temperature setting/response here*: ____________
98. Don't know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q17. And what about your new wifi thermostat? At what temperature is the new thermostat typically set in the winter?

1. *Record temperature setting/response here*: ____________
98. Don't know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q18. If you used your old thermostat to control air conditioning, at what temperature was your old thermostat typically set in the summer for air conditioning?

1. *Record temperature setting/response here*: ____________
2. Did not use my old thermostat to control air conditioning
98. Don’t know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED AND Q18<>2]

Q19. And what about your new wifi thermostat? At what temperature is the new thermostat typically set in the summer?

1. *Record temperature setting/response here*: ____________
98. Don't know
99. Refused

[ASK IF SMART THERMOSTAT WAS INSTALLED]

Q20. What motivated you to install a wi-fi enabled thermostat? [*RECORD VERBATIM*]

[ASK IF HVAC TIER = 2 OR 3, AND QUALITY INSTALL REBATE WAS RECEIVED]

Q21. Program records show that you received an additional $60 rebate for a quality installation from your contractor. This additional rebate was included on the VISA gift card you received in the mail from Duke Energy. This rebate was for additional work your contractor did to ensure that your new [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] was installed to run as efficiently as possible. Prior to today, were you aware that you received a quality installation rebate?

1. Yes
2. No

[*Do not read*:]

98. Don’t know
99. Refused

[ASK IF Q21=1]

Q22. Prior to talking with the contractor that installed the [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**], were you aware of quality installation practices that ensure the [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP**] is installed to run as efficiently as possible?

1. Yes – I was already familiar with quality installation practices
2. No – I was not previously familiar with quality installation practices

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know

[ASK IF Q21=1]

Q23. Did your contractor let you choose between a standard installation service that was not eligible for the additional rebate and a quality installation that would get you an additional rebate from Duke Energy?

1. Yes – they let me choose between standard and quality
2. No – they did not give me a choice

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q24. Which of the following best describes the condition of the previous water heater that you replaced?

[*READ* – MULTIPLE RESPONSE]

1. It was broken or malfunctioning
2. It was getting old, or
3. It was in good working condition

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Q25. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] Approximately, how many years old was the previous water heater that you replaced with your new heat pump water heater? [*RECORD VERBATIM*]

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q26. Where did you install your new heat pump water heater?

1. Garage
2. Basement
3. Closet
4. Laundry room

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED and IF Q26<>98 or 99]

Q27. Do you use your HVAC system to heat and cool the [PIPE IN ANSWER FROM Q26] where the heat pump water heater is located?

1. Yes
2. No

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Q28. [ASK IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS **NOT** INSTALLED] What type of system do you use to heat your home? [Multiple response allowed]

1. Heat pump
2. Electric baseboard heaters
3. Natural gas furnace
4. Plug in space heaters
5. Cadet wall heaters

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS **NOT** INSTALLED]

Q29. What type of system do you use to cool your home? [Multiple response allowed]

1. Central air conditioner
2. Heat pump
3. Room/window air conditioner
4. Evaporative/swamp cooler
5. I do not have any air conditioning in my home

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Q30. What motivated you to install an **energy efficient** water heater rather than a less efficient one that would use more energy? [*RECORD VERBATIM*]

[ASK IF DUCT SEALING OR INSULATION WAS PERFORMED/INSTALLED]

Q31. What motivated you to [IF DUCT SEALING WAS PERFORMED, READ: repair your ductwork; IF ATTIC INSULATION WAS INSTALLED, READ: add insulation to your attic]? [*RECORD VERBATIM*]

[ASK IF POOL PUMP WAS INSTALLED]

Q32. What motivated you to install an ENERGY STAR pool pump? [*RECORD VERBATIM*]

[ASK IF POOL PUMP WAS INSTALLED]

Q33. Approximately what month do you first open your pool for the season?

1. January
2. February
3. March
4. April
5. May
6. June
7. July
8. August
9. September
10. October
11. November
12. December

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know
99. Refused

[ASK IF POOL PUMP WAS INSTALLED]

Q34. Approximately what month do you close your pool for the season?

1. January
2. February
3. March
4. April
5. May
6. June
7. July
8. August
9. September
10. October
11. November
12. December

[*Do not read*:]

96. Other, please specify: [[OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Free-ridership

I'd like to ask a few questions about what you most likely would have done had you not received assistance from Duke Energy for the **[LIST ALL MEASURES]**.

[ASK IF THEY INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP]

Q35. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [*READ LIST*]

[SINGLE RESPONSE]

1. Would not have installed the **[PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]** and would have just continued using your old system
2. Would have postponed the purchase for at least one year
3. Would have bought a less expensive or less energy efficient system
4. Would have bought the exact same [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP**], and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q35= 3]

Q36. You said you would have bought a/an [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP**] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy. Do you think it is more likely that you would have bought equipment that was…?

1. Almost as efficient as the one you bought, or
2. Significantly less efficient than the one you bought

[*Do not read*:]

98. Don't know
99. Refused

[ASK IF Q21=1]

Q37. If Duke Energy did not offer the additional rebate for quality installation services, would you have allowed your contractor to perform a quality installation service that ensured the [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP**] was performing as efficiently as possible, even if it meant you had to pay more money?

[SINGLE RESPONSE]

1. Yes – I would have allowed quality installation if no rebates were available
2. No – I would not have allowed quality installation if no rebates were available

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q21=1]

Q38. If Duke Energy did not offer the additional rebate for quality installation services and your contractor did not offer you the service in their initial bid, would you have demanded that your contractor perform a quality installation service that ensured the [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP**] was performing as efficiently as possible, even if it meant you had to pay more money?

[SINGLE RESPONSE]

1. Yes – I would have demanded quality installation if no rebates were available and my contractor did not initially offer it
2. No – I would not have demanded quality installation if no rebates were available and my contractor did not initially offer it

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF THEY INSTALLED: SMART THERMOSTAT]

Q39. Now we want to ask you about the smart thermostat you got with your [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP**]. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [*READ LIST*]

[SINGLE RESPONSE]

1. Would not have purchased the wi-fi enabled thermostat
2. Would have postponed the purchase of the wi-fi thermostat for at least one year
3. Would have installed some other type of thermostat, or
4. Would have bought the exact same wi-fi thermostat, and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q39=3]

Q40. What type of thermostat would you have bought then? Would you have bought… [*READ*]

1. A manual non-programmable thermostat, or
2. A programmable thermostat that is <u>*not*</u> wi-fi enabled

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don’t know
99. Refused

[ASK IF THEY INSTALLED: HEAT PUMP WATER HEATER]

Q41. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [*READ LIST*]

[SINGLE RESPONSE]

1. Would not have replaced my water heater
2. Would have postponed the water heater replacement for at least one year
3. Would have bought a less expensive or less energy efficient water heater, or
4. Would have bought the exact same high efficiency Heat Pump Water Heater, and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q41=3]

Q42. You said you would have bought a water heater that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy. Do you think it is more likely that you would have bought equipment that was…?

1. Almost as efficient as the one you bought, or
2. Significantly less efficient than the one you bought

[*Do not read*:]

98. Don’t know
99. Refused

[ASK IF THEY UPGRADED: ATTIC INSULATION]

Q43. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

1. Would not have done the attic insulation
2. Put off doing attic insulation for at least one year
3. Would have added less insulation
4. Would have done the exact same upgrade, and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q43=3]

Q44. You said you would have added less insulation if you had not received the rebate or information from Duke Energy. How much less insulation would you have purchased? Please answer in a percentage, such as “50% less.”

1. [*RECORD VERBATIM*:] _______________
98. Don’t know
99. Refused

[ASK IF THEY DID DUCT SEALING]

Q45. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [*READ LIST*]

[SINGLE RESPONSE]

1. Would not have had ducts sealed, insulated, or repaired
2. Would have postponed the work for at least one year
3. Would have had the exact same work done, and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF THEY INSTALLED A VARIABLE SPEED POOL PUMP]

Q46. Which of the following statements best describes the actions you would have taken if Duke Energy rebates and information were not available: [*READ LIST*]

[SINGLE RESPONSE]

1. Would not have installed or replaced the pool pump
2. Would have postponed the installation of the pool pump for at least one year
3. Would have bought a less expensive or less energy efficient pool pump, or
4. Would have had the exact same high efficiency pool pump installed, and paid the full cost yourself

[*Do not read*:]

96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK ALL]

Q47. Using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential" how influential were the following factors on your decision to purchase the [**MEASURE**]? *How influential was…*

[*INTERVIEWER NOTE: IF RESPONDENT SAYS 'NOT APPLICABLE; I DIDN'T GET/USE THAT,' THEN FOLLOW UP WITH: "So would you say it was "not at all influential?" AND PROBE TO CODE*] [MATRIX QUESTION: SCALE]

Elements	0 – Not at all influential	1	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF
The rebate you received													
Information or advertisements from Duke Energy, including their website													
Recommendation from your contractor													
Did anything else influence you? If so, please specify: ______________ [*INTERVIEWER: PROBE IF UNCLEAR. RECORD VERBATIM RESPONSE*]													

[PROGRAMMER: REPEAT Q47 FOR EACH MEASURE IN MEASURE LIST. WHEN REPEATING, CALLERS CAN USE ABBREVIATED LANGUAGE (E.G.: "AND FOR THE INSULATION, HOW INFLUENTIAL WAS…"]

Spillover

Q48. Since receiving your rebate from Duke Energy for the [LIST ALL SMART $AVER MEASURES], have you purchased any other products or services to help save energy in your home?

1. Yes
2. No
98. Don't know

[If Q48= 1]

Q49. What **products** have you purchased and installed to help save energy in your home?

[*Do not read list. After each response, ask, "Anything else?"*] [MULTIPLE RESPONSE]

1. Bought energy efficient appliances
2. Moved into an ENERGY STAR home [*VERIFY: "Is Duke Energy still your gas or electricity utility?" Yes/No*]
3. Bought efficient heating or cooling equipment
4. Bought efficient windows

5. Added insulation
6. Sealed air leaks in windows, walls, or doors
7. Sealed or insulated ducts
8. Bought LEDs
9. Bought CFLs
10. Installed an energy efficient water heater
11. None – no other actions taken [*EXCLUSIVE ANSWER*]
96. Other, please specify: ____________________
98. Don't know [*EXCLUSIVE ANSWER*]

[ASK IF Q49<>11, 98, OR 99]

Q50. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones? [MULTIPLE RESPONSE]

[LOGIC] Item
[IF Q49.1 IS SELECTED] 1. Bought energy efficient appliances
[IF Q49.2 IS SELECTED] 2. Moved into an ENERGY STAR home
[IF Q49.3 IS SELECTED] 3. Bought efficient heating or cooling equipment
[IF Q49.4 IS SELECTED] 4. Bought efficient windows
[IF Q49.5 IS SELECTED] 5. Bought additional insulation
[IF Q49.6 IS SELECTED] 6. Sealed air leaks in windows, walls, or doors
[IF Q49.7 IS SELECTED] 7. Sealed or insulated ducts
[IF Q49.8 IS SELECTED] 8. Bought LEDs
[IF Q49.9 IS SELECTED] 9. Bought CFLs
IF Q49.10 IS SELECTED] 10. Installed an energy efficient water heater
[IF Q49.96 IS SELECTED] **[Q49 open ended response]**
I did not get any Duke rebates [*EXCLUSIVE ANSWER*]
Don’t know [*EXCLUSIVE ANSWER*]

[ASK IF ANY ITEM IN Q49 WAS SELECTED]

Q51. On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how much influence did the [**LIST ALL SMART $AVER MEASURES**] rebate have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] Item	Response
[IF Q49.1 IS SELECTED] 1. Buy energy efficient appliances	0-10 scale with DK
[IF Q49.2 IS SELECTED] 2. Move into an ENERGY STAR home	0-10 scale with DK
[IF Q49.3 IS SELECTED] 3. Buy efficient heating or cooling equipment	0-10 scale with DK
[IF Q49.4 IS SELECTED] 4. Buy efficient windows	0-10 scale with DK
[IF Q49.5 IS SELECTED] 5. Buy additional insulation	0-10 scale with DK
[IF Q49.6 IS SELECTED] 6. Seal air leaks in windows, walls, or doors	0-10 scale with DK
[IF Q49.7 IS SELECTED] 7. Seal or insulate ducts	0-10 scale with DK
[IF Q49.8 IS SELECTED] 8. Buy LEDs	0-10 scale with DK
[IF Q49.9 IS SELECTED] 9. Buy CFLs	0-10 scale with DK
IF Q49.10 IS SELECTED] 10. Install an energy efficient water heater	0-10 scale with DK
[IF Q49.96 IS SELECTED] **[Q49 open ended response]**	0-10 scale with DK

[ASK IF Q49.1 IS SELECTED AND Q51.1 <> 0]

Q52. What kinds of appliance(s) did you buy?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Refrigerator
2. Stand-alone Freezer
3. Dishwasher
4. Clothes washer
5. Clothes dryer
6. Oven
7. Microwave
96. Other, please specify: ____________
98. Don’t know
99. Refused

[ASK IF Q52 = 1-96]

Q53. Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q52]

[ASK IF Q52 = 5]

Q54. Does the new clothes dryer use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don't know
99. Refused

[ASK IF Q49.3 IS SELECTED AND Q51.3 > 0]

Q55. What type of heating or cooling equipment did you buy?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Central air conditioner
2. Window/room air conditioner unit
3. Wall air conditioner unit
4. Air source heat pump
5. Geothermal heat pump
6. Boiler
7. Furnace
8. Wifi-enabled thermostat
96. Other, please specify: ________________
98. Don't know
99. Refused

[ASK IF Q55= 6-7]

Q56. Does the new [INSERT Q55 RESPONSE] use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don't know
99. Refused

[ASK IF Q55= 1-7, 96]

Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No

98. Don't know
99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q55, EXCLUDING wifi-enabled thermostat]

[ASK IF Q49.4 IS SELECTED AND Q51.4 > 0]

Q58. How many windows did you install?

1. [*RECORD VERBATIM* _______________]
98. Don't know
99. Refused

[ASK IF Q49.5 IS SELECTED AND Q51.5 > 0]

Q59. Did you add insulation to your attic, walls, or below the floor?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Attic
2. Walls
3. Below the floor
98. Don't know
99. Refused

[ASK IF Q59<>98-99]

[PROGRAMMER: REPEAT Q60 FOR EACH ITEM MENTIONED IN Q59]

Q60. Approximately what proportion of the [ITEM MENTIONED IN Q59] space did you add insulation?

1. [RECORD VERBATIM AS % - INPUT MID-POINT IF RANGE IS OFFERED:] _______________[IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.8 IS SELECTED AND Q51.8 > 0]

Q61. How many of LEDs did you install in your property?

1. [RECORD VERBATIM:] _______________ [IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.9 IS SELECTED AND Q51.9 > 0]

Q62. How many of CFLs did you install in your property?

1. [RECORD VERBATIM:] _______________ [IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]

Q63. Does the new water heater use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]

Q64. Which of the following water heaters did you purchase? [*read list*]

1. A traditional water heater with a large tank that holds the hot water
2. A tankless water heater that provides hot water on demand
3. A solar water heater
4. Other, please specify: _______________
98. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]

Q65. Is the new water heater an ENERGY STAR model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

How They Search for EE Information

[ASK ALL]

Q66. Where do you typically search for information on how to save energy in your property?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Online – read reviews about products
2. Go to utility website

3. Read my utility information – it has tips on how to save energy
4. Go to the store and talk to salespeople
5. Look for ENERGY STAR logo on products
96. Other, please specify: [OPEN-ENDED RESPONSE]
97. Not applicable – I don't typically search for information on how to save energy in my home/property
98. Don't know
99. Refused

Program Satisfaction and Challenges

The next few questions are about your satisfaction with the program.

[ASK ALL]

Q67. Using a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied," how satisfied were you with the rebate amount for [**LAST PROJECT**]? [SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK ALL]

Q68. How satisfied were you with how long it took to receive that rebate? Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." [SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK IF Q68<5 (Somewhat to Very Dissatisfied)]

Q69. Why did you give that rating? ________ [RECORD VERBATIM]

[ASK ALL]

Q70. In the course of participating in the Duke Smart $aver program, how often did you contact Duke Energy or program staff with questions?

[*Do not read list*] [SINGLE RESPONSE]

1. Never
2. Once
3. 2 or 3 times
4. 4 times or more
98. Don't know
99. Refused

[ASK IF Q70 = 2-4]

Q71. How did you contact them?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Phone
2. Email
3. Fax
4. Letter
5. In person

98. Don't know
99. Refused

[ASK IF Q70 =2-4]

Q72. Using that same scale, how satisfied were you with these communications? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK IF Q72<5 (Somewhat to Very Dissatisfied)]

Q73. Why did you give that rating? ________ [RECORD VERBATIM]

[ASK ALL]

Q74. Have you noticed any savings on your electric bill since the [**LAST PROJECT**] project?

[SINGLE RESPONSE]

1. Yes, they noticed savings
2. No - They looked but **did not** notice any savings
3. No - They looked but it is too soon to tell
4. They didn't look
98. Don't know
99. Refused

[ASK IF Q74= Yes (if noticed savings)]

Q74_B. How satisfied are you with any savings you noticed on your electric bill since the [**LAST PROJECT**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK ALL]

Q75. How satisfied are you with your [**LAST PROJECT**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."*] [*INTERVIEWER NOTE: IF RESPONDENT SAYS 'TOO SOON TO TELL,' THEN FOLLOW UP WITH: "So would you say you are "Neither satisfied nor dissatisfied?" or you just don't know yet AND PROBE TO CODE*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don’t Know
99.	Refused

[ASK IF Q75<5 (Somewhat to Very Dissatisfied)]

Q76. Why did you give that rating?

1. [*RECORD VERBATIM*] ________
98. Don't know
99. Refused

[ASK ALL]

Q77. How satisfied are you with the interaction with the contractors who worked on the [**LAST PROJECT**] project? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.”*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don’t Know
99.	Refused

[ASK IF Q77< 5 (Somewhat to Very Dissatisfied)]

Q78. Why did you give that rating?

1. [*RECORD VERBATIM*] ________
98. Don't know
99. Refused

Q79. How satisfied you are with Duke Energy’s overall performance as your electricity supplier? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.”*]

[SINGLE RESPONSE]

0.	0. Very dissatisfied.
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

Q80. Would you say that your participation in Duke Energy Smart $aver Rebate Program has had a positive effect, a negative effect, or no effect on your overall satisfaction with Duke Energy?

1. Negative effect
2. No effect
3. Positive effect
98. Don't know
99. Refused

[ASK ALL]

Q81. Finally, if you were rating your overall satisfaction with the Duke Energy Smart $aver Rebate Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? [SINGLE RESPONSE]

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat dissatisfied
5. Very dissatisfied
98. Don't Know
99. Refused

[ASK IF Q81 = 4 or 5]

Q82. Why do you give that rating? __________

[ASK ALL]

Q83. Do you have any suggestions to improve Duke Energy's Smart $aver Program?

1. [YES, *RECORD VERBATIM*] ________
2. No
98. Don't know
99. Refused

Demographics/Property Characteristics

Finally, I just need to ask you some questions about the residence where the rebated work was done.

[ASK ALL]

Q84. Do you live at this residence where the work was performed?

1. Yes
2. No
99. Refused

[ASK IF Q84=2]

Q85. Are you a property manager or an owner of the residence where the work was performed?

1. Owner
2. Property manager
96. Other, please specify: [OPEN-ENDED RESPONSE]
99. Refused

[ASK IF Q84=1]

Q86. Do you own or rent this residence?

[SINGLE RESPONSE]

1. Own
2. Rent
98. Don't know
99. Refused

[ASK IF Q86=Rent]

Q87. Do you pay your own electric bill or is it included in your rent? [*DO NOT READ*]

[SINGLE RESPONSE]

1. Pay own bill
2. Included in rent
98. Don't know
99. Refused

[ASK ALL]

Q88. Approximately when was this residence first built? [*DO NOT READ*]

[SINGLE RESPONSE]

1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006-2010
8. 2011-2015
9. 2016
98. Don't know
99. Refused

[ASK ALL]

Q89. Excluding unfinished basements, how many square feet is the residence?

1. NUMERICAL OPEN END [RANGE 0-99,999] _______
98. Don't know
99. Refused

[ASK IF Q89=Don't Know or Refused]

Q90. Would you estimate the residence is about: [*READ LIST*]

[SINGLE RESPONSE]

1. less than 1,000 sqft
2. 1,001-2,000 sqft
3. 2,001-3,000 sqft
4. 3,001-4,000 sqft
5. 4,001-5,000 sqft
6. Greater than 5,000 sqft
98. Don't know

99. Refused

[ASK ALL]

Q91. Does the primary heating system at the residence run on… [*READ*]

[SINGLE RESPONSE]

1. Electricity
2. Natural Gas (not propane)
3. Liquid propane gas
4. Fuel Oil
5. Wood
6. Or something else, please specify: [OPEN-ENDED RESPONSE]

[*Do not read list*:]

98. Don't know
99. Refused

[ASK ALL]

Q92. I'm going to read a list of income ranges. Please stop me when I reach the range that includes your annual household income. [*READ LIST*]

[SINGLE RESPONSE]

1. Less than $25,000
2. $25,000 to less than $50,000
3. $50,000 to less than $75,000
4. $75,000 to less than $100,000
5. $100,000 to less than $150,000
6. $150,000 or more
98. Don't know
99. Refused

That is all of the questions I have for you today. Thank you very much for your time

Appendix D Participant Survey Results

This section reports the results from each question in the participant survey. Since the results reported in this appendix represent the "raw" data (that is, none of the open-ended responses have been coded and none of the scale questions have been binned), some values may be different from those reported in the Process Evaluation Findings chapter (particularly: percentages in tables with Other categories and scale response questions). Only respondents who completed the survey are included in the following results.

Q1. I'm going to read a list of building types. Please stop me when I mention the building type that best describes the residence where this work was done.

Response Option	Percent (n=73)
Single-family detached home	89%
Factory manufactured single family home	3%
Row house or town house	5%
Duplex	1%
Triplex	0%
Apartment or condo building with four or more units	1%
Other	0%
Don't know	0%
Refused	0%

Q2. How did you hear about the Duke Energy Smart $aver rebate(s) that you received?

Response Option	Count (n=73)
Airworks told us about it when they came out.	1
Company that did hvac system did everything through Duke Energy for us.	1
Company that installed the unit.	1
conbtractor	1
contractor	1
contratcor	4
Doesn't remember anything about the rebate.	1
Don't remember.	1
From let see aimes receiving and plumping put it in.	1
From my neighbor.	1
From my vendor, the people the air conditioning folks.	1
From the air conditioner installers.	1
from the contractor	1
from the installer	1
From the installer.	1
From the people that installed the air conditioning.	1
from the pool installer	1
from thje contractor	1
Guy that puts the heat and air in the units, told us about it.	1
hvac installer	1
I believe I read it on the internet when I was researching pool pumps.	1
I Don’t know, unless it was applied for by the person who put it in.	1
I don't remember that.	1
I got an energy efficient heat pump and they called me about it.	1
I got one for my AC and one for my pump.	1
I picked it up from a mailer. The contractor I used was recommended by Duke.	1
I think it was the sales person who told us when he was writing up the contract for the new AC.	1
I think the Guy that installed our HVAC	1
I was in need in repair and they were going to stop making the freon. The guy that came for the repair told me about the rebate.	1
In the duke energy bill and the contractor that did the work.	1
insert in the statement	1
It was actually through the person that installed the equipment.	1
It was through my AC guy. He's the one who mentioned it and did it.	1
mailer	1
on the internet	1

Response Option	Count (n=73)
on the my energy alert	1
One: Online from Duke Energy Website because I moved from FL and got a rebate from that utility company	
Two: The contractor that I got the AC unit through mentioned it.	1
Read about it online. Also, the people that installed it said we would get a rebate.	1
Repairman from All Seasons told us about it.	1
the company	1
the contractor	1
The Contractor	1
The contractor told me.	1
The guy that put the heat in, the brotham brothers.	1
The people that put the AC in	1
the person who installed the HVAC	1
The website, the Duke Energy Website.	2
Through a vendor at our job.	1
Through our installer, hvac company.	1
Through the company that installed the air conditioner	1
Through the company that installed the unit.	1
through the contractor	1
Through the contractor	1
Through the contractor that did the work	1
Through the heating and air company.	1
through the HVAC company	1
Through the installers. The sales people.	1
Through the patterson, company that installed the air conditioning for the heat pump.	1
through the representative that did the install	1
through the vendor	1
throught the contractor	1
unknown	1
We found out about it from the Heating and AC contractor	1
website	1
went online	1

Q3. Are you familiar with other energy-efficiency rebates that Duke Energy offers, aside from the [LIST ALL MEASURES THEY RECEIVED FROM SMART $AVER PROGRAM] rebate(s)?

Response Option	Percent (n=73)
Yes	30%
No	70%
Don’t know	0%
Refused	0%

Q4. [If Q3=YES] Which other rebates are you familiar with?

Response Option	Percent (n=22)*
Heat pump water heater rebate	9%
Heating and cooling system rebate	14%
Geothermal heat pump rebate	14%
Smart Wi-Fi enabled thermostat rebate	5%
Attic insulation and air seal rebate	5%
Duct sealing/insulation rebate	5%
In-home energy audit	9%
Pool pump rebate	9%
Power Manager bill discounts (for allowing Duke Energy to ramp down air conditioning during peak usage events)	5%
Discounted efficient lighting (CFLs, LEDs, and specialty bulbs)	36%
Other	9%
Don’t know	5%
Refused	0%

* Multiple responses allowed.

Verbatim Other Response	Count (n=3)
Solar Power	1
Washers, things like that	1

Q5. [If Q3=YES] Have you received any of these other rebates?

Response Option	Percent (n=22)
Yes	36%
No	59%
Don’t know	5%
Refused	0%

Q6. [If Q5=YES and Q4<>DON’T KNOW OR REFUSED] Which rebate(s) did you receive?

Response Option	Percent (n=9)

Not asked*	100%

* Due to a programming error, this question was not asked.

Q7. [If Q5=YES] Did you receive the [INSERT REBATED MEASURES FROM Q6] before or after [PROJECT #1 LIST] work was done? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN Q6]

Response Option	Percent (n=?)
Not asked*	100%

* Due to a programming error, this question was not asked.

Q8. [IF Q7=AFTER OR Q7=BOTH BEFORE AND AFTER] Using a scale from 0 to 10, where 0 means “Not at all influential” and 10 means “Extremely influential,” how influential was the rebate for [PROJECT #1 LIST] in your decision to take advantage of Duke Energy’s [INSERT RESPONSE FROM Q6]? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN Q6 WHERE RESPONSE TO Q7=AFTER OR Q7=BOTH BEFORE AND AFTER]

Response Option	Percent (n=?)
Not asked*	100%

* Due to a programming error, this question was not asked.

Q9. [ASK IF RESPONDENT HAS A PROJECT #2 LIST] Using a scale from 0 to 10, where 0 means “Not at all influential” and 10 means “Extremely influential,” how influential was the rebate for [PROJECT#1 LIST] in your decision to take advantage of additional Duke Energy rebates for [PROJECT#2 LIST]?

Response Option	Percent (n=73)
Not asked*	100%

* No respondents met display logic condition.

Q10. [ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED]

Which of the following best describes the condition of the previous HVAC system that you replaced with a [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]?

Response Option	Percent (n=30)*
It was broken or malfunctioning	70%
It was getting old, or	43%
It was in good working condition	7%
Other	7%
Don't know	0%
Refused	0%

* Multiple responses allowed.

Verbatim Other Response	Count (n=2)
It was a space heater that it was replacing.	1
It was undersized for the house.	1

[IF CENTRAL AIR CONDITIONER WAS INSTALLED] Which of the following best describes the condition of the previous air conditioner that you replaced?

Response Option	Percent (n=33)*
It was broken or malfunctioning	42%
It was getting old, or	76%
It was in good working condition	0%
Other	0%
Don't know	0%
Refused	0%

* Multiple responses allowed.

Q11. [ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, OR CENTRAL AIR CONDITIONER WAS INSTALLED] Approximately, how many years old was the previous HVAC unit that you replaced with your new [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP]?

Verbatim Response	Count (n=63)
10	5
10 year old	1
10 years	1
10 years roughly	1
11	1
12	1
12 years old	1
13	4
14	1
15	5
16	1
16 years old	1
17	2
17 or 18 years old	1
17+ years old.	1
18	5
18 years old	1
20	7
20 years old	1
20 years old.	1
21 or 22	1
23	2
24	1
25	1
26	1
29	1
30	1
30 years old and still working fine.	1
4	1
5	1
8	2
9.5	1
approx 15 years	1
approximately 20	1
Doesn't know	1
it was 2002 or 2003	1
probably 18 or 19	1

Verbatim Response	Count (n=63)
probably 7	1
unknown	1

Q12. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] What motivated you to install an energy efficient system rather than a less efficient one that would use more energy?

Verbatim Response	Count (n=63)
Always looking for the best energy-efficiency regardless of what it is.	1
Because it was old.	1
Because of all the dang money we were spending on electricity. We were tired of paying so much on our energy bill.	1
Because the one I had was propane and propane is expensive.	1
Because what they offered. It was able to do what we need it to do.	1
cost	1
Cost	3
cost and better for the environment	1
cost and efficiency made sense	1
Cost savings	1
Cost savings.	1
cut cost	1
Fact that we were upgrading, might as well choose one that uses less energy.	1
Get a cheaper deal each month and one that would last longer.	1
Guess the main reason was the actual rebate.	1
I plan to stay in this house and I know I can recoup the cost through energy efficiency for both the AC and the Furnace.	1
I try to go with something that's more efficient.	1
It's what was recommended by the AC company.	1
Just having a better system, and having a cheaper cost system. I Don't know they put it one that was not what it should have been.	1
Just the energy efficiency.	1
Just to be more energy efficient.	1
Just to save money.	1
Long-Term Savings	1
Lower Bill, Better for Environment.	1
Lower bills and more consistent cooling.	1
makes sense for rverybody	1
Money!	1
Our bills were really really high.	1
Over the long-haul, end up being cheaper	1
price	1
Read through a lot of things about energy savings, Long term savings	1
save money	4
Save Money	1
save money and energy	1
save money and to help with the environment	1

Verbatim Response	Count (n=63)
Save Money, Save Energy, No brainer!	1
Save money.	1
Save on my energy bill.	1
Saving	1
saving on the cost	1
savings	1
savings and the rebate	1
smaller bills	1
Smarter Long Term Investment.	1
That's a no-brainer.	1
The cost and be cheaper, and better for environment and would've got the rebate.	1
The one that made the most sense to me.	1
the return on the investment is good	1
The sales person who came out told us the options we had.	1
the savings	1
to make the home more efficient	1
to save money	1
To save money and cut down our cost.	1
Try to be conservative, recycle things.	1
Try to do that on anything that has good energy star ratings, try to do that on all electrical appliances.	1
wanted it to be dependable.	1
We got a good deal on it.	1
We wanted to save energy.	1

Q13. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] I'd like to know how you selected the specific make and model of the [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP] you purchased. Would you say that you chose it…

Response Option	Percent (n=63)
Yourself, based entirely on your own research?	24%
From a list of options provided by the contractor?	57%
Because it was the only option recommended by your contractor?	13%
Other	6%
Don't know	0%
Refused	0%

Verbatim Other Response	Count (n=4)
Combination of my own research and the several options provided by contractor.	1
I just asked he contractor what the best unit to buy, he said it was the best one.	1
talked with a neighbor	1
Refused	1

Q14. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS INSTALLED] Suppose the contractor that installed your [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP] did not offer high efficiency [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP]s that qualify for Duke rebates. Which of the following is most likely what you would have done?

Response Option	Percent (n=63)
You would have installed the cheaper, less efficient, unit that would not have qualified for rebates if that's all your contractor offered, or	14%
You would have looked for a contractor that could install a rebate-qualified high efficiency unit	84%
Other	2%
Don't know	0%
Refused	0%

Verbatim Other Response	Count (n=1)
Just kept old unit	1

Q15. [ASK IF SMART THERMOSTAT INSTALLED] Which of the following best describes the old thermostat that you replaced?

Response option	Percent (n=32)
Manual non-programmable thermostat,	50%
Programmable thermostat that does not communicate with your Wi-Fi network, or	47%
Programmable thermostat that communicates with your Wi-Fi network	3%
Other	0%
Don't know	0%
Refused	0%

Q16. [ASK IF SMART THERMOSTAT INSTALLED] Thinking of your old thermostat, at what temperature was that thermostat typically set in the winter?

Verbatim Response	Count (n=32)
55	1
60	1
64	1
65	3
66	1
67	1
68	2
69	1
69-70	1
69-71	1
70	8
72	6
74	1
75	1
76-77	1
Don't know	2

Q17. [ASK IF SMART THERMOSTAT INSTALLED] And what about your new wi-fi thermostat? At what temperature is the new thermostat typically set in the winter?

Verbatim Response	Count (n=32)
55	1
60	1
64	1
65	2
65-66	1
66	2
67	1
68	4
69	1
69-70	1
70	5
72	5
76-77	1
Don't know	6

Q18. [ASK IF SMART THERMOSTAT INSTALLED] If you used your old thermostat to control air conditioning, at what temperature was your old thermostat typically set in the summer for air conditioning?

Verbatim Response	Count (n=32)
68	2
70	5
71	1
71-72	1
72	5
73	1
74	7
75	2
76	1
76-77	1
77	1
78	2
Did not use my old thermostat to control air conditioning	1
Don't know	2

Q19. [ASK IF SMART THERMOSTAT INSTALLED AND Q18<>DID NOT USE MY OLD THERMOSTAT TO CONTROL AIR CONDITIONING] And what about your new wi-fi thermostat? At what temperature is the new thermostat typically set in the summer?

Verbatim Response	Count (n=31)
65	1
68-72	1
69-71	1
70	4
71-72	1
72	3
73	1
74	9
75	2
76	2
77	2
77-78	1
78	2
79	1

Q20. [ASK IF SMART THERMOSTAT INSTALLED] What motivated you to install a wi-fi enabled thermostat?

Verbatim Response	Count (n=32)
amazing convenience and different options	1
background as IT. to make it more comfortable	1
Better rebate with that.	1
came with the heat pump	1
came with the system	1
came with the unit	1
came with the unit	2
Came with the unit	1
Convenience and More Energy Efficient.	1
Convenient.	1
Future technology I guess.	1
I didn't know it was Wi-fi.	1
I don't have Wi-fi, I guess it just came with it.	1
I Don't know, I don't understand all these terms.	1
I honestly Don't know. It was an option and I took it. I like the idea of being able to control the temp with my phone.	1
I thought it would work better, as far as the programs and all that.	1
I wasn't interested in the Wi-fi part of it. Just that it was high efficiency. Just that it was programmable.	1
it came with the system	1
It came with the unit.	1
It was recommended by the contractor.	1
Just a suggestion through the installer.	1
keeping up with the times	1
Loved the fact that control it from anywhere in the house.	1
nothing	1
Really only one that was offered to us.	1
So that we could get it on the phone and turn it up when we're away.	1
That was just what came with it.	1
That way we could do it on vacation if we had to adjust anything. More accessible.	1
Things I've been reading about them. It's the only way to go	1
unsure	1
We didn't choose that, it was just the one that was recommended.	1

Q21. [ASK IF HVAC TIER=2 OR 3, AND QUALITY INSTALL REBATE WAS RECEIVED] Program records show that you received an additional $60 rebate for a quality installation from your contractor. This additional rebate was included on the VISA gift card you received in the mail from Duke Energy. This rebate was for additional work your contractor did to ensure that your new [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP] was installed to run as efficiently as possible. Prior to today, were you aware that you received a quality installation rebate?

Response Option	Percent (n=28)
Yes	25%
No	68%
Don't know	7%
Refused	0%

Q22. [ASK IF Q21=YES] Prior to talking with the contractor that installed the [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP], were you aware of quality installation practices that ensure the [PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP, CENTRAL AIR CONDITIONER, OR GEOTHERMAL HEAT PUMP] is installed to run as efficiently as possible?

Response Option	Percent (n=7)
Yes – I was already familiar with quality installation practices	71%
No – I was not previously familiar with quality installation practices	29%
Don't know	0%
Refused	0%

Q23. [ASK IF Q21=YES] Did your contractor let you choose between a standard installation service that was not eligible for the additional rebate and a quality installation that would get you an additional rebate from Duke Energy?

Response Option	Percent (n=7)
Yes – they let me choose between standard and quality	86%
No – they did not give me a choice	14%
Don't know	0%
Refused	0%

Q24. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] Which of the following best describes the condition of the previous water heater that you replaced?

Response Option	Percent (n=1)
It was broken or malfunctioning	0%
It was getting old, or	100%
It was in good working condition	0%
Other	0%
Don’t know	0%
Refused	0%

Q25. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] Approximately, how many years old was the previous water heater that you replaced with your new heat pump water heater?

Verbatim Response	Count (n=1)
16	1

Q26. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] Where did you install your new heat pump water heater?

Response Option	Percent (n=1)
Garage	0%
Basement	0%
Closet	0%
Laundry Room	0%
Other	100%
Don’t know	0%
Refused	0%

Verbatim Other Response	Count (n=1)
Crawl space	1

Q27. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED AND IF Q26 <> DON’T KNOW OR REFUSED] Do you use your HVAC system to heat and cool the [PIPE IN ANSWER FROM Q26] where the heat pump water heater is located?

Response Option	Percent (n=1)
Yes	0%
No	100%
Other	0%
Don't know	0%
Refused	0%

Q28. [ASK IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS NOT INSTALLED] What type of system do you use to heat your home?

Response Option	Percent (n=43)*
Heat pump	30%
Electric baseboard heaters	2%
Natural gas furnace	74%
Plug in space heaters	0%
Cadet wall heaters	0%
Other	7%
Don't know	0%
Refused	0%

* Multiple responses allowed.

Verbatim Other Response	Count (n=3)
forced air	1
Geothermal	1
Propane heater.	1

Q29. [ASK IF CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP, OR GEOTHERMAL HEAT PUMP WAS NOT INSTALLED] What type of system do you use to cool your home?

Response Option	Percent (n=10)*
Central air conditioner	60%
Heat pump	30%
Room/window air conditioner	0%
Evaporative/swamp cooler	0%
Other	10%
Don't know	0%
Refused	0%
I do not have any air conditioning in my home	0%

* Multiple responses allowed.

Verbatim Other Response	Count (n=1)
Geothermal	1

Q30. [ASK IF HEAT PUMP WATER HEATER WAS INSTALLED] What motivated you to install an energy efficient water heater rather than a less efficient one that would use more energy?

Verbatim Response	Count (n=1)
switched to solar and it would save more money	1

Q31. [ASK IF DUCT SEALING OR ATTIC INSULATION WAS PERFORMED/INSTALLED] What motivated you to [IF DUCT SEALING WAS PERFORMED, READ: repair your ductwork; IF ATTIC INSULATION WAS INSTALLED, READ: add insulation to your attic]?

Duct Sealing

Verbatim Response	Count (n=1)
needed to be done	1

Attic Insulation

Verbatim Response	Count (n=5)
need it	1
needed to be done	1
power bills were way high and wanted to lower the bills. A/C was really old	1
the bills were too high	1
Well, I knew it was thin. I just took the opportunity to handle it	1

Q32. [ASK IF POOL PUMP WAS INSTALLED] What motivated you to install an ENERGY STAR pool pump?

Verbatim Response	Count (n=4)
efficiency savings and the rebate from Duke help with the decision	1
Just doing the math on it and having a single speed pump as opposed to an energy efficient pump.	1
lower the bills. recommended by the pool company	1
the rebate	1

Q33. [ASK IF POOL PUMP WAS INSTALLED] Approximately what month do you first open your pool for the season?

Response Option	Percent (n=4)
January	0%
February	0%
March	0%
April	0%
May	50%
June	0%
July	0%
August	0%
September	0%
October	0%
November	0%
December	0%
Other	50%
Don't know	0%
Refused	0%

Verbatim Response	Count (n=2)
Year round	2

Q34. [ASK IF POOL PUMP WAS INSTALLED] Approximately what month do you close your pool for the season?

Response Option	Percent (n=4)
January	0%
February	0%
March	0%
April	0%
May	0%
June	0%
July	0%
August	0%
September	0%
October	25%
November	25%
December	0%
Other	25%
Don't know	0%
Refused	25%

Verbatim Response	Count (n=1)
Year round	1

I'd like to ask a few questions about what you most likely would have done had you not received assistance from Duke Energy Carolinas for the [LIST ALL MEASURES].

Q35. [ASK IF THEY INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP] Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Percent (n=63)
Would not have installed the [Measure]	0%
Would have postponed the purchase for at least one year	10%
Would have bought a less expensive or less energy efficient system	13%
Would have bought the exact same high efficiency [Measure], and paid the full cost yourself	71%
Other	2%
Don't know	3%
Refused	0%

Verbatim Other Response	Count (n=1)
Would have just kept shopping around.	1

Q36. [ASK IF Q35=WOULD HAVE BOUGHT A LESS EXPENSIVE OR LESS ENERGY EFFICIENT HEATING ND COOLING SYSTEM] You said you would have bought a/an [PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy Carolinas. Do you think it is more likely that you would have bought equipment that was…?

Response Option	Percent (n=8)
Almost as efficient as the one you bought, or	75%
Significantly less efficient than the one you bought	25%
Don't know	0%
Refused	0%

Q37. [ASK IF Q21=YES] If Duke Energy did not offer the additional rebate for quality installation services, would you have allowed your contractor to perform a quality installation service that ensured the [PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP] was performing as efficiently as possible, even if it meant you had to pay more money?

Response Option	Percent (n=7)
Yes – I would have allowed quality installation if no rebates were available	71%
No – I would not have allowed quality installation if no rebates were available	14%
Other	0%
Don't know	0%
Refused	14%

Q38. [ASK IF Q21=YES] If Duke Energy did not offer the additional rebate for quality installation services and your contractor did not offer you the service in their initial bid, would you have demanded that your contractor perform a quality installation service that ensured the [PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP] was performing as efficiently as possible, even if it meant you had to pay more money?

Response Option	Percent (n=7)
Yes – I would have demanded quality installation if no rebates were available and my contractor did not initially offer it	86%
No – I would not have demanded quality installation if no rebates were available and my contractor did not initially offer it	0%
Other	0%
Don't know	0%
Refused	14%

Q39. [ASK IF THEY INSTALLED: SMART THERMOSTAT] Now we want to ask you about the smart thermostat you got with your [PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]. Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Percent (n=32)
Would not have purchased the Wi-Fi enabled thermostat	9%
Would have postponed the purchase of the Wi-Fi thermostat for at least one year	0%
Would have installed some other type of thermostat, or	38%
Would have bought the exact same Wi-Fi thermostat, and paid the full cost yourself	44%
Other	6%
Don't know	3%
Refused	0%

Verbatim Other Response	Count (n=2)
I would have got whatever thermostat that went with the system	1
This was the only option. Only model available for the HVAC we purchased.	1

Q40. [ASK IF Q39=WOULD HAVE INSTALLED SOME OTHER TYPE OF THERMOSTAT] What type of thermostat would you have bought then? Would you have bought…

Response Option	Percent (n=12)
A manual non-programmable thermostat, or	17%
A programmable thermostat that is not Wi-Fi enabled	83%
Other	0%
Don't know	0%
Refused	0%

Q41. [ASK IF THEY INSTALLED: HEAT PUMP WATER HEATER] Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Count (n=1)
Would not have replaced my water heater	0%
Would have postponed the water heater replacement for at least one year	0%
Would have bought a less expensive or less energy efficient water heater, or	0%
Would have bought the exact same high efficiency Heat Pump Water Heater, and paid the full cost yourself	100%
Other	0%
Don't know	0%
Refused	0%

[ASK IF Q41=WOULD HAVE BOUGHT A LESS EXPENSIVE OR LESS ENERGY EFFICIENT WATER HEATER]

Q42. You said you would have bought a water heater that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy Carolinas Do you think it is more likely that you would have bought equipment that was…?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

[ASK IF THEY UPGRADED: ATTIC INSULATION]

Q43. Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Count (n=5)
Would not have done the attic insulation	0%
Put off doing attic insulation for at least one year	60%
Would have added less insulation	0%
Would have done the exact same upgrade, and paid the full cost yourself	40%
Other	0%
Don't know	0%
Refused	0%

[ASK IF Q43=WOULD HAVE ADDED LESS INSULATION]

Q44. You said you would have added less insulation if you had not received the rebate or information from Duke Energy Carolinas. How much less insulation would you have purchased? Please answer in a percentage, such as "50% less."

Response Option	Percent (n=5)
Not asked*	100%

* No respondents met display logic condition.

[ASK IF THEY DID DUCT SEALING]

Q45. Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Count (n=2)
Would not have had ducts sealed or repaired	0%
Would have postponed the work for at least one year	50%
Would have had the exact same work done, and paid the full cost yourself	50%
Other	0%
Don't know	0%
Refused	0%

[ASK IF THEY INSTALLED A VARIABLE SPEED POOL PUMP]

Q46. Which of the following statements best describes the actions you would have taken if Duke Energy Carolinas rebates and information were not available:

Response Option	Count (n=4)
Would not have installed or replaced the pool pump	0%
Would have postponed the installation of the pool pump for at least one year	0%
Would have bought a less expensive or less energy efficient pool pump, or	50%
Would have had the exact same high efficiency pool pump installed, and paid the full cost yourself	50%
Other	0%
Don't know	0%
Refused	0%

[ASK ALL]

Q47. Using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential" how influential were the following factors on your decision to purchase the [MEASURE]? How influential was…

Air-Source Heat Pump

Response Option	Percent (n=29)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	7%	34%	0%	0%
1	0%	3%	0%	0%
2	0%	3%	0%	0%
3	3%	7%	0%	0%
4	3%	0%	0%	0%
5	24%	7%	3%	0%
6	7%	7%	7%	0%
7	7%	7%	7%	3%
8	10%	14%	17%	0%
9	14%	3%	21%	3%
10	24%	10%	45%	10%
Don't know	0%	3%	0%	41%
Refused	0%	0%	0%	41%

Verbatim Other Descriptor	Count (n=5)
A neighbor that used the contractor.	1
dependability and expected maintenance on the unit	1
I needed to fix the old one and they weren't sure if that would help. They said I needed a new one.	1
It was a good perk or a bonus to know I was getting a rebate.	1
Online and different sources giving information.	1

Attic Insulation and Air Sealing

Response Option	Percent (n=5)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	0%	20%	40%	0%
1	0%	0%	0%	0%
2	0%	0%	0%	0%
3	0%	0%	0%	0%
4	0%	0%	0%	0%
5	0%	20%	0%	0%
6	40%	0%	0%	0%
7	20%	20%	0%	0%
8	20%	20%	0%	0%
9	0%	0%	0%	0%
10	20%	20%	40%	0%
Don’t know	0%	0%	20%	100%
Refused	0%	0%	0%	0%

Central Air Conditioner

Response Option	Percent (n=33)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	9%	24%	0%	3%
1	0%	6%	0%	0%
2	3%	6%	0%	0%
3	6%	9%	0%	0%
4	3%	3%	0%	0%
5	21%	6%	6%	0%
6	9%	12%	0%	0%
7	15%	6%	9%	0%
8	15%	12%	21%	3%
9	6%	3%	18%	6%
10	9%	9%	45%	15%
Don’t know	3%	3%	0%	55%
Refused	0%	0%	0%	18%

Verbatim Other Descriptor	Count (n=9)
Fact that the system broke and were looking to replace it.	1
How energy efficient it was.	1
Needing it to replace before the summer.	1
Neighbor got same information	1
no	1
Past experience with the product.	1
Rebate from contractor as well as Duke Energy.	1
Very high monthly bills and the age of our old unit.	1
We needed a new AC.	1

Duct Sealing

Response Option	Percent (n=1)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	0%	0%	0%	0%
1	0%	0%	0%	0%
2	0%	0%	0%	0%
3	0%	0%	0%	0%
4	0%	0%	0%	0%
5	100%	0%	0%	0%
6	0%	0%	0%	0%
7	0%	0%	0%	0%
8	0%	0%	0%	0%
9	0%	0%	0%	0%
10	0%	100%	100%	0%
Don’t know	0%	0%	0%	100%
Refused	0%	0%	0%	0%

Geothermal Heat Pump

Response Option	Percent (n=1)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	0%	100%	0%	0%
1	0%	0%	0%	0%
2	0%	0%	0%	0%
3	0%	0%	0%	0%
4	0%	0%	0%	0%
5	100%	0%	0%	0%
6	0%	0%	0%	0%
7	0%	0%	0%	0%
8	0%	0%	0%	0%
9	0%	0%	0%	0%
10	0%	0%	100%	0%
Don't know	0%	0%	0%	100%
Refused	0%	0%	0%	0%

Smart Thermostat

Response Option	Percent (n=32)			
	Rebate	Information or advertisements from Duke Energy Carolinas including their website	Recommendation from your contractor	Other
0	9%	34%	3%	0%
1	0%	0%	0%	0%
2	3%	6%	0%	0%
3	6%	6%	0%	0%
4	0%	0%	0%	0%
5	25%	6%	13%	0%
6	9%	6%	6%	0%
7	6%	19%	6%	0%
8	9%	6%	25%	3%
9	6%	3%	13%	0%
10	22%	3%	34%	0%
Don't know	3%	9%	0%	69%
Refused	0%	0%	0%	28%

Verbatim Other Descriptor	Count (n=1)
Research and information	1

Pool Pump

Response Option	Percent (n=4)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	0%	50%	25%	0%
1	25%	0%	0%	0%
2	0%	0%	0%	0%
3	0%	0%	0%	0%
4	0%	0%	0%	0%
5	0%	25%	0%	0%
6	0%	0%	0%	0%
7	25%	25%	0%	0%
8	50%	0%	25%	0%
9	0%	0%	0%	0%
10	0%	0%	50%	25%
Don’t know	0%	0%	0%	75%
Refused	0%	0%	0%	0%

Verbatim Other Descriptor	Count (n=1)
Research on different pool pumps.	1

Heat Pump Water Heater

Response Option	Percent (n=1)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	0%	100%	0%	0%
1	0%	0%	0%	0%
2	0%	0%	0%	0%
3	100%	0%	0%	0%
4	0%	0%	0%	0%
5	0%	0%	0%	0%
6	0%	0%	100%	0%
7	0%	0%	0%	0%
8	0%	0%	0%	0%
9	0%	0%	0%	0%
10	0%	0%	0%	0%
Don't know	0%	0%	0%	100%
Refused	0%	0%	0%	0%

Quality Installation

Response Option	Percent (n=28)			
	Rebate	Information or advertisements from Duke Energy Carolinas, including their website	Recommendation from your contractor	Other
0	21%	39%	7%	4%
1	0%	4%	0%	0%
2	4%	0%	0%	0%
3	4%	4%	0%	0%
4	0%	4%	0%	0%
5	7%	4%	0%	0%
6	7%	4%	4%	0%
7	0%	0%	7%	0%
8	18%	11%	21%	4%
9	11%	11%	14%	0%
10	21%	11%	36%	11%
Don't know	7%	11%	11%	50%
Refused	0%	0%	0%	32%

Verbatim Other Descriptor	Count (n=4)
Brand	1
High efficiency.	1
Inefficiency of the unit and the high cost for Duke Energy with the unit.	1
Word of Mouth.	1

Q48. Since receiving your rebate from Duke Energy Carolinas for the [LIST ALL SMART $AVER MEASURES], have you purchased any other products or services to help save energy in your home?

Response Option	Percent (n=73)
Yes	30%
No	70%
Don't know	0%
Refused	0%

[If Q48=YES]

Q49. What products have you purchased and installed to help save energy in your home?

Response Option	Percent (n=22)
Bought energy efficient appliances	14%
Moved into an ENERGY STAR home [VERIFY: Duke Energy still your gas or electricity utility?]	0%
Bought efficient heating or cooling equipment	14%
Bought efficient windows	0%
Added insulation	5%
Sealed air leaks in windows, walls, or doors	5%
Bought LEDs	45%
Bought CFLs	5%
Installed an energy efficient water heater	14%
Sealed or insulated ducts	0%
None - no other actions taken	0%
Other	14%
Don't know	0%
Refused	0%

Verbatim Other Responses	Count (n=3)
Dish washer	1
High efficiency pool pump	1
solar panels	1

Q50. [ASK IF Q49<>NONE, DON'T KNOW, OR REFUSED] Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

Response Option	Percent (n=22)*
Bought energy efficient appliances	0%
Moved into an ENERGY STAR home	0%
Bought efficient heating or cooling equipment	9%
Bought efficient windows	0%
Bought additional insulation	0%
Sealed air leaks in windows, walls, or doors	0%
Sealed or insulated ducts	0%
Bought LEDs	14%
Bought CFLs	5%
Installed an energy efficient water heater	0%
Other	9%
I did not get any Duke rebates	59%
Don't know	9%
Refused	0%

* Multiple responses allowed.

Q51. [ASK IF ANY ITEM IN Q49 WAS SELECTED] On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the [LIST ALL SMART $AVER MEASURES] rebate have on your decision to…

Buy Efficient Heating or Cooling Equipment

Response Option	Percent (n=3)
0	67%
1	0%
2	0%
3	0%
4	0%
5	33%
6	0%
7	0%
8	0%
9	0%
10	0%
Don’t know	0%
Refused	0%

Buy Additional Insulation

Response Option	Percent (n=1)
0	100%
1	0%
2	0%
3	0%
4	0%
5	0%
6	0%
7	0%
8	0%
9	0%
10	0%
Don't know	0%
Refused	0%

Sealed air leaks in windows, walls, or doors

Response Option	Percent (n=1)
0	100%
1	0%
2	0%
3	0%
4	0%
5	0%
6	0%
7	0%
8	0%
9	0%
10	0%
Don't know	0%
Refused	0%

Buy LEDs

Response Option	Percent (n=10)
0	70%
1	0%
2	0%
3	0%
4	0%
5	10%
6	0%
7	0%
8	10%
9	0%
10	0%
Don't know	10%
Refused	0%

Buy CFLs

Response Option	Percent (n=1)
0	100%
1	0%
2	0%
3	0%
4	0%
5	0%
6	0%
7	0%
8	0%
9	0%
10	0%
Don't know	0%
Refused	0%

Installed an energy efficient water heater

Response Option	Percent (n=3)
0	67%
1	0%
2	0%
3	0%
4	0%
5	0%
6	0%
7	33%
8	0%
9	0%
10	0%
Don't know	0%
Refused	0%

Other

Response Option	Percent (n=3)
0	33%
1	0%
2	0%
3	0%
4	0%
5	33%
6	0%
7	0%
8	0%
9	0%
10	33%
Don't know	0%
Refused	0%

Q52. [ASK IF Q49.1 IS SELECTED AND Q51.1<>0 – NOT AT ALL INFLUENTIAL] What kinds of appliance(s) did you buy?

Response Option	Percent (n=1)
Refrigerator	0%
Stand-alone Freezer	0%
Dishwasher	0%
Clothes washer	0%
Clothes dryer	0%
Oven	0%
Microwave	0%
Other	100%
Don't know	0%
Refused	0%

Verbatim Other Response	Count (n=1)
TV	1

Q53. [ASK IF Q52<>DON'T KNOW OR REFUSED] Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

Television

Response Option	Percent (n=1)
Yes	100%
No	0%
Don't know	0%
Refused	0%

Q54. [ASK IF Q52=CLOTHES DRYER] Does the new clothes dryer use natural gas?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

Q55. [ASK IF Q49 BOUGHT EFFICIENT HEATING OR COOLING EQUIPMENT IS SELECTED AND Q51 FOR EFFICIENT HEATING OR COOLING EQUIPMENT > 0] What type of heating or cooling equipment did you buy?

Response Option	Percent (n=1)
Central air conditioner	100%
Window/room air conditioner unit	0%
Air source heat pump	0%
Geothermal heat pump	0%
Boiler	0%
Furnace	0%
Wi-Fi enabled thermostat	0%
Wall air conditioner unit	0%
Other	0%
Don’t know	0%
Refused	0%

[ASK IF Q55=BOILER OR FURNACE]

Q56. Does the new [INSERT Q55 RESPONSE] use natural gas?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

[ASK IF Q55<>DON’T KNOW OR REFUSED]

Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

Central Air Conditioner

Response Option	Percent (n=1)
Yes	100%
No	0%
Don’t know	0%
Refused	0%

Q58. [ASK IF Q49 BOUGHT EFFICIENT WINDOWS IS SELECTED AND Q51 WINDOWS > 0] How many windows did you install?

Response Option	Percent (n=22)
Not asked*	100%

* No respondents met display logic condition.

Q59. [ASK IF Q49 ATTIC INSULATION IS SELECTED AND Q51 FOR ATTIC INSULATION > 0] Did you add insulation to your attic, walls, or below the floor?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

Q60. [ASK IF Q59<>DON'T KNOW OR REFUSED] Approximately what proportion of the [ITEM MENTIONED IN Q59] space did you add insulation?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

Q61. [ASK IF Q49 LEDS IS SELECTED AND Q51 FOR LEDS > 0] How many of LEDs did you install in your property?

Verbatim Other Response	Count (n=3)
12	1
27	1
Don't know	1

Q62. [ASK IF Q49 CFLS IS SELECTED AND Q51 FOR CFLS > 0] How many of CFLs did you install in your property?

Response Option	Percent (n=1)
Not asked*	100%

* No respondents met display logic condition.

Q63. [ASK IF Q49 WATER HEATER IS SELECTED AND Q51 FOR WATER HEATER > 0] Does the new water heater use natural gas?

Response Option	Percent (n=1)
Yes	100%
No	0%
Don't know	0%
Refused	0%

Q64. [ASK IF Q49 WATER HEATER IS SELECTED AND Q51 FOR WATER HEATER > 0] Which of the following water heaters did you purchase? [read list]

Response Option	Percent (n=1)
A traditional water heater with a large tank that holds the hot water	100%
A tankless water heater that provides hot water on demand	0%
A solar water heater	0%
Other, please specify:	0%
Don’t know	0%
Refused	0%

Q65. [ASK IF Q49 WATER HEATER IS SELECTED AND Q51 FOR WATER HEATER > 0] Is the new water heater an ENERGY STAR model?

Response Option	Percent (n=1)
Yes	100%
No	0%
Don’t know	0%
Refused	0%

Q66. Where do you typically search for information on how to save energy in your property?

Response Option	Percent (n=73)*
Online - read reviews about products	48%
Go to utility website	25%
Read my utility information - it has tips on how to save energy	29%
Go to the store and talk to salespeople	1%
Look for ENERGY STAR logo on products	3%
Other, please specify:	5%
N/A - I don't typically search for information on how to save energy in my home/property	22%
Don’t know	1%
Refused	0%

* Multiple responses allowed.

Verbatim Other Response	Count (n=4)
Google	1
Information from Electrician, builders and contractors	1
Someone from Duke Energy gave information once.	1
talk to neighbors	1

Q67. Using a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied,” how satisfied were you with the rebate amount for [LAST PROJECT]?

Response Option	Percent (n=73)
0	1%
1	0%
2	0%
3	0%
4	3%
5	10%
6	5%
7	1%
8	11%
9	8%
10	59%
N/A	0%
Don’t know	1%
Refused	0%

Q68. How satisfied were you with how long it took to receive that rebate? Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.”

Response Option	Percent (n=73)
0	0%
1	0%
2	0%
3	3%
4	1%
5	8%
6	3%
7	3%
8	15%
9	12%
10	51%
N/A	1%
Don't know	3%
Refused	0%

Q69. [ASK IF Q68 IS SOMEWHAT TO VERY DISSATISFIED] Why did you give that rating?

Verbatim Response	Count (n=3)
It's strange the contractor said it would take 4-5 weeks to get the rebate. It took much longer to get it. Contractor said it would be a rebate check, we got a visa gift card. Would be nice to just get a credit on our power bill because that's what we're using the visa gift card for. We would prefer a check or that amount of credit applied to our duke energy bill.	1
Took over a month and a half or two months I think.	1
Waiting for my rebate, three weeks go buy and I called. They dont know what I'm talking about. I was on the phone for 3 hours talking with 4 employees of duke. When I got the rebate it came from Raleigh and I told a supervisor, Williams, that she needed to inform her customer service about the rebates and about the Smart Saver Program.	1

Q70. In the course of participating in the Duke Smart $aver program, how often did you contact Duke Energy or program staff with questions?

Response Option	Percent (n=73)
Never	75%
Once	15%
2 or 3 times	8%
4 or more times	1%
Don’t know	0%
Refused	0%

Q71. [ASK IF Q70=MORE THAN NEVER] How did you contact them?

Response Option	Percent (n=18)*
Phone	100%
Email	6%
Fax	0%
Letter	0%
In person	0%
Don’t know	0%
Refused	0%

* Multiple responses allowed.

Q72. [ASK IF Q70 > NEVER] Using that same scale, how satisfied were you with these communications? [*INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.”*]

Response Option	Percent (n=18)
0	6%
1	0%
2	0%
3	0%
4	0%
5	11%
6	0%
7	11%
8	11%
9	11%
10	50%
N/A	0%
Don’t know	0%
Refused	0%

Q73. [ASK IF Q72 IS SOMEWHAT TO VERY DISSATISFIED] Why did you give that rating?

Verbatim Response	Count (n=1)
Because nobody knew about the Smart Saver Program. It's called communication with your employees. It's like NOBODY knew what I was talking about.	1

Q74. Have you noticed any savings on your electric bill since the [LAST PROJECT] project?

Response Option	Percent (n=73)
Yes, they noticed savings	62%
No - They looked, but did not notice any savings	10%
No - They looked, but it is too soon to tell	4%
They didn't look	14%
Don’t know	11%
Refused	0%

Q74_B. [ASK IF Q74=YES, NOTICED SAVINGS] How satisfied are you with any savings you noticed on your electric bill since the [LAST PROJECT] project?

Response Option	Percent (n=45)
0	0%
1	0%
2	0%
3	0%
4	0%
5	0%
6	0%
7	7%
8	29%
9	4%
10	58%
Don’t know	0%
Refused	2%

Q75. How satisfied are you with your [LAST PROJECT] project?

Response Option	Percent (n=73)
0	0%
1	0%
2	0%
3	1%
4	0%
5	1%
6	1%
7	4%
8	11%
9	12%
10	68%
Don’t know	0%
Refused	0%

Q76. [ASK IF Q75 IS SOMEWHAT TO VERY DISSATISFIED] Why did you give that rating?

Verbatim Response	Count (n=1)
the company was not good	100%

Q77. How satisfied are you with the interaction with the contractors who worked on the [LAST PROJECT] project?

Response Option	Percent (n=73)
0	0%
1	0%
2	1%
3	0%
4	1%
5	0%
6	0%
7	3%
8	7%
9	16%
10	71%
Don't know	0%
Refused	0%

Q78. [ASK IF Q77 IS SOMEWHAT TO VERY DISSATISFIED] Why did you give that rating?

Verbatim Response	Count (n=2)
The company couldn't keep the same workers on the job. They made mistakes. They didn't do it right and had to be called back out. They caused damage to the house and made cracks in the and knocked some of the siding off.	1
They did make me aware of the replacement for the duct work rebate and after I called them about it they told me the inspection would be more than the rebate amount and refused to do it.	1

Q79. How satisfied you are with Duke Energy's overall performance as your electricity supplier?

Response Option	Percent (n=73)
0	0%
1	0%
2	0%
3	1%
4	0%
5	0%
6	4%
7	12%
8	12%
9	14%
10	56%
N/A	0%
Don’t know	0%
Refused	0%

Q80. Would you say that your participation in Duke Energy Carolinas Smart $aver Rebate Program has had a positive effect, a negative effect, or no effect on your overall satisfaction with Duke Energy?

Response Option	Percent (n=73)
Negative effect	1%
No effect	15%
Positive effect	84%
Don’t know	0%
Refused	0%

Q81. Finally, if you were rating your overall satisfaction with the Duke Energy Smart $aver Rebate Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

Response Option	Percent (n=73)
Very satisfied	77%
Somewhat satisfied	16%
Neither satisfied nor dissatisfied	3%
Somewhat dissatisfied	4%
Very dissatisfied	0%
Don’t know	0%
Refused	0%

Q82. [ASK IF Q81=SOMEWHAT OR VERY DISSATISFIED] Why do you give that rating?

Verbatim Response	Count (n=3)
Because I am very disappointed in the Thermostat. It's memory is having a negative impact on the environment of my house. I would prefer just a straight programmable thermostat like I had before, but I’d like to be able to control it through Wi-fi. I would like someone to call me about my thermostat.	1
Because there should be a higher value than $300 when you buy an entire system. I put in a heat pump with propane backup and an AC to the tune of $14,000 and I think a $300 rebate is kinda cheap. In Delaware, the rebate I got was around $2,500 for a complete Heater/AC system.	1
I don't want the prepaid debit card.	1

Q83. Do you have any suggestions to improve Duke Energy’s Smart $aver Program?

Verbatim Response	Count (n=25)
As long as the contractors notify the customer about the rebates. I guess DUKE sends news letters so that customers know about the rebates. TV and Commercials don't help me at all. I do get letters from DUKE that I read once in a while, like the light bulb rebates.	1
Communication with their employees. So when someone calls with questions about the rebate, they know who to send them to.	1
Depending on the price and size of unit, that you are going to have a furnace or ac or both, or even a water heater, even of those major appliances, it would be nice to have a price range and base that cost on the rebate you received.	1
get more rebates and give a better LED	1
get with the Acosta Vendors about the additional savings and don't give them the option to participate or not	1
getting more information out to the public	1
give out rebate checks instead of Cards	1
Guess if anything, the only thing I would recommend is to have a pamphlet of some type about LED Bulbs, and other things.	1
Just keep doing what they're doing. If products come along, the rebate was a great idea. It was an expensive project and the rebate helped out a lot.	
That will encourage people to get a newer system.	1
Keep the good work up	1
larger rebate	1
Make it easier for their contractors to submit the info needed to get the rebate and if an error is made let the contractors resubmit it	1
make it more available to people	1
make more noticeable	1
make the surveys shorter	1
More availability of auditors or assessors in the western part of North Carolina. I'm in the mountains next to TN.	1
Only thing would suggest on Monthly Bill, what the temperature was during the time. Like to see something that would allow him to evaluate how efficient my unit is.	1
show where the big rebates are	1
that they check out who they recommend	1
The contractor was not aware Duke was not sending checks. Better information between contractors and Duke Energy.	1
The only thing that was a surprise that the rebate card more like a credit card, and not a cash rebate. The card itself could not be exchanged for cash.	1
They could promote a little bit more. If you don't go online, I Don't know, just think they could a little bit more promotion on it.	1
Think when I bought my washer and dryer, never heard if she qualified for anything with it.	1
Wasn't aware of a lot of it because they were just moving into the area. Just was	1

Verbatim Response	Count (n=25)
following the advice of our contractors. Smart Thermostat was replaced with a different type of thermostat after.	
Don't know	1

Q84. Do you live at this residence where the work was performed?

Response Option	Percent (n=73)
Yes	95%
No	4%
Refused	1%

Q85. [ASK IF Q84=NO] Are you a property manager or an owner of the residence where the work was performed?

Response Option	Percent (n=3)
Owner	67%
Property manager	33%
Other	0%
Refused	0%

Q86. [ASK IF Q84=YES] Do you own or rent this residence?

Response Option	Percent (n=69)
Own	100%
Rent	0%
Don't know	0%
Refused	0%

Q87. [ASK IF Q86=RENT] Do you pay your own electric bill or is it included in your rent

Response Option	Percent (n=69)
Not asked*	100%

* No respondents met display logic condition.

Q88. Approximately when was this residence first built?

Response Option	Percent (n=73)
Before 1960	12%
1960-1969	7%
1970-1979	16%
1980-1989	11%
1990-1999	29%
2000-2005	14%
2006-2010	8%
2011-2015	0%
2016-2017	0%
Don’t know	3%
Refused	0%

Q89. Excluding unfinished basements, how many square feet is the residence?

Verbatim Response	Count (n=73)
1000	2
1100	1
1200	2
1260	1
1380	1
1400	2
1425	1
1490	1
1500	2
1553	1
1576	1
1590	1
1600	3
1700	2
1800	4
1898	1
1900	1
1950	1
1990	1
2000	4
2150	1
2200	1

Verbatim Response	Count (n=73)
2300	2
2384	1
2400	1
2500	2
2600	1
2700	6
2800	1
2900	1
3000	4
3100	2
3200	2
3500	1
3600	1
3700	1
4000	2
4800	1
5000	1
5800	1
6000	1
Don't know	6

Q90. [ASK IF Q89=DON'T KNOW OR REFUSED] Would you estimate the residence is about:

Response Option	Percent (n=6)
less than 1,000 sq. ft.	0%
1,001-2,000 sq. ft.	17%
2,001-3,000 sq. ft.	33%
3,001-4,000 sq. ft.	17%
4,001-5,000 sq. ft.	0%
Greater than 5,000 sq. ft.	0%
Don't know	33%
Refused	0%

Q91. Does the primary heating system at the residence run on…

Response Option	Percent (n=73)
Electricity	53%
Natural Gas (not propane)	41%
Liquid propane gas	4%
Fuel Oil	0%
Wood	0%
Or something else	1%
Don't know	0%
Refused	0%

Verbatim Response	Count (n=1)
Geothermal	1

Q92. I'm going to read a list of income ranges. Please stop me when I reach the range that includes your annual household income.

Response Option	Percent (n=73)
Less than $25,000	4%
$25,000 to less than $50,000	8%
$50,000 to less than $75,000	14%
$75,000 to less than $100,000	11%
$100,000 to less than $150,000	14%
$150,000 or more	16%
Don't know	3%
Refused	30%

Appendix E Trade Ally Survey Results

This section reports the results from each question in the trade ally survey. Since the results reported in this appendix represent the "raw" data (that is, none of the open-ended responses have been coded and none of the scale questions have been binned), some values may be different from those reported in the Process Evaluation Findings chapter (particularly: percentages in tables with Other categories and scale response questions). Only respondents who completed the survey are included in the following results.

S1. How many locations does your company have?

Response Option	Percent (n=58)
One	85%
Two	15%
Three	0%
Four	0%
Five	0%
More than five	0%
Don't know	0%

S2. [Ask if S1 > ONE] We would like to talk today about the projects that were sold and installed by the [PIPE IN ADDRESS] location. Are you able to speak to the work associated with that location?

Response Option	Percent (n=9)
Yes	100%
No	0%
Don't know	0%
Refused	0%

S3. Does your firm primarily focus on new construction or existing home projects?

Response Option	Percent (n=58)
Existing Homes	78%
New construction projects	22%
Don’t know	0%
Refused	0%

Q1. How did you first hear about Duke Energy Smart $aver rebate offers for HVAC equipment, variable speed pool pumps, insulation, and duct sealing?

Response Option	Percent (n=58)
Word-of-mouth (co-worker, another contractor)	14%
Duke Energy website	2%
Duke Energy program representative	26%
TV/Radio/Newspaper/Billboard Ad	0%
Event	2%
Other	17%
Don't know	40%
Refused	0%

Verbatim Other Response	Count (n=10)
were already filing them when I started	1
Through Pump Manufactures	1
They were doing it when I started 3 years ago.	1
The boss got us enrolled	1
Sense we've been in business	1
Followed in from an old program.	1
Email or letter. It's been so long ago.	1
Been doing it sense employee first started.	1
Already in place when I started working here	1
Already in place over a year when I started	1

Q2. Since August 2016, about what proportion of the [MEASURE] projects that your company did in Duke territory would have qualified for a Duke rebate?

Central Air Conditioners

Verbatim Responses	Count (n=42)
0%	1
10%	1
20%	2
25%	3
30%	2
33%	1
40%	5
50%	7
60%	1
70%	2
80%	6
85%	4
90%	2
99.9%	1
100%	2
Don't know	2

Air Source Heat Pumps

Verbatim Responses	Count (n=46)
0%	1
10%	3
20%	1
25%	4
30%	1
33%	1
40%	3
50%	7
60%	1
70%	1
75%	2
80%	6
85%	3
90%	4
100%	6
Don't know	2

Attic Insulation & Air Sealing

Verbatim Responses	Count (n=5)
5%	1
10%	1
15%	1
25%	1
40%	1

Pool Pumps

Verbatim Responses	Count (n=5)
50%	1
80%	1
85%	1
95%	1
Don't know	1

Heat Pump Water Heater

Verbatim Responses	Count (n=3)
15%	1
40%	1
100%	1

Geothermal Heat Pump

Verbatim Responses	Count (n=4)
0%	1
90%	1
100%	1
Don't know	1

Duct Sealing

Verbatim Responses	Count (n=4)
25%	1
40%	1
100%	1
Don't know	1

Q3. And since August 2016, what percent of all your Duke rebate qualified [MEASURE] projects did you actually apply for a rebate? [If needed: Your best estimate is fine.]

Central Air Conditioners

Verbatim Responses	Count (n=42)
0%	1
5%	1
30%	2
50%	1
55%	1
70%	1
80%	2
90%	3
100%	28
Don't know	2

Air Source Heat Pumps

Verbatim Responses	Count (n=46)
0%	1
5%	2
20%	1
25%	1
50%	1
70%	1
85%	1
90%	4
95%	2
100%	29
Don't know	3

Attic Insulation and Air Sealing

Verbatim Responses	Count (n=5)
15%	1
80%	1
95%	1
100%	2

Pool Pumps

Verbatim Responses	Count (n=5)
100%	4
Don't know	1

Heat Pump Water Heaters

Verbatim Responses	Count (n=3)
10%	1
100%	2

Geothermal Heat Pumps

Verbatim Responses	Count (n=4)
0%	1
100%	2
Don't know	1

Duct Sealing

Verbatim Responses	Count (n=4)
10%	1
15%	1
95%	1
100%	1

Q4. About what proportion of your rebate qualifying [MEASURE] customers specifically requested the [MEASURE] on their own and were not influenced by your recommendation?

Central Air Conditioners

Verbatim Responses	Count (n=42)
0%	10
2%	1
5%	5
10%	1
15%	1
20%	2
25%	1
40%	1
50%	3
60%	1
75%	1
80%	1
85%	1
90%	2
100%	2
Don't know	9

Air Source Heat Pumps

Verbatim Responses	Count (n=46)
0%	9
1%	1
2%	2
3%	1
5%	2
10%	3
15%	1
20%	2
25%	2
30%	1
50%	5
75%	2
80%	1
90%	1
100%	2
Don't know	10

Attic Insulation and Air Sealing

Verbatim Responses	Count (n=5)
25%	1
50%	2
75%	1
80%	1

Pool Pumps

Verbatim Responses	Count (n=5)
0%	1
2%	1
50%	1
80%	1
Don't know	1

Heat Pump Water Heaters

Verbatim Responses	Count (n=3)
0%	2
10%	1

Geothermal Heat Pumps

Verbatim Responses	Count (n=4)
0%	1
50%	1
60%	1
Don't know	1

Duct Sealing

Verbatim Responses	Count (n=4)
25%	1
30%	1
60%	1
75%	1

Q5. Using a 0 to 10 scale, where 0 is “not at all influential” and 10 is “extremely influential,” how much influence has the Duke program had on your business practice of recommending rebate qualifying [MEASURE] to your customers?

Central Air Conditioners

Response Option	Percent (n=42)
0	5%
1	5%
2	0%
3	2%
4	5%
5	19%
6	17%
7	10%
8	7%
9	10%
10	12%
Don't know	10%
Refused	0%

Air Source Heat Pumps

Response Option	Percent (n=46)
0	9%
1	4%
2	2%
3	2%
4	0%
5	17%
6	11%
7	9%
8	13%
9	4%
10	13%
Don't know	15%
Refused	0%

Attic Insulation and Air Sealing

Response Option	Percent (n=5)
0	0%
1	0%
2	0%
3	0%
4	40%
5	60%
6	0%
7	0%
8	0%
9	0%
10	0%
Don't know	0%
Refused	0%

Pool Pumps

Response Option	Percent (n=5)
0	0%
1	0%
2	20%
3	0%
4	0%
5	0%
6	20%
7	0%
8	20%
9	20%
10	20%
Don't know	0%
Refused	0%

Heat Pump Water Heaters

Response Option	Percent (n=3)
0	33%
1	0%
2	0%
3	33%
4	0%
5	33%
6	0%
7	0%
8	0%
9	0%
10	0%
Don’t know	0%
Refused	0%

Geothermal Heat Pumps

Response Option	Percent (n=4)
0	0%
1	0%
2	25%
3	0%
4	0%
5	25%
6	0%
7	0%
8	0%
9	0%
10	0%
Don’t know	50%
Refused	0%

Duct Sealing

Response Option	Percent (n=4)
0	25%
1	0%
2	0%
3	0%
4	25%
5	25%
6	0%
7	25%
8	0%
9	0%
10	0%
Don’t know	0%
Refused	0%

Q6. [ASK IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, POOL PUMPS, OR WATER HEATERS] Thinking back to before you were involved in the Duke Energy program, how often did you recommend higher efficiency equipment that uses less energy than standard models to your customers? Would you say none of the time, some of the time, most of the time, or every time?

Response Option	Percent (n=53)
None of the time	2%
Some of the time	15%
Most of the time	43%
Every time	34%
Not applicable – I’ve been involved with the Duke program since starting in the industry/this company	4%
Don't know	2%
Refused	0%

Q7. [ASK IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS, CENTRAL AIR CONDITIONERS, GEOTHERMAL HEAT PUMPS, POOL PUMPS, OR WATER HEATERS] And what about now?

Response Option	Percent (n=53)
None of the time	0%
Some of the time	7%
Most of the time	36%
Every time	55%
Not applicable – I've been involved with the Duke program since starting in the industry/this company	0%
Don't know	2%
Refused	0%

Q8. Would you say your knowledge of energy efficient products and services has increased, decreased, or stayed about the same since you became involved with the program?

Response Option	Percent (n=58)
Increased	62%
Stayed about the same	36%
Decreased	0%
Don't know	2%
Refused	0%

Q9. [Ask if Q8=INCREASED] Using a 0 to 10 scale, where 0 is "not at all influential" and 10 is "extremely influential," how much influence has the Duke Energy program had on your increased knowledge of energy efficient products and services?

Response Option	Percent (n=36)
0	3%
1	0%
2	8%
3	6%
4	0%
5	14%
6	3%
7	25%
8	17%
9	8%
10	14%
Don't know	3%
Refused	0%

Q10. [ASK IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS] How much more difficult or easier is it to sell 15 SEER central air conditioners now that the code is 14 SEER?

Response Option	Percent (n=41)
Much more difficult	0%
Somewhat more difficult	15%
No different	51%
Somewhat easier	15%
Much easier	12%
Don't sell SEER 15	2%
Don't know	5%
Refused	0%

Q11. [ASK IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS] How much more difficult or easier is it to sell 15 SEER HVAC heat pumps now that the code is 14 SEER?

Response Option	Percent (n=47)
Much more difficult	2%
Somewhat more difficult	11%
No different	36%
Somewhat easier	28%
Much easier	13%
Don't sell SEER 15	2%
Don't know	8%
Refused	0%

Q12. [ASK IF CONTRACTOR INSTALLED SMART THERMOSTATS] As you may know, Duke Energy offers a rebate for smart thermostats. By how much did your installations of smart thermostats increase since Duke began offering smart thermostat rebates? Would you say…

Response Option	Percent (n=41)
No increase	27%
Some increase	44%
A large increase	27%
Don't know	2%
Refused	0%

Q13. [ASK IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS] Thinking of these higher incentives, did those help you sell more central air-conditioners that are 15 SEER or higher?

Response Option	Percent (n=41)
Yes	71%
No	24%
Don't know	5%
Refused	0%

Q14. [ASK IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS] Thinking of these higher incentives, did those help you sell more air-source heat pumps that are 15 SEER or higher?

Response Option	Percent (n=47)
Yes	70%
No	21%
Don't know	9%
Refused	0%

Q15. [ASK IF CONTRACTOR PERFORMED QUALITY INSTALLS] As you may know, Duke Energy recently added "quality install" requirements for installations of heat pumps and air conditioners? Were you already doing all the techniques on the quality install check list prior to Duke requiring them?

Response Option	Percent (n=28)
Yes	79%
No	18%
Don't know	3%
Refused	0%

Q16. [Ask if Q15=YES] Prior to using Duke's quality install checklist, did you have a system in place to document that your installers were following these same quality install techniques?

Response Option	Percent (n=22)
Yes	86%
No	14%
Don't know	0%
Refused	0%

Q17. [Ask if Q15=YES] Prior to using Duke's quality install checklist, what specific quality install techniques were you using? Please be as specific as possible.

Response Option	Percent (n=22)
Airflow/static pressure	36%
Blower door tests	18%
System capacity	18%
Condenser measurements	18%
Enthalpy conversion	14%
Duct blaster tests	9%
System CFM	5%
Other	36%
Don't Know	36%

Q18. [ASK IF CONTRACTOR PERFORMED QUALITY INSTALLS ON TIER 2 OR 3 HVAC MEASURES] Do you charge your customers extra on the invoice for completing the quality installation rebate checklist on tier 2 and tier 3 HVAC jobs?

Response Option	Percent (n=23)
Yes	4%
No	91%
Don’t know	4%
Refused	0%

Q19. [ASK IF CONTRACTOR PERFORMED QUALITY INSTALLS] Do you have any suggestions on how Duke Energy could improve the quality install requirements?

Response Option	Percent (n=28)
Yes	71%
Don’t know	25%
Refused	4%

Verbatim Responses	Count (n=20)
When it first came out. There was only one check sheet for all seasons. I like that there are two sheets for different seasons. It's easier to get the rebate processed.	1
They should be more lenient. Sometimes we get apps back from customers and everything has to match with dates. It's difficult to get anything through that's 14 SEER.	1
the only thing I have is when I submit the info for the customer and them it takes 8-10 weeks to process. If there is a problem with the application you contact the Customer and us. If you contacted us before customer so we could fix the issue	1
Stop doing the quality install checklist. That's at the engineering level, not the installation level. I am a licensed contractor, most guys don't have their own license. The processing center is slow, inaccurate, and not very efficient. Go back to the one page fax or email that completed the process, Also, when the contractor got paid.	1
No. the software is kinda difficult when uploading and putting information in. So much that we don't enter the quality pledge. We've ran into too many cases where it was not completed correctly.	1
No	1
Make it easier. Do away with the enthalpy requirements.	1
make it easier. Add more options to the checklist and prorating if added	1
Make it easier to enter into the computer. If you don't want to offer a rebate for a 14 SEER, don't offer a rebate for a quality installation for that 14 SEER.	1
it would be nice to have guidelines where we would need to be so we know if the customer qualifies	1
It is tedious to scan all the documents and put them in. It's a lot of time to input the data to Duke. It would be nicer if the guys in the field could upload the information and get it done there. Like an app on their phone. We do the quality install on each rebate qualified installation, regardless if it's required or not. It would be good if Duke paid the contractor for the extra work and time we are putting into the rebates.	1
If there was an app where it could all be submitted	1
I believe the amount of time it takes to complete the rebates... We don't get anything as a company. It's difficult when you have 200 installs. It's time consuming and the company doesn't want to hire a specific person for just rebates. The existing employees have to be used to process the rebates. Very time consuming.	1
Get rid of it. It takes too long. It's a 2 1/2 hour process.	1
Do away with it. Minimize paperwork sense we're, in essence, working for free for the customer. The less paperwork we're doing for free, the more we would be willing to push the higher efficiency stuff. It would be good to compensate the contractors because we are doing a lot of excessive work and paperwork.	1
Do away with it. It would stop the install department from extra work. It has slowed down the install department. It has really made a hardship on the installation department. If you would give the contractor something for all the extra work.	1
Biggest problem we're having is when we start a house without AC for several days. The AC load is so big inside the house, when you let it run an hour, we will run 160% to 190% capacity above, the requirement is between 80%-180%. To not charge them extra, it's not feasible for us to come back to check it again because duke doesn't give the contractor any incentive. It's a losing proposition. A lot of times we don't do the QI test on the 15 and 16 SEER because we've had the numbers being so wild with the crazy temperatures. We lose the money on a service call if we go	1

Verbatim Responses	Count (n=20)
back out there to get the customer an extra $75.	
Have people who understand the industry creating the process. change the time frame when the inspection needs to be done.	1
Give the dealers something back like you used to	1
Give the company that's doing the rebate some of the rebate. Do away with the quality checklist because it's time consuming. Scanning, putting it in the document, submitting it, attaching is very time consuming.	1

Q20. What energy efficient products, technologies, or services should be added to the Duke Energy rebate program?

Response Option	Percent (n=58)*
Modulating furnaces	2%
Heat recovery ventilation systems	2%
Boilers	0%
Electronically commutated motor furnaces	3%
Tankless water heaters	5%
humidifiers	2%
air handlers	3%
Windows	2%
Doors	0%
No others should be added	38%
Other	34%
Don't Know	21%
Refused	0%

Verbatim Other Responses	Count (n=20)
Wifi Thermostat ONLY (without HVAC)	1
Tier rating for SEER. Keep it easy	1
Solar and the geothermal split system	1
Solar	1
Solar	1
Pool water heaters	1
Package products, because most don't achieve the HSPF minimum requirements even though they're 14 or 15 SEER	1
More Programmable Thermostats, Air filtration systems	1
More models of Smart Thermostats	1
mini split heat pumps	1
Lighting for the pools	1
LED swimming pool lights	1
Energy Audits, figure out what they (Duke) need on Smart Installations	1
Drop the 14 SEER and make efficiency requirements higher	1
Douglas Mini-Splits	1
dealer incentive	1
Crawl Space Insulation	1
being able to upload copies of the bill so the info matches	1
Attic Fan/Ventilation	1
14 SEER without Quality Installation requirement.	1

Q21. Have you attended any orientations or training events from DEC?

Response Option	Percent (n=58)
Yes	33%
No	67%
Don't know	0%
Refused	0%

Q22. [Ask if Q21=YES] What topics were covered in the last Duke Energy event you attended?

Verbatim Responses	Count (n=19)
When the new changes at the first of the year, when they implemented the new rebate system	1
What was being input on the QI	1
What qualified for the rebates	1
Trade ally portal	1
The rebates. How to file them and how much trouble we were having to get through	1
The new rebate system	1
the administrative part of the website	1
Submitting the rebate. Went over the new program.	1
New programs coming out, what is required, educational programs, courses.	1
Just about rebates	1
It was about the Duke rebates and how they worked and how things were processed. And how the system was supposed to operate.	1
Hydraulics and energy consumption on pool pumps.	1
heat pump water heater. went over other programs	1
General Knowledge and Best sales Practices.	1
Duct testing and heat pump training.	1
Duct sealing	1
Duct sealing	1
Different qualifying equipment and the general proceeds on how it works	1
Don’t know	1

Q23. [Ask if Q21=YES] On a scale from 0 to 10, how helpful was the last Duke Energy event you attended?

Response Option	Percent (n=19)
0	0%
1	5%
2	0%
3	0%
4	5%
5	16%
6	0%
7	10%
8	16%
9	0%
10	47%
Don't know	0%
Refused	0%

Q24. What types of training, if any, would you be interested in receiving from Duke Energy?

Response Option	Percent (n=58)
Offered verbatim response	47%
Don’t know	50%
Refused	3%

Verbatim Responses	Count (n=27)
Would like training on all the programs. I would feel like a good training on BPI. It would be good to have air flow training	1
When you update things it would be nice to have a class that would go over that. Also if it is rejected I would like a class going over what we can do.	1
We would like training on going over the different systems	1
Training about the rebates. To make sure we're updated.	1
Thermal class and refresher courses where a contractor could come in and talk	1
Selling points about rebates. Other rebates related to HVAC industry. Up-and-Coming rebate information.	1
Sales for efficiency purposes. Benefits for customer. Technology that is out on Variable speed pump equipment	1
Requirements	1
Open to anything	1
Nothing	1
None	1
None	1
None	1
Net Zero Information.	1
More training on energy efficiency.	1
More paperwork information and more information about the energy efficient products.	1
More of the rebate information. Some of the rebates are very vague.	1
More information for the contractors about when there will be changes and how to adapt to those changes.	1
Love to know when the programs change. Have notification there.	1
Installation or service.	1
How to market the program better	1
Equipment selection. Class for installers to perform the quality install checklist.	1
Energy efficiency and how they would like the process done. What duke energy is looking for in an installation	1
Energy consumption training	1
Duct sealing certification	1
Any and all. The past training has been good.	1
Any communication. When you started this up, we had 2 meetings to understand the rebate processing. There's a LOT that cannot be done on the contractors end.	1

Q25. On a scale from 0 to 10, how interested would you be in a training course on how to effectively sell high efficiency equipment to your customers if it was offered by the program?

Response Option	Percent (n=58)
0	19%
1	9%
2	5%
3	5%
4	2%
5	14%
6	2%
7	15%
8	5%
9	3%
10	17%
Don't know	3%
Refused	0%

Q26. How often do your customers ask about the Duke Energy rebates before you've had the chance to bring them up? Would you say…

Response Option	Percent (n=58)
Never	2%
Rarely	36%
Occasionally	41%
Frequently	14%
Always	0%
Don't know	7%
Refused	0%

Q27. Since Duke transitioned to the online application system in April 2016, how frequently have you experienced problems or frustrations with the rebate application process? Would you say…

Response Option	Percent (n=58)
Never	3%
Rarely	24%
Occasionally	33%
Frequently	28%
Always	10%
Don't know	2%
Refused	0%

Q28. [Ask if Q27=RARELY, OCCASIONALLY, FREQUENTLY, OR ALWAYS] What types of problems or frustrations did you experience?

Verbatim Responses	Count (n=55)
A couple quality installation checklist issues with the 14 SEER. This may have been an issue on our end.	1
Don't know	1
When we first started, getting everyone on the same page was difficult.	1
The online process is frustrating. It's easier now. To get the documentation in the thermostat is where we've struggled. Not being able to go in and attach information later. Info was entered, but it was frustrating you could not edit it.	1
Rebates declining for no reason	1
Right now, I have 4 that say "attention required" and I have to call a Duke representative, Aaron, to find out exactly what's wrong. It just tells me "Invalid reason, the smart thermostat number cannot be validated". Before, when I would send in a thermostat, we were just using the complete model number. Now we need to enter it "exactly as they appear on the product list". It's a simple fix, but I need to look twice. "The quality installation did not meet program requirements". If they would tell exactly why something would not qualify so I did not have to contact Aaron, it would save a lot of time. I think we should not have to call someone for every reason it says "Attention Required". Give us a reason on your website WHY the rebate needs attention. Contractor contacts Aaron at Duke, then Aaron has to contact Blackhawk. Then Blackhawn needs to respond to Aaron and he can get back to me. This takes a lot longer than it should. We should be working directly with the vendor that gives the rebates. I have a rebate we did 5/10/17 that says "Attention required-Rejected-The account holder name does not match the application name" Glen vs Glenn was the only issue with this. I sent the account number in with this application but it was still rejected because of an extra N in the customer name Glen.	1
Always kicking out application saying not enough info.	1
Submitting the rebates	1
Rejections are bring sent out before resolved. sounds like there may be a glitch	1
There were issues with model numbers and rebates not going through. Customers call back to ask where there rebates were. Some issue with Insurance not updating.	1
It is very frustrating to start with. then you need to resubmit. So you resubmit and it wouldn't do anything. If you click resubmit, it would not work, so you had to start over. It's gotten better, but the old system was easier in some ways. I like the online, without paper.	1
If it declined the application, or said it had an issue, it never told you exactly what the issue was. Simple things like the name on the paperwork being husband and wife, and the bill was just the husband would not work. I misspelled an address once, and I had to call Duke instead of just seeing what the problem was and fixing it online.	1
Feedback information from Duke as far as status and delay of rebates.	1
All the attachments are time consuming.	1
Mostly with Quality Checks and 14 SEER.	1
It needs attention and we call Duke and find out we're not able to complete the rebate on our side. Calling duke takes a lot of time. Tracking. Status Updates on OLD rebates that still say "in review". The system went down for a week or two for a manual update, we should get a warning if you're going to update the system.	1
It's the inability to change something that's been input within 48 hours. As soon as I enter a rebate, I might get a call from an installer to change the name or address. I cannot change the info for 48 hours. Once I update something, regarding MY Account, it takes days or up to a week before I can	1

Verbatim Responses	Count (n=55)
submit rebates or receive referrals. It's like someone needs to approve it at Duke. This mostly affects referrals.	
When you switch from winter to spring it would take a while to get the different checklist up	1
Applications were not showing up	1
The last one I had needed a qualified thermostat. When I called customer service, they said it was qualified, but the price was messed up in the system. Customer service fixed it for me. It usually has to do with the thermostat.	1
The process was a little slow at times.	1
Sending in/Scanning info that is sent and has never been received. Lost information.	1
Wouldn't accept the application and said it wasn't right.	1
No guide to the quality installation process. It requires certain things that you need to test at certain times of the year according to outdoor temp. No guide to CFM, I just have to guess the numbers because Duke doesn't tell where to test the CFMs	1
Confusion with the system would enter info and it would say it was unfinished	1
Just when I'd go back to track the process, it'd say it would need more paperwork. When I was uploading, I had to split up the files instead of processing it all in one file.	1
Homeowners were getting things sent saying there was an issue with the rebate.	1
Mostly just the beginning, when we were trying to switch the program over. When it was initially setup, you could get an extra rebate for a certain thermostat. The system kept asking me to submit specific paperwork for a thermostat that the customer did not order.	1
Started before 2016. Thought we'd never get the first few rebates to process.	1
Never got an email about an issue	1
Just once I could not get the site to load. Just an issue with Cookies and Cache, I think. Once it didn't accept a serial number and kicked back an application.	1
Incorrect info provided and having trouble getting it corrected.	1
It kept adding more requirements that you had to have on the paperwork that needed to qualify. Kept adding things that need to be on there. The paper that we'd fax was much easier than using the scanner. When you're limited on time, having to scan and then upload to a computer is frustrating. The address and names are VERY PICKY and would kick back, then we need to call to address the issue. It should be more human friendly, simpler to find discrepancies. Husbands/Wives is the same thing. If the husband on the power bill and both are on the rebate, it will kick it back and we have to call to get an answer on the issue. We don't get paid for the rebate. There's no incentive for the contractor, but we need to do them because the customer wants the savings.	1
When you try to track a rebate, part of its missing. Information is wrong. Double rebates, duplicated applications, then the application would be gone. Would not take specific wording. Have a hard time uploading documents, as well.	1
You have to upload everything, scan it, put the QI think and invoice together and then upload it.	1
Losing paperwork on Dukes side. Denying claims that were properly done. Paying out less than what the claim was. Long time delays between completing a claim and finding out if it was accepted. Many frustrated customers who didn't receive their claim that they were supposed to, in a timely fashion. It's really hard to have customers angry with us when it was Duke who was being slow on the process.	1

Verbatim Responses	Count (n=55)
After you fill out the application, it takes about 30 days to get it back. Sometimes I would end up duplicating the application because it would take so long. It's very unforgiving because it will cancel the rebate after 60 days. 1 or 2 things that are not entered will reject the rebate.	1
When things get denied that should not be denied. They get kicked out and when I call Duke, they say "that shouldn't have been denied" and then approve. Whenever I call, except one, it has been erroneously denied. The one I messed up on was because the homeowners name was different from the account holder.	1
Estimation work. Insurance certificates. Quality Checklist, filling out and submitting it. If the customer didn't want the WiFi thermostat, Duke would reject the refund. The communication back and forth is horrible. The ease of uploading files is not user friendly.	1
When we first started using it was rejecting a lot of applications saying need more details. When we called, I was told it was a glitch	1
It took Duke 2 months to create our profile so we could submit rebates. It took 6-7 phone calls and 1 to management to realize the IT issue was on Dukes end. I had to get special approval to get expired rebates approved because of the IT issue. I had several customers upset because of the delay on their rebates.	1
The initial onset is having a hard time adding a new user. The referral program is harder to navigate	1
Giving me errors when accessing the application	1
What we see says the application was accepted and paid but the customer gets a letter saying it's rejected.	1
I didn't know the server was going to be down for updates. I didn't get any notification. When I was trying to do my billing, I could not.	1
Having to submit new paperwork for things that were already submitted in the online portal.	1
First, it was in a foreign language. Asking for additional paperwork that I had already submitted. On follow-up, it takes forever for DUKE to respond to the submission, it gets too close to the deadline. They say it takes 24 hours, but in reality, it takes 2-3 weeks to get back.	1
Getting the whole program setup. It kept getting pushed back. But now it works just fine.	1
There was quite a while where I had to go to different browsers to get it to work because I couldn't stay logged in.	1
Would not let me submit all the way. Would say it was submitted but would not be in my portfolio	1
The portal and when you scan a document they want you to send in.	1
Names not matching on the accounts	1
Worst part is that it would not go anywhere. I called and was told to use Google Chrome instead of Internet Explorer. As long as I get my numbers in right, it works smooth.	1
Can't enter the information. System is down.	1
Thermostat model number cannot be validated.	1

Q29. [Ask if Q27=RARELY, OCCASIONALLY, FREQUENTLY, OR ALWAYS] Overall, have these problems persisted or gotten better over time?

Response Option	Percent (n=55)
Persisted	24%
Gotten somewhat better	58%
Have been completely resolved at this point	18%
Don't know	0%
Refused	0%

Q30. Do you have any suggestions on how Duke Energy could improve the rebate application process?

Response Option	Percent (n=58)
Verbatim response offered	62%
Don’t know	33%
Refused	5%

Verbatim Responses	Count (n=36)
Allow things to be attached or addendum to be done.	1
Have better training for your employees	1
Let the home owner do the application like they did before. Keep the contractors out of it because we are not compensated for any of these rebates. Let the homeowner fill out the information. Contractor can give the homeowner the Model, Serial number, and invoice and the home owner can send in the information.	1
If it is duke energy or duke progress it should be the same application.	1
Makes the system faster	1
Make the customers file instead of the contractor.	1
Not have to do a checklist for 14 SEER. Add more programmable thermostats that are applicable. The duct work should be a little more lenient.	1
Keep the questions on the rebate application worded similarly, or more simple. E.X. There's a question on the pool pump application regarding the horsepower on Old and New that is hard to determine which line I am supposed to put the information for the old pump or the information on the new pump.	1
Pay the company that's submitting it. Go back to the rebate for the contractor.	1
More leniency on quality checklist being submitted with applications.	1
Give it back to the customer. Let the customer submit it. Contractor puts the equipment on the form and hands the form to the customer. Take it out of the hands of the contractor.	1
Make it more human friendly. Make the requirements be more user friendly and not kick back because simple things like the names don’t match exactly.	1
Maybe try to get the software to work better.	1
If you'd stop the QI, it would speed it up a whole lot. I've scanned over 50 rebates this morning, double checked everything, and it takes a LOT OF TIME.	1
Go back to the old way that worked. Go back to the one page that was faxed in with the customer name, number, what was installed and an AHRI number. The claims department is the problem. All the things that are requested are way over the top and at the engineering level, not the installer level.	1
It asks what the total cost is, this is not necessary information, then you ask for the price of the thermostat, but we price our jobs as a whole. There are redundant and ridiculous questions on the online forms. They don’t have anything to do with efficiency or SEER rating.	1
Streamline the process. There's 4 documents I have to scan and that takes a lot of time.	1
Less paperwork. Be more user friendly. Less work for the contractor. Compensate the contractor for the extra time. Go back to faxing the paperwork.	1
wait until the application process has been looked at before rejecting the application	1
If the customer doesn't qualify, would be nice to be able to delete the application.	1
Scanning and uploading was hard at first. I've gotten used to it and it works just fine when the scanner works.	1
Pay the contractors some of the rebate as well. Especially because we have to do the rebate paperwork. We interact if the customer has any questions.	1
It would be great if there were some kind of check system where it would validate the info immediately	1

Verbatim Responses	Count (n=36)
Give the contractor back the incentive	1
Easier use of the portal.	1
Giving the option to upload sheets electronically	1
Shorter Forms.	1
When there's a problem (like checking a box or if something doesn't match) with an application, make it easier to fix it online instead of calling Duke to get it corrected.	1
I feel that it's redundant to answer electronic questions in the applications. They're the same as the paperwork. That's not good time management to be required to submit them on paper AND be required to submit them electronically within the application online.	1
Making an app where you can scan the equipment tags. automatically input AHRI	1
If it is just A/c only make it so it bypasses the indoor info	1
Be more detailed in what the rebate is for. Not so many choices.	1
The whole Visa Gift Card Card Thing. I've had 1/2 of my customers contact us again wondering when they filed, when they'll get the rebate, when it was completed, when it was sent. I have to have the customer give Duke a call to get the information because it's been over 6 weeks.	1
Downsizing what needs to be submitted	1
Make it faster. Faster turn around for processing and rejecting (if applicable). Respond back to the contractor when a customer gets paid a rebate. Make it more clear to the contractor when, and how much, a rebate has been paid to the customer.	1
They could go back to giving the contractor money as well as the customer.	1

Q31. Do you have any suggestions on how Duke Energy could improve the project inspection process?

Response Option	Percent (n=58)
Verbatim response offered	19%
Don't know	76%
Refused	5%

Verbatim Responses	Count (n=11)
It requires a lot of data and man hours and it isn't worth it to do it	1
No	1
None	1
No	1
None	1
I don't think I've ever had them inspect one of my project.	1
Stop it! We usually do a load calculation to make sure we're welling the right equipment. If the SEER rating is there, the ECM motor is there, there's no need for an inspection.	1
None	1
I think most of it works really well. It would be nice if there was an auto-fill option on the website.	1
I don't know too much about it.	1
Nope	1

Q32. Please rate the extent to which you are satisfied with the following aspects of the program using a 0 to 10 scale. How satisfied are you with:

Program training offered by Duke

Response Option	Percent (n=58)
0	3%
1	2%
2	2%
3	2%
4	5%
5	24%
6	7%
7	5%
8	10%
9	3%
10	17%
N/A	12%
Don't know	3%
Refused	0%

Your Duke energy trade ally representative

Response Option	Percent (n=58)
0	10%
1	12%
2	0%
3	0%
4	0%
5	29%
6	3%
7	9%
8	7%
9	5%
10	34%
N/A	5%
Don’t know	7%
Refused	0%

The program website for customers

Response Option	Percent (n=58)
0	2%
1	0%
2	2%
3	%
4	2%
5	10%
6	2%
7	12%
8	3%
9	3%
10	10%
N/A	19%
Don’t know	34%
Refused	0%

The trade ally portal applications tracking system

Response Option	Percent (n=58)
0	3%
1	3%
2	3%
3	0%
4	9%
5	5%
6	5%
7	14%
8	19%
9	12%
10	26%
N/A	0%
Don't know	0%
Refused	0%

The marketing of the program

Response Option	Percent (n=58)
0	2%
1	0%
2	0%
3	3%
4	3%
5	29%
6	5%
7	10%
8	12%
9	2%
10	17%
N/A	7%
Don't know	9%
Refused	0%

The incentive applications submission process

Response Option	Percent (n=58)
0	3%
1	2%
2	3%
3	3%
4	9%
5	10%
6	5%
7	16%
8	16%
9	7%
10	22%
N/A	2%
Don't know	2%
Refused	0%

The selection of eligible equipment and services

Response Option	Percent (n=58)
0	0%
1	2%
2	0%
3	0%
4	3%
5	14%
6	9%
7	12%
8	24%
9	5%
10	29%
N/A	0%
Don't know	2%
Refused	0%

The overall program

Response Option	Percent (n=58)
0	2%
1	3%
2	5%
3	2%
4	0%
5	9%
6	5%
7	19%
8	21%
9	14%
10	21%
N/A	0%
Don't know	0%
Refused	0%

Q33. [ASK IF ANY ANSWER IN Q32 < 5] Please explain why you were dissatisfied with:

Program training offered by Duke Energy

Verbatim Response	Count (n=8)
I don't know that I've been offered training for it. I don't know what you're talking about.	1
Didn't even know it was there.	1
Never had any offered to me. I didn't know it existed.	1
I have never received any training or any notification about it.	1
See previous answer.	1
There isn't really any training. I haven't received any training.	1
They haven't provided any within the last year.	1
Don't know	1

Your Duke energy trade ally representative

Verbatim Response	Count (n=7)
I don't know who he is. Lack of communication with me or our company.	1
Didn't even know that I had one.	1
They don't return calls or emails. I'm not sure who it is because it changes regularly.	1
That's the company that handles the rebates. It's awful now. The feedback, website, insurance is difficult.	1
Never had any contact with him. Emailed 3 times and got no response.	1
I haven't from anybody	1
Not aware they exist.	1

The program website for customers

Verbatim Response	Count (n=3)
Don't know	1
Don't know	1
Ease of use.	1

The trade ally portal applications tracking system

Verbatim Response	Count (n=11)
Slow Process	
It's not up to date. It doesn't report. It's just not accurate.	
Mostly because of the length of time to get a response if it was been approved. If it does not get approved, it's been 30 days and gets entirely rejected after 60 days.	
It's just not correct. I have to call in a lot and then they put the application on hold for days. I end up calling a lot.	
Ease of use. Not user friendly. Upload hard.	
If it's in review, it won't tell you why. I don't know why applications pass or fail.	
Don't know	
Some have gotten to be taken care of, but mostly never gets updated on my end.	
needs more information. It needs when the customer has been paid	
It takes a little while to upload, if there is information put in wrong, can't go back and fix it. Doesn't tell me what is wrong all the time, most the time I have to call. The way it wants us to fix things is silly.	
It doesn't show that the customer has been paid their rebate. The rebates just seem to disappear and I am unable to find that they've been processed.	

The marketing of the program

Verbatim Response	Count (n=5)
Don't know	1
Don't know	1
Never seen any marketing.	1
hasn't really looked at the website	1
I've never seen marketing as a customer or a contractor.	1

The incentive applications submission process

Verbatim Response	Count (n=12)
Don't know	1
It just doesn't take what I put in there.	1
I can change that to a 5 of 10. The submission is fine, the requirements are inadequate.	1
Slow Process. Inaccurate. False Results. People I know FOR A FACT that qualify that don't get the rebate, then the contractor looks like a liar.	1
Some of the questions don't seem relevant.	1
Ease of use. Difficult sense last switch to new rebate company	1
The other way was so simple. For us to not get any compensation, except a referral (which I have not received), this takes the installers 1 hour extra and takes 45 minutes in paperwork to submit the rebate.	1
It's a pain in the butt. It's extra work I need to do to get a rebate for the customer and I don't get anything out of it. It's extra work to do.	1
not sure if you will be accepted	1
they require a lot of information.	1
It's redundant. I upload hand written paperwork that's identical to the electronic application. Considering the number of applications our company submits.	1
It takes too dang long. It's very tedious.	1

The selection of eligible equipment and services

Verbatim Response	Count (n=3)
Don't know	1
Because of the quality installation program for extra money. It's too time consuming. It costs the contractor more money than Duke is offering the customer. It costs us too much labor. You should just do away with the quality installation program.	1
I don't feel that 14 SEER equipment should get a rebate. Also there are other thermostats out there that are not the list. The heat pump package unit should be included.	1

The overall program

Verbatim Response	Count (n=7)
It was easy to deal with when you were using good-sense to submit applications. The PDF applications were much easier. If anything is wrong, now, it really makes this frustrating.	1
I don't think there's enough marketing. It's too difficult for any product under 15 SEER	1
Too much of a hassle. Unhappy customers. Slow. Bad results. Too complicated. NO incentive for contractors.	1
I've been here for 2 years, a guy applied for a rebate in Feb 2015 and he didn't get his rebate until late spring 2016. He would call me every three weeks. I would call duke and get different answers from different representatives. Despite the many re-submissions and reasons, he finally got his rebate. From a company standpoint, you put all the work on the contractor and the contractor needs to pay to do your rebate application. You don't give an incentive to the contractor.	1
Ease of use. Difficult sense last switch to new rebate company	1
it is a big hassle. Every time something is wrong they send a card to the customer	1
Quality Inspection Process is really the killer. It takes too much time to complete.	1

Q34. Thanks so much for your time today. Are there any other comments you would like to provide?

Verbatim Response	Count (n=13)
What is a Duke energy contracted truck?? I see smaller vans that says "Duke Energy Contracted" and they're not just meter readers, they were doing something else. I don't know what they were doing.	1
We already try to sell higher end stuff. This is just extra work we are doing to get the customer money. You can't go from paying someone to do something to making it WAY harder and not paying them anymore.	1
they ought to offer the dealer some incentive like they before for doing all the paperwork.	1
Sometimes our customers get a pre-paid visa card, sometimes a check. It would be nice to know what determined which one they will receive so that we can tell our customers. For people who are not as technologically enhanced, a check would be MUCH NICER than a VISA card.	1
Please start paying the contractors for the rebate paperwork and making sure the installations are done correctly. This all takes time. Do away with the 14 SEER rebates and start at a higher SEER level.	1
on the portal when it says it is in review it could give more of an explanation on if it was completed and when the card was mailed	1
My experience is that most HVAC companies will offer their own rebates because of the Quality Install process. The percentages and calculations that Duke is asking for is very redundant and pointless. Because the contractors are supposed to have the inspection done by the county, the quality install process is not necessary.	1
It would be nice if Duke would offer incentive the people that install the rebated equipment.	1
I'm very upset that my employer has to pay me a salary to process the rebates and he gets no compensation for it.	1
I wish you would provide an incentive to the contractor. I wish you hadn't taken our incentive because it is extra work. We should be paid for the time it takes us to submit the rebate	1

Verbatim Response	Count (n=13)
paperwork.	
give money back to the dealers	1
A lot of the time when someone else gets the job they will send us a thing that requires us to look at their reference number. On the paper it says "Loss". When I check it, it shows that the people never call us to give them a quote. That is just wording. Marketing can improve. We get a lot of referrals but we don't have a lot of people that call us. Put a check box that asks the customer if they would like us to call them or not. That will improve rebates and business for contractors.	1
Get rid of the quality checklist/quality inspection.	1

Nexant

Headquarters
101 2nd Street, Suite 1000
San Francisco CA 94105-3651
Tel: (415) 369-1000
Fax: (415) 369-9700
www.nexant.com

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Carolinas

2015 Low Income Weatherization Program Evaluation Report – Final

June 13, 2018

Opinion Dynamics

Contributors

Ann Collier
Principal Consultant, Opinion Dynamics

Matt Drury
Senior Engineering Manager, Opinion Dynamics

Evan Tincknell
Consultant, Opinion Dynamics

Eric Ziemba
Consultant, Opinion Dynamics

Opinion Dynamics

Table of Contents

Table of Tables

Opinion Dynamics

Table of Figures

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1. Evaluation Summary

This report presents findings from our evaluation of the Duke Energy Carolinas (DEC) Low Income Weatherization Program (DEC Weatherization Program). Process results are based on a materials review, in-depth interviews with program staff and weatherization agencies, and a telephone survey of program participants. Impact evaluation activities included a deemed savings review and billing analysis. This report includes methods, results, and findings of both process and impact analyses.

1.1 Program Summary

The DEC Weatherization Program aims to improve the health, safety, and energy efficiency of income-qualified Duke Energy customer households. Duke Energy does so by leveraging existing weatherization programs that fund a comprehensive package of electric conservation measures that increase energy efficiency and lower household energy costs. The weatherization, health, and safety benefits are provided at no cost to Duke Energy's customers. The program's secondary goals are to provide customer education on energy efficiency actions, measures, and other available programs, and to track and report on how DEC Weatherization Program funding is being expended across the DEC service territory. Duke Energy's implementation partners consist of the program administrator (the North Carolina Community Action Association, or NCCAA); the database administrator (Lockheed Martin); and a network of local implementing agencies that include community action agencies, local governments, and other nonprofit organizations that enroll customers and complete weatherization projects.

As noted above, Duke Energy designed the DEC Weatherization Program to leverage the federally-funded state weatherization assistance programs (State WAP) that agencies in North Carolina and South Carolina already implement.[1] Although the State WAP provides extensive weatherization resources, agencies report that need in their communities exceeds annual resources and that certain customers face barriers in receiving weatherization measures. The high demand results in long wait times, and the lack of funding available to complete pre-requisite building health and safety upgrades means that eligible homes in poor condition are further delayed. To enable additional weatherization, the DEC Weatherization Program uses the State WAP as a framework for distributing Duke Energy funding to implementing agencies. Specifically, Duke Energy pays agencies a fixed price per State WAP project completed at qualifying Duke Energy customer homes,[2] with the requirement that agencies then use the funds to support future weatherization-related activities.

The State WAP programs treat this transaction as a "purchase" of savings by Duke Energy. Further, WAP programs and Duke Energy agree that Duke Energy can claim 100% of the savings at each home it credits an agency for, including cases where Duke Energy funds cover just part of the upgrade costs. According to the National DOE/State WAP manager interviewed for this evaluation, such a setup is common among income-qualified weatherization programs that leverage both public and utility funds. Agencies in North Carolina then spend their funds on future weatherization-related projects, wherever they are most needed.[3]

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[1] The State WAP is funded by the U.S. Department of Energy (DOE) Weatherization Assistance Program and the U.S. Department of Health and Human Services (DHHS) Low Income Home Energy Assistance Program (LIHEAP).

[2] The price is "fixed" in that Duke Energy offers set payments per measure installed, up to a per-project cap. The per-project cap is determined by eligibility tier (Tier I, Tier II, refrigerator replacement) and is discussed later in this report.

[3] DOE rulings about how agencies can spend DEC funds differ by state and have changed over time. DOE rulings in place for 2015 treated funds as 'program income,' requiring North Carolina and South Carolina agencies to spend the money by the end of the fiscal year. In 2016, the North Carolina DOE ruling changed such that DEC funds are now treated as 'unrestricted' and agencies no longer

Projects eligible for DEC Weatherization Program funds must have been completed for a Duke Energy customer who lives in an individually metered, single family home, and who has a household income less than or equal to 200% of the federal poverty guideline. The DEC Weatherization Program offers two tiers of funding for owner-occupied homes, as well as a refrigerator replacement offering to both owners and renters (with landlord approval). Tier I covers eligible projects at homes using less than 7 kWh per square foot annually and provides up to $600 for air sealing and low-cost energy efficiency upgrades like CFLs, domestic water heater tank insulation, low-flow shower heads, faucet aerators, and others. Tier II funds cover eligible projects at homes using at least 7 kWh per square foot annually and provide up to $4,000 for Tier I measures plus insulation improvements. Tier II projects can qualify for a higher funding cap of $6,000 if they include a qualifying heat pump upgrade or a heat pump system replacement. Refrigerator replacement is available even if the home did not receive any Tier I or Tier II measures. Refrigerator replacement eligibility and incentive levels are dependent on the old refrigerator's size and a two-hour metering test.

Duke Energy launched the DEC Weatherization Program in January 2015. This report evaluates impacts achieved from the 651 projects completed by 12 agencies between January 1, 2015 and March 31, 2016. This impact evaluation period was selected to obtain enough projects for a billing analysis.

1.2 Evaluation Objectives

The evaluation had several impact and process evaluation objectives. Given that the program is still relatively new and uses a unique delivery model, we focused our process evaluation on exploring how program processes affect agency participation and performance. This final report offers process findings and adds impact analysis results. The overall objectives of the evaluation are discussed below.

Impact Evaluation Objectives

1. Review program savings assumptions and calculations, and develop measure-specific deemed savings estimates for measures provided through the program.
2. Verify measure receipt, installation, and persistence.
3. Estimate program energy savings (kWh), summer and winter peak demand (kW) savings, and realization rates.

Process Evaluation Objectives

1. Understand how program processes, including funding allocations to implementing agencies, contribute to program participation and performance.
2. Identify program strengths and potential ways that the program can increase average per-household savings from the program.
3. Identify barriers to increasing program participation by eligible customers and ways that the program can address those barriers.

To achieve these objectives, we completed a number of data collection and analytic activities.

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have to spend them during the fiscal year. South Carolina rulings are unchanged and as a result few South Carolina agencies are participating in the program so far.

Process evaluation activities included materials review, interviews with Duke Energy program staff, two series of interviews with implementing agency staff, an interview with the NCCAA and Lockheed Martin, an interview with North Carolina WAP and Federal WAP managers, and a participant survey of customers who live in the homes weatherized through State WAP and submitted to the DEC Weatherization Program.

Impact evaluation activities included a review of program-tracking data, a deemed savings review, an engineering analysis, and a billing analysis. We conducted the deemed savings review and engineering analysis (including development of in-service rates (ISRs) based results of the participant survey) to provide insight into the contributions of individual measures to overall program savings. We also used the engineering analysis results to develop a ratio of overall kWh to kW savings. The billing analysis provided average per-household net energy savings to which we applied the kWh-to-kW ratio to calculate demand savings.

1.3 Key Evaluation Findings

Program net energy and demand savings for the DEC Weatherization Program are derived from the results of our billing analysis and our engineering analysis. Table 1-1 presents the net ex post savings results on an annual per-participant basis, as well as net program savings for participants who received weatherization during the evaluation period (January 1, 2015 through March 31, 2016). Ex post savings for refrigerator replacements come from the engineering analysis. Ex post savings for Tier I and Tier II weatherization projects come from the billing analysis and reflect total per-home savings for each Tier, without refrigerators. Based on these billing analyses, Tier I participants saved 3.3% of their baseline energy usage and Tier II participants saved 15.5% of their usage, after receiving weatherization measures from the program (and not including any efficient refrigerator replacements). At the participant level, Tier I and Tier II results are not additive (because Tier II projects include Tier I measures), but savings from refrigerator replacements can be added to weatherization savings (due to the billing analysis specification).

Table 1-1. Participant and Program Impact Results

Program Component	Net Annual Savings Per Participant			Net Program Savings		
	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Refrigerator Replacement	1,194	0.136	0.136	103,878	11.8	11.8
Weatherization – Tier I	262	0.044	0.070	28,820	4.9	7.7
Weatherization – Tier II	2,241	0.178	0.911	1,192,212	94.8	484.8
Overall Program	n/a	n/a	n/a	1,324,910	111.4	504.3

Program savings reflect the mix of measures provided to participants in each component. According to program-tracking data, 17% of participants received Tier I measures and 82% received Tier II measures. In addition, 13% received a refrigerator replacement, usually as an addition to weatherization and sometimes as a stand-alone upgrade. Table 1-2 shows the share of homes that received measures from each of six main categories, with most homes receiving the air sealing and weatherstripping measures provided in Tier I (97%). A majority of homes also received HVAC measures (77%), hot water measures (74%), insulation (73%), and lighting (65%). We present the share of customers receiving specific measures in the body of the report.

Table 1-2. Program Measure Mix from Program-Tracking Data

Measure Category	% Receiving Measure Category (N=651)
Air Sealing and Weatherstripping	97%
HVAC	77%
Hot Water	74%
Insulation	73%
Lighting	65%
Refrigeration	13%

The process evaluation documented ways that the DEC Weatherization Program was able to minimize the training and development normally required to begin implementing a new program. For one, the Weatherization Program's design builds on systems already in place for the State WAP. Additionally, the program uses Lockheed Martin's program-tracking software, LM Captures, which agencies already use to track projects for the Duke Energy Helping Home Fund (HHF) Program. The NCCAA, Lockheed Martin, and agencies give the software high marks for its flexibility and comprehensiveness and indicated that the program's overall logistical processes are working smoothly. By building on these preexisting frameworks, the DEC Weatherization Program benefits from previously established relationships, implementation processes, and program-tracking systems.

The process evaluation also showed that the DEC Weatherization Program is not only appreciated by both implementers and customers, but is also poised to provide notable social welfare benefits. Although the program faced some initial challenges in getting agencies to participate early on due to statewide weatherization guidelines, changes to the North Carolina State WAP guidelines helped to increase agency interest in the program. As of this report, all agencies in North Carolina submit 100% of eligible projects to the program; as a side benefit, these agencies have been spending their new funds on under-funded health and safety upgrades and other activities. Many of the participating agencies feel that the DEC funds have allowed them to be more flexible when serving customers, and about one-half report being able to complete larger weatherization projects than they would have otherwise been able to do.

In South Carolina, agencies have struggled to participate in the DEC Weatherization Program. This occurred because most of the South Carolina agencies either have not spent their annual DOE/LIHEAP grant from the South Carolina State WAP program or have not met their required annual quota of completed homes in that program. Since the South Carolina State WAP DOE/LIHEAP grant is their primary funding source, it is critical that the agencies first meet their completion quotas before taking on any additional programs, otherwise they are at risk of possibly losing future funding. If the South Carolina agencies requested the DEC Weatherization Program incentive, South Carolina State WAP would require them to add the incentive back into the DOE/LIHEAP grant, to adhere to all DOE rules for the funding and to complete more homes.

1.4 Evaluation Recommendations

Based on our process evaluation, Opinion Dynamics has the following recommendations for improving program performance and overall savings:

- **Continue to expand training and informational resources for implementing agencies.** Agencies noted that in the first few months after the program kicked off, they had frequent communications with Duke Energy and NCCAA to clarify certain measure specifications and eligibility requirements. Agency staff expressed their satisfaction with the responsiveness and attentiveness of Duke Energy and NCCAA

Opinion Dynamics

staff. This goodwill can be built on to provide additional resources that enable agencies to implement the program self-sufficiently in the future. For example, agency staff suggested that more detailed information upfront could have enabled them to address some issues on their own. To help them operate more self-sufficiently, some agencies suggested that Duke Energy provide written materials like program implementation plans and decision-making tools (e.g., decision trees or flowcharts). Developing these or other written materials would be valuable to provide a smoother on-boarding for any agencies that join in the future.

- **Consider including existing refrigerator "test-in" results as part of the program enrollment records entered into LM Captures.** Auditors routinely collect baseline efficiency of inefficient refrigerators before they are replaced through State WAP. During the evaluation period, agencies did not report these data to Duke Energy when requesting DEC Weatherization Program funding. As savings from refrigerators are expected to provide about 10% of total program savings (on an ex ante basis), refrigerator test-in data are valuable inputs to the deemed savings analysis. In our evaluation, we found that refrigerators replaced by the program are considerably less energy efficient than industry-standard baselines for new refrigerators; thus, having project-specific data moving forward will enable the program to continue claiming savings based on the most accurate deemed savings estimate. As the parameters are already captured for State WAP reporting, the change may not represent a noticeable increase in reporting time for the agencies.

- **Consider including more detail on air sealing as part of the program records entered into LM Captures.** Based on the deemed savings review, air sealing drives the whole-home savings from Tier I projects and is one of the top drivers of whole-home savings from Tier II projects. To develop deemed savings for air sealing, the engineering review made industry-standard assumptions about the extent and type of air sealing conducted based on available program material, as the program-tracking data did not provide specific project-level details. If the program is interested in obtaining further updates to the air sealing deemed savings, it would be useful to record details of air sealing projects in tracking data, such as blower door test results or the specific air sealing activities completed.

- **If feasible from a Duke Energy standpoint, consider providing funding as biweekly payments instead of monthly payments.** Overall, the funding request and processing system works well in the eyes of the NCCAA and the implementing agencies, and the system received their praise for its consistency. Nonetheless, several agency staff suggested that biweekly payments would be helpful to ensure that agencies can avoid funding gaps that delay project implementation. Biweekly payments may particularly benefit smaller agencies that have less week-to-week funding available by improving the steadiness with which they receive funds. The shift would also bring the funding cycle more into sync with the Duke Energy Helping Home Fund which is administered by the same organizations and implemented by some of the same agencies as DEC Weatherization.

2. Program Description

For many years, income-qualified Duke Energy customers in North Carolina and South Carolina have been able to receive weatherization assistance through state weatherization assistance programs (State WAP) that are funded via the U.S. Department of Energy (DOE) and U.S. Department of Health and Human Services (DHHS).[4] Due to a combination of factors, some customers in need of weatherization find themselves on waiting lists for years before receiving help from the State WAP. Key drivers are the high level of need for weatherization services among these states' low-income communities, the State WAP's approach to prioritizing customers based on need, and the lack of funding to fulfill State WAP requirements that building health and safety are addressed before weatherization.

Working within this context, Duke Energy Carolinas (DEC) began offering its Low Income Weatherization program (DEC Weatherization Program) in January 2015 to improve the health, safety, and energy efficiency of income-qualified DEC customers' homes. To meet these goals, the program allocates funding to local community agencies based on qualified weatherization projects that agencies have recently completed for eligible DEC customers using State WAP funding. The amount of DEC Weatherization Program funding provided corresponds to measure costs incurred in implementing the State WAP project. The funding is considered unrestricted program income in North Carolina that the agencies can use to either indirectly support future weatherization activities (e.g., health and safety upgrades, administrative staff) or directly support weatherization by financing the installation of weatherization measures at customer homes. Providing funding in this way is intended to help agencies to serve more customers than they would otherwise be able to with State WAP grants alone. Specifically, agencies can use the DEC funds to meet the greatest needs that they observe in the community, e.g., to accelerate certain projects, to complete larger projects, and/or to complete more projects. Through the funding mechanism, Duke Energy achieves savings and enables agencies to install energy-saving measures and weatherization services at more customer homes than they would otherwise be able to serve through the State WAP alone. All upgrades are provided at no cost to the customer.

The program period under evaluation is January 1, 2015 through March 31, 2016. Over this period, the program credited agencies for weatherization services at 651 unique customer homes. The remainder of this section describes the weatherization services, customer eligibility criteria, and additional details about the program's administration and funding models.

2.1 Program Administration

The North Carolina Community Action Association (NCCAA) administers the DEC Weatherization Program, and its subcontractor, Lockheed Martin, manages the program-tracking database. Fourteen local agencies are eligible to implement the program—including community action agencies, local and regional government offices, and other nonprofit organizations. These agencies also implement a variety of poverty relief activities, including the State WAP. Twelve of the eligible agencies participated during evaluation period. All 11 North Carolina agencies participated, plus one of three South Carolina agencies.

Agencies' processes of implementing the State WAP entail recruiting and enrolling customers, conducting energy efficiency assessments at enrolled homes, installing measures, and performing a comprehensive

[4] The State WAP are funded by the DOE Weatherization Assistance Program and the DHHS Low Income Home Energy Assistance Program (LIHEAP). Since 1976, the DOE has provided federal funding for more than 7 million households across the U.S. to receive weatherization services. The DOE allocates these funds to each state or territory, which then provides the funding to implementers, sometimes in conjunction with its own contributions.

quality control analysis once the work has been completed. The State WAP is supported with two forms of federal funding: the DOE Weatherization Assistance Program and the DHHS's LIHEAP.

To request and receive DEC Weatherization funds based on their State WAP activity, agencies are responsible for identifying State WAP projects that meet DEC eligibility requirements and then applying for DEC funds via NCCAA's tracking database. The program's original intent was to provide the funds as a direct rebate for completed weatherization work. Based on North Carolina WAP program guidelines, agencies can record and spend the funds not as a rebate, but as income that they may spend on any weatherization-related activity, including weatherization measures and installation costs, health and safety upgrades, weatherization program administration, and other related activity. External to the program, State WAP rulings in states within the DEC territory (North Carolina or South Carolina) may place additional restrictions on how agencies must handle this funding. In 2015, North Carolina required that agencies spend the DEC funding within the same program year, although that restriction was lifted in mid-2016. Continuing since 2015, South Carolina State WAP considers the DEC program's process a reimbursement of the State WAP funds, and requires agencies to return to WAP the value of any funding received from Duke Energy and not spent during the program year. As State WAP funding is critical to agency operations, this ruling appears to have prevented all but one eligible South Carolina agency from participating during the evaluation period. Nearly all agencies (and customers) served through the 2015 program are located in North Carolina.

2.2 Program Funding Tiers and Requirements

As noted above, Duke Energy uses State WAP projects completed at eligible DEC customer homes as a vehicle to distribute DEC Weatherization Program funding. Funds are available on a tiered schedule of eligibility and benefits corresponding roughly to the extent of the energy-saving measures provided. At a minimum, State WAP services must have been provided to a Duke Energy Carolinas customer living in an individually metered residence and, in compliance with State WAP guidelines, the customer must have a household income less than or equal to 200% of the federal poverty guideline. As shown in Table 2-1, the DEC Weatherization Program provides funding based on two tiers available for owner-occupied single-family homes, and a separate refrigerator offering for both owners and renters of single- or multi-family homes (with landlord approval). Additionally, the level of energy usage at the home (kWh per square foot of living area) determines eligibility for the service tiers, while customers' heating fuel type determines eligibility for specific HVAC measures within the highest tier. Generally, Duke Energy provides more agency funding for projects that completed a more-comprehensive package of upgrades, were done at homes with a higher baseline energy usage, and in the case of HVAC upgrades and replacements, homes with electric heat.

- Tier I funds are available for weatherization at eligible customer homes that use less than 7 kWh per square foot annually. Funding is provided per measure based on a mix of low-cost energy efficiency upgrades, such as electric heating system tune-ups, CFLs, domestic water heater tank insulation, low-flow shower heads, and faucet aerators (up to $600 in DEC funding).
- Tier II funds are available for eligible customer homes using at least 7 kWh per square foot annually, and cover any Tier I measures provided, plus additional insulation improvements (up to a total cap of $4,000). In select circumstances, Tier II projects can qualify for a total cap of $6,000 if they also included a heat pump upgrade or replacement.
- Refrigerator replacement, based on replacing a renter's or homeowner's inefficient refrigerator with an energy-efficient one, regardless of whether or not the customer received Tier I or Tier II measures (up to $1,080). Refrigerator replacement eligibility and program funding levels are also dependent on the old refrigerator's size and a two-hour metering test.

Table 2-1. Overview of Program Offerings (January 2015 through March 2016)

Program Tier (# of customers)[1]	State WAP Services Contributing to DEC Weatherization Tiered Funding Cap	Project Eligibility Requirements
Tier I Weatherization (N=110)	Provides up to $600 in funding based on the following: • Water heating (domestic water heater tank and pipe insulation, tank temperature adjustment, low-flow shower heads, low-flow aerators) • Heating system tune-up • Lighting (CFLs) • Air sealing, weatherstripping	• Income-eligible DEC customers • Property owners • Single family homes • Home has electric, oil/liquefied petroleum (LP) gas, or natural gas heat
Tier II Weatherization (N=532)	Provides up to $4,000 in funding based on the following: • Tier I services • Insulation (attic, belly, floor, knee wall, manufactured home roof cavity) • Heating system duct insulation, sealing If customer qualifies, Tier II funding cap is $6,000: • Tier I services • Insulation (attic, belly, floor, knee wall, manufactured home roof cavity) • Heating system duct insulation, sealing • HVAC (heat pump upgrade *or* replacement)	Tier II Insulation: • Income-eligible DEC customers • Property owners • Single family homes • Home has electric, oil/LP gas, or natural gas heat • Using ≥7 kWh/ft^2 Tier II Insulation plus HVAC: • Same requirements as Tier II Insulation, but home must have electric heat
Refrigerator Replacement (N=87[2])	Provides up to $1,080 in funding based on the following: • ENERGY STAR® refrigerator (15, 18, or 21 cu. ft.)	• Income-eligible DEC customer • Property owners, or renters with landlord approval • Old refrigerator must meet size and efficiency cutoff as determined by a 2-hour metering test

1: Per program-tracking data, agencies requested DEC Weatherization Program funding based on a total of 651 unique customers served through the State WAP between January 1, 2015 and March 31, 2016. Of the 87 total customers who received refrigerator replacement, 9 received only the refrigerator while 11 also received Tier I weatherization and 67 also received Tier II weatherization.

3. Overview of Evaluation Activities

To answer the research questions outlined as part of the evaluation objectives (Section 1.2), the evaluation team performed a range of data collection and analytic activities, including:

- Program materials review
- Program stakeholder interviews
  - Interviews with Duke Energy program staff (n=2)
  - A combined interview with two program administrator staff: NCCAA and its subcontractor, Lockheed Martin (n=1)
  - Two series of interviews with implementing agency staff (n=3 in 2016, n=9 in 2017)
  - A combined interview with the State WAP manager, several Duke DEC Weatherization staff, and a Federal WAP manager (n=1)
- Participant survey (n=98)
- Impact analyses
  - Deemed savings review and engineering analysis
  - Billing analysis

In Sections 4 and 5, we provide more details on the methods and results of the impact and process analyses, respectively. Below, we summarize the scope of the program stakeholder interviews, program materials review, impact analyses, and the scope and sampling approach for the participant survey. Each of these components supported the impact and process evaluation.

3.1 Program Materials Review

Duke Energy staff provided Opinion Dynamics with program materials, including documentation of program plans and designs. The materials we received included:

- Program-tracking data
- Program orientation presentation slides for implementing agencies
- Plan and program descriptions for the DOE WAP and DHHS LIHEAP on which DEC's Weatherization program is based
- List of implementing agencies in North Carolina and South Carolina

The information from program documentation provided insight into program design and delivery and supported evaluation activities.

3.2 Program Stakeholder Interviews

We conducted a series of in-depth interviews with current program staff, the program administrator, implementing agencies, and WAP funding agencies. The primary purpose of each interview was to gain insight into program implementation processes. In particular, the interviews allowed us to identify consistencies and inconsistencies across the program, processes that are working well, and processes that could use improvement moving forward.

3.2.1 Duke Energy Program Staff Interview

Two interviews with Duke Energy program staff documented the program's structure and helped identify program-wide successes and challenges. The interviews allowed us to learn more about the program's overall design, program goals, and areas in which the program may look to improve in the future.

3.2.2 Program Administrator Staff Interview

We conducted one in-depth interview with NCCAA (the program administrator) and its database management subcontractor, Lockheed Martin. This interview explored program-wide coordination, delivery, and enrollment processes. It provided insight into the program's payment process and gauged administrators' satisfaction with program elements. The interview also helped identify key similarities and differences across implementing agencies.

3.2.3 Implementing Agency Staff Interviews

Of the 17 agencies identified as implementers of the DEC Weatherization Program, 12 submitted requests for funding during the evaluation period. Individual agencies each received funding for between 7 and 304 projects. These agencies are a mix of branches of regional government, accredited Community Action Agencies, and other nonprofit organizations. Eleven of the 12 participating agencies are in North Carolina, and one is in South Carolina.

We conducted two sets of semi-structured in-depth interviews with implementing agencies. The first set explored early feedback on program processes, including implementation processes and funding structure, as well as agencies' program satisfaction and views about successes and barriers to participation. We completed these general process interviews in August 2016 with staff at three agencies selected to represent varied types of organizations and levels of program participation. This initial set of interviews spurred discussion about how to most appropriately attribute savings and how the reimbursement model enables additional weatherization savings in the service area, leading to a second set of interviews focused on agency staff's program experience and the influence of Duke Energy funds. We completed the follow-up interviews in August and September 2017 and attempted a census of all agencies active during the current evaluation period. We completed interviews with nine of the twelve agencies, accounting for 75% of the active agencies and 71% of all projects that received DEC Weatherization funding during the evaluation period. Table 3-1 summarizes the sample and outcome for each set of agency interviews.

Table 3-1. Agency General Process Interview Sample

Interview Focus	Completed Interviews	Agencies in Sample	Cooperation Rate
General process (2016)	3	4	75%
Follow-up (2017)	9	12	75%

3.2.4 State WAP and Federal WAP Staff Interview

We conducted one interview that included the National WAP manager at the US Department of Energy (DOE), the North Carolina State WAP program manager at the NC Department of Environmental Quality (DEQ), DEC Weatherization Program staff, and Duke Energy EM&V staff. This interview established consensus about Duke Energy's ability to claim 100% of savings from the State WAP projects it uses to distribute funds. The interview provided insights into how WAP programs interface with other utility energy efficiency programs throughout the United States, documenting that the WAP agencies do not claim credit for kWh and kW impacts of utility-funded projects as part of their reporting, therefore negating any concerns about potential double-counting of savings.

3.3 Impact Analysis

3.3.1 Deemed Savings Review and Engineering Analysis

Duke Energy provided ex ante savings assumptions at the level of each program tier (Tier I, Tier II, and refrigerator replacement). While the primary source for evaluated program savings is the billing analysis, Opinion Dynamics conducted an engineering analysis to develop measure-specific deemed savings values and assumptions. The goals of the engineering analysis were to provide estimates of savings at the measure level that are consistent with standard industry practice and comparable with applicable Technical Reference Manuals (TRMs), thereby developing an understanding of the relative contribution of different measures to overall program savings. Opinion Dynamics reviewed the latest available TRMs and other secondary resources to develop estimated deemed savings for each measure. We used the deemed savings values to develop a ratio of kW demand to kWh energy savings that we applied to derive demand savings from billing analysis results. Engineering analysis also provides the ex post kWh and kW savings for refrigerator replacements.

3.3.2 Billing Analysis

Opinion Dynamics conducted a billing analysis to determine the savings attributable to the DEC Weatherization Program Tier I and Tier II projects during the evaluation period. We used a linear fixed effects regression (LFER) model to estimate the overall ex post program savings. The model allowed us to control for all household factors that do not vary over time by the individual constant terms in the equation. To increase statistical power in the model with additional sample sizes, we developed a treatment group that includes participants receiving weatherization within the evaluation period (January 1, 2015 through March 31, 2016) as well as several months thereafter. Thus, the billing analysis model included a treatment group of participants from January 1, 2015 through May 31, 2016, and a comparison group of participants from June 1, 2016 through June 18, 2017. Program impacts were calculated by applying these per-participant savings to only those participants whose homes were weatherized during the evaluation period. Section 4.3 provides a summary of the billing analysis approach; Appendix F provides a detailed description of the billing analysis methodology.

As customary for low-income programs, a formal net-to-gross analysis was not part of this scope of work. Note however, that billing analyses estimate holistic changes in energy use per customer home, and therefore incorporate the effects of any free-ridership and spillover, thus providing program net savings. For example, the energy use patterns of the members of the comparison group during the study period reflect any equipment installations or behavioral changes that treatment group participants may have performed if they not received weatherization measures through the program. In addition, the estimated participation coefficient captures the effect of any measures installed during the evaluation period beyond program measures (spillover).

3.4 Participant Survey

Opinion Dynamics implemented a computer-assisted telephone interviewing (CATI) survey with 98 customers for whom agencies requested funding for weatherization services during the evaluation period. We conducted the survey between June 6, 2016 and June 20, 2016. Program-tracking data for the evaluation period included 651 participants (covering 2015 and the first quarter of 2016, as noted above). After excluding records with missing or invalid phone numbers, we were left with a sample frame of 595 participants. We pulled a simple random sample of 300 customers from the sample frame. To meet precision targets for measure-level installation and persistence analyses, the evaluation team set a quota of 100 completes, designed to meet the industry-standard two-tail 90/10 confidence and precision criteria in terms of sampling error (at the level of individual measures asked about during measure verification questions). Quotas and precision estimates were tracked while fielding the survey to monitor progress toward the quotas and resulting confidence and precision. As a result of these tracking steps, we closed the survey at 98 responses, as that number provided the required 90% confidence that ISR results for nearly all key measures were within 10% of the true value in the population.[5] As detailed further in Appendix A, the survey achieved a 39% response rate (AAPOR Response Rate 3) and a 75% cooperation rate.

[5] Of the eight measure-specific ISR estimates, seven achieved precision of 10% or less with 90% confidence, including CFLs (10%), faucet aerators (10%), weatherstripping (5%), water heater tank and pipe wrap (4%), heating system repair (7%), air sealing (5%), and insulation (2%). Only showerheads (14%) did not achieve the desired precision with 90% confidence, which would have required surveying roughly 20 additional respondents to meet 90/10, which was not feasible within the available budget.

4. Impact Evaluation

This section describes the methodology and results of our impact analysis for the DEC Weatherization Program, including engineering analysis and billing analysis.

4.1 Measure Verification

4.1.1 Measure Verification Methods

The participant telephone survey instrument included questions designed to verify that participants received and installed program measures and that those measures remained in place and operational. We completed interviews with 98 respondents who recalled participating in the program. We used the survey results to estimate measure-level ISRs. Our engineering estimates use these ISR values in calculations of measure-specific savings.

Specifically, we asked sampled participants to confirm that they received the quantity of measures recorded in the program-tracking data and, when necessary, to update the quantity. We then divided the number of measures verified by the respondent by the quantity in the tracking database to calculate a rate of receipt. Where appropriate for the measure, we also asked respondents who confirmed receiving a measure to tell us the verified quantity of measures that had been installed; dividing the installed quantity by the received quantity provides the rate of installation. Finally, we asked respondents who had installed measures to tell us how many of the installed measures remained in place and operating to calculate a measure persistence rate. We then created a measure-specific ISR by multiplying the three components.

As noted above, we did not ask measure verification questions for all measures. Based on evaluation best practices, we confirmed installation for any measures that a weatherization technician may have left for the customer to install on his or her own time (e.g., CFLs). Similarly, we asked persistence questions only for measures that could be easily removed by customers. We assumed 100% installation and persistence where customer responses were not collected or where we deemed customer responses less reliable than program-tracking data (i.e., customer reasonably may not have known that a specific measure was installed at the visit). Table 4-1 outlines the development of ISRs by measure.

Table 4-1. Verification Steps by Measure

Measures	Confirmed Receipt	Confirmed Installation	Confirmed Persistence	ISR Formula
CFLs, faucet aerators, low-flow shower heads	✓	✓	✓	(% Received) x (% Installed) x (% Persisting)
Door weatherstripping, domestic water heater tank/pipe insulation	✓	X	✓	(% Received) x (% Persisting)
Heating system repair, heat pump upgrade, air sealing, insulation, refrigerator	✓	X	X	(% Received)

4.1.2 Measure Verification Results

The results of our participant survey showed relatively high ISRs for most measures in the DEC Weatherization Program (Table 4-2). We achieved a relative precision of 10% with 90% confidence around 8 of the 9 measure-level ISRs that we report based on survey findings (Table 4-2). Customers confirmed receiving the majority of measures recorded in the program-tracking data. Only two measures (low-flow shower heads and low-flow aerators) are reportedly still installed in fewer than 80% of cases.

Table 4-2. Measure-Specific In-Service Rates

Measure (number of respondents)	Receipt Rate	Installation Rate	Persistence Rate	ISR [b]
Duct insulation; duct sealing[a]	N/A	N/A	N/A	100%
Heat pump upgrade[a]	N/A	N/A	N/A	100%
Water heater temperature adjustment[a]	N/A	N/A	N/A	100%
Refrigerator (n=11)	100%	N/A	N/A	100%
Insulation (n=87)	98%	N/A	N/A	98%
Domestic water heater tank/pipe insulation (n=70)	96%	N/A	100%	96%
Door weatherstripping (n=50)	93%	N/A	99%	92%
Air sealing (n=93)	91%	N/A	N/A	91%
Heating system repair (n=42)	90%	N/A	N/A	90%
CFLs (n=57)	88%	99%	96%	84%
Low-flow aerators (n=59)	78%	96%	99%	74%
Low-flow shower heads (n=55)	84%	89%	94%	70%

[a] Deemed at 100% due to unreliable recall (duct insulation and sealing), survey non-response (heat pump upgrade), or possible lack of awareness that upgrades had been completed (water heater temperature adjustment).
[b] All ISRs based on survey findings achieved a relative precision of 10% with 90% confidence, except for low-flow shower heads, which achieved a relative precision of 14% with 90% confidence.

The resulting ISRs are comparable to evaluation results for Duke Energy Neighborhood Energy Saver (NES) programs (DEC NES and Duke Energy Progress [DEP] NES). Like the DEC Weatherization Program, the DEC and DEP NES programs offer multiple measures for low-income Duke Energy customers using a direct installation delivery model (Table 4-3).

Table 4-3. ISR Cross-Program Comparison

Measure	DEC Weatherization 2015	DEC NES 2015[a]	DEP NES 2014[a]	DEC NES 2014[b]
Refrigerator	100%	--	--	--
Insulation	100%	--	--	--
Domestic water heater tank/pipe insulation	96%	67%	81%	100%
Weatherstripping	92%	80%	85%	86%
Air sealing	91%	--	--	--
Heating system repair	90%	--	--	--
CFL	84%	79%	86%	95%
Low-flow aerator	74%	87%	72%	99%
Low-flow shower head	70%	91%	85%	99%

[a] Used participant survey to verify receipt, installation, and persistence; no other factors are incorporated.
[b] Assumed all measures installed by auditor so did not verify receipt; used participant survey to verify persistence, incorporated future installations for CFLs.

4.2 Engineering Analysis

4.2.1 Engineering Analysis Methodology

Opinion Dynamics conducted a deemed savings review and engineering analysis for each measure. The program has overall ex ante savings assumptions for Tier I, Tier II, and refrigerator replacement; it does not currently have estimates of savings for individual measures within Tiers I and II. The purposes of the deemed savings review were to:

1. Provide insight into the individual measure contributions to the overall program savings
2. Develop a ratio of kW demand to kWh energy savings, which is then applied to the billing analysis net energy savings to estimate net demand savings

To complete this review, Opinion Dynamics used engineering algorithms from several TRMs and used DEC-specific inputs to those algorithms whenever possible. Since neither North Carolina nor South Carolina has a statewide TRM, we used DEC-specific assumptions whenever possible and relied on other TRMs for algorithms and assumptions as needed. TRMs utilized for algorithms and inputs included the Arkansas TRM, Illinois TRM, Indiana TRM, Mid-Atlantic TRM, and Tennessee Valley Authority TRM.

For many measures, the amount of savings that a home achieves from the measure depends on the type of fuel and heating system the home uses (e.g., heat pump, electric resistance, gas heat) and whether air conditioning is present. For example, air sealing provides the most savings to electric-heated homes, less savings to a gas-heated home that uses summer air conditioning, and no electricity savings to a home that is gas-heated and does not use air conditioning. Through a review of the participant database (covering January 1, 2015 through March 31, 2016), Opinion Dynamics determined that approximately 17% of participants have gas heat and approximately 68% have central air conditioning. We used this data to weight per-measure savings by the prevalence of electric- and non-electric-heated homes and homes with air conditioning. Deemed per-measure electricity and demand savings are, therefore, weighted average savings given participant characteristics.

The engineering analysis takes into consideration the measure in-service rates (ISRs) determined from the participant survey to ensure that program-level savings estimates reflect savings for installed measures only. Note that the billing analysis determines net evaluated energy (kWh) impacts for the program; this engineering analysis only supplements the billing analysis for the aforementioned reasons. Appendix D contains all detailed algorithms and assumptions used in the engineering analysis.

4.2.2 Engineering Analysis Results

This section provides gross energy and demand savings estimates for each measure offered by the DEC Weatherization Program in the evaluation period. Table 4-4 summarizes estimated gross per-measure deemed energy and demand savings across the measures installed through the DEC Weatherization Program, as determined through our engineering analysis. Opinion Dynamics did not estimate savings for heating system repair or for dryer vent replacement, as we believe savings for these measures are negligible based on our secondary review of TRMs and other references.[6] We based the measure-level savings shown in Table 4-4 on

[6] A heating system repair only “fixes” an inoperable system and does not actually improve efficiency. Through a review of Technical Reference Manuals across many areas, we have not found any jurisdictions that claim savings for a dryer vent replacement. While some savings may occur if the dryer vent was previously clogged, insufficient information is available to estimate savings from this measure.

the secondary review and on DEC Weatherization Program-specific assumptions determined from program-tracking data and the participant survey (i.e., the portions of homes using electricity for heating, cooling, and hot water heating). The deemed savings estimates in Table 4-4 also account for ISRs determined through the 2015 participant survey.

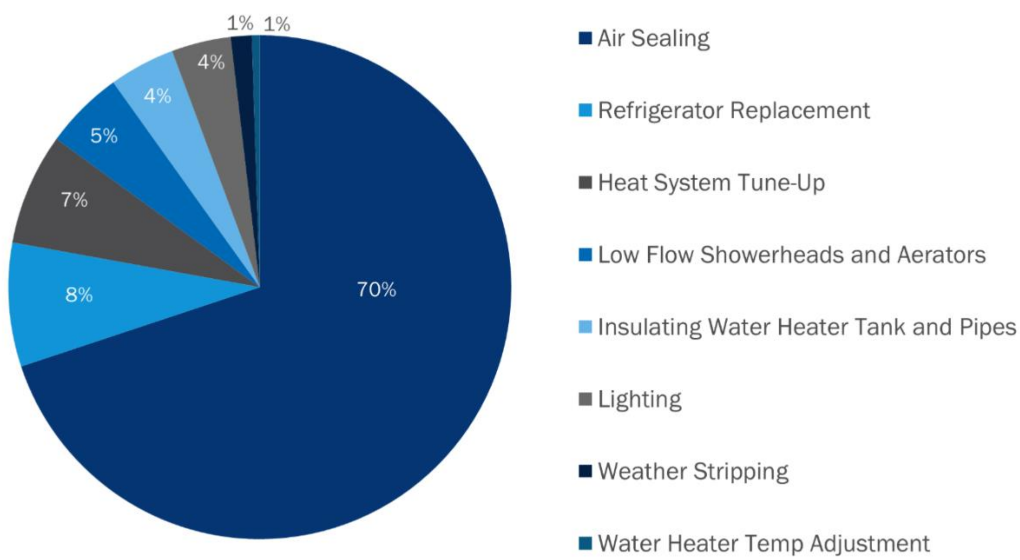
Table 4-4. Engineering Analysis Deemed Savings Summary

Type	Measure	Unit of Measure	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Water Heating					
Tier I	Domestic Water Heater Pipe Insulation	Per 10 feet	122	0.014	0.014
Tier I	Domestic Water Heater Tank Insulation	Per tank	102	0.012	0.012
Tier I	Water Heater Temperature Adjustment	Per tank	76	0.009	0.009
Tier I	Low-Flow Shower Head	Per shower head	51	0.005	0.010
Tier I	Low-Flow Aerator	Per aerator	88	0.007	0.013
Lighting					
Tier I	13W CFL	Per bulb	13	0.002	0.001
Tier I	18W CFL	Per bulb	29	0.004	0.003
Air Sealing and Weatherstripping					
Tier I	Air Sealing	Per home	1,069	0.217	0.339
Tier I	Door Weatherstripping	Per door	33	0.007	0.011
Insulation					
Tier II	Attic Insulation - Cellulose, Blown - R-30	Per sq. ft.	1.8	0.0001	0.0009
Tier II	Attic Insulation - Cellulose, Blown - R-38	Per sq. ft.	1.9	0.0001	0.0009
Tier II	Attic Insulation - Fiberglass, Blown - R-30	Per sq. ft.	1.8	0.0001	0.0009
Tier II	Attic Insulation - Fiberglass, Blown - R-38	Per sq. ft.	1.9	0.0001	0.0009
Tier II	Belly Fiberglass Loose	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Floor Insulation - Fiberglass, Batts - R-19	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Wall Insulation - Fiberglass, Blown - R-13	Per sq. ft.	1.4	0.0001	0.0006
Tier II	Wall Insulation - Cellulose, Blown - R-13	Per sq. ft.	1.4	0.0001	0.0006
Tier II	Knee Wall Insulation	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Manufactured Home Roof Cavity	Per sq. ft.	1.6	0.0001	0.0008
Heating System					
Tier I	Heating System Tune-Up	Per system	911	0.000	0.193
Tier II	Duct Insulation	Per system	415	0.022	0.197
Tier II	Duct Sealing	Per system	2,772	0.149	1.315
HVAC Upgrade/Replacement					
Tier II HVAC	Heat Pump Upgrade	Per heat pump	854	0.101	0.321
Tier II HVAC	Heat Pump Replacement	Per heat pump	2,837	0.343	1.066
Refrigerator					
Refrigerator	ENERGY STAR Refrigerator (15 cu. ft.)	Per refrigerator	1,229	0.140	0.140
Refrigerator	ENERGY STAR Refrigerator (18 cu. ft.)	Per refrigerator	1,206	0.138	0.138
Refrigerator	ENERGY STAR Refrigerator (21 cu. ft.)	Per refrigerator	1,182	0.135	0.135

Note: Table does not report savings from heating system repair or from dryer vent cleaning, which the evaluation team deemed to be *de minimis*.

Using the deemed savings values and participation data (referenced in Section 5.3.3, Program Participation), we calculated energy savings per-participant by Tier, and also calculated an overall kW per kWh savings ratio from the engineering analysis. Figure 4-1 shows the composition of energy savings among Tier I projects. Based on our engineering analysis, the largest share of Tier I energy savings came from air sealing (70%), followed by refrigerator replacements (8%) and heating system tune-ups (7%). Air sealing is a significant measure within the Weatherization Assistance Program guidelines. Technicians complete a comprehensive effort to identify all sources of air infiltration and leakage, guided by a blower door test. Then, technicians are directed to complete all air sealing needed to address the identified air infiltration issues, and which can be done cost-effectively. According to the North Carolina Weatherization Installation Standards, this can be an extensive undertaking including resolving sources of both primary and secondary leakage in attics, conditioned living areas, and basements/crawlspaces (North Carolina Weatherization Assistance Program, 2012).[7]

Figure 4-1. Engineering Results: Percentage of Tier I Energy Savings



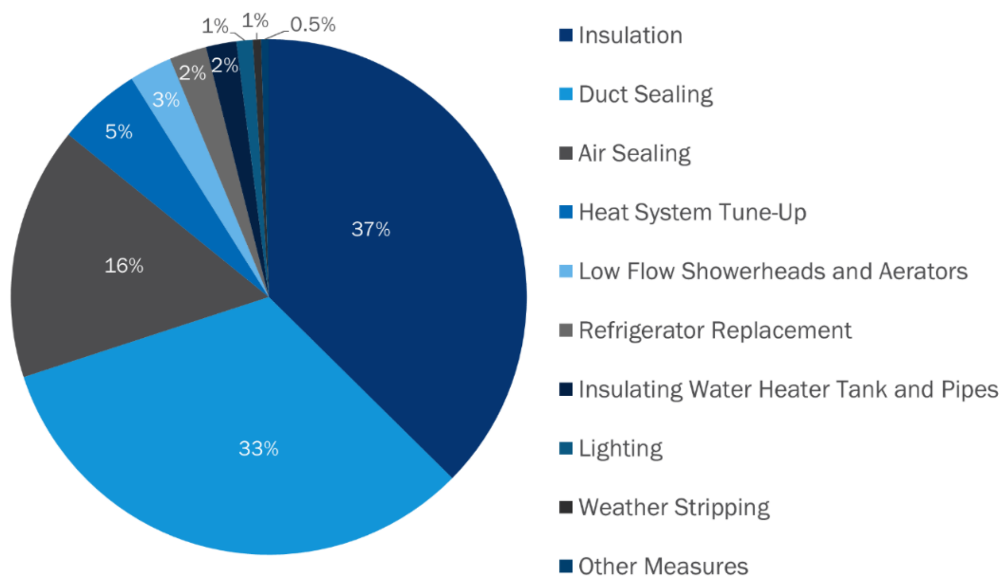
Percentages show measures' contribution to total Tier I savings, based on engineering analysis (ex post assumptions) of the total quantities installed across all Tier I participants (n=110).

Figure 4-2 shows the composition of energy savings among Tier II projects. Based on the engineering analysis, the largest share of energy savings from these projects came from insulation (37%), followed by duct sealing (33%) and air sealing (16%). Insulation and air sealing are common drivers of whole-home weatherization program savings, and as shown below, this is also true for the DEC Weatherization Program. Additionally, the engineering review shows that duct sealing also plays a large role in the program's Tier II savings. Duct sealing for forced air systems improves system efficiency and comfort for occupants. Duct sealing savings depend on the heating fuel and system in place at a home; savings are highest for customers with electric heat (compared to gas heat or heat pumps). Accordingly, because a relatively high share of North Carolina and South Carolina

[7] The DEC Weatherization Program tracking data received for this evaluation do not specify which air sealing measures were completed at each home. However, the North Carolina Weatherization Assistance Program guidelines reference measures like primary air sealing (e.g., holes in ceilings or walls, broken windows, missing dampers in chimneys and flues, leaks around window air conditioners, and others) and secondary air sealing (e.g., penetrations around chimneys, plumbing, electrical wiring, other small seams or gaps between conditioned and unconditioned spaces, loose window glazing, and others).

participants have electric resistance heat, engineering results point to a relatively large share of savings coming from duct sealing.

Figure 4-2. Engineering Results: Percentage of Tier II Energy Savings



Percentages show measures' contribution to total Tier II savings, based on engineering analysis (ex post assumptions) of the total quantities installed across all Tier II participants (n=532).

Based on the results of the engineering analysis, we calculated an overall kW per kWh savings ratio, as shown in Table 4-5. We applied this ratio to the billing analysis results to estimate net demand savings for both summer and winter peak periods.

Table 4-5. Engineering Demand-to-Energy Ratios

Metric	Tier 1		Tier 2	
	Summer Coincident Peak	Winter Coincident Peak	Summer Coincident Peak	Winter Coincident Peak
Average annual energy (kWh) savings per household	262	262	2,241	2,241
Average demand (kW) per household	0.0442	0.0702	0.1782	0.9112
Ratio multiplier (kW/kWh)	0.0001686	0.0002679	0.0000795	0.0004066

Refrigerator Replacement Ex Post Savings

To develop ex post savings for refrigerator replacements, we use results of the engineering analysis. Based on Duke Energy's need for one planning value for all refrigerators, we developed weighted average refrigerator savings values of 1,194 kWh/year and 0.136 kW/year, based on the deemed savings by unit size and the mix of unit sizes reported in program-tracking data during the evaluation period (55% 21 cu. ft., 33% 18 cu. ft., and 9% 15 cu. ft.).

4.3 Billing Analysis

4.3.1 Billing Analysis Methodology

Opinion Dynamics conducted a billing analysis to determine the overall evaluated program savings from Tier I and Tier II projects. Billing analyses are statistical analyses of energy consumption recorded in utility billing records. Because billing records reflect whole-building energy use, the method is well suited for studying the combined impact of the Weatherization Program's mix of energy efficiency measures per home. Total program savings from Tier I and Tier II weatherization are estimated by examining variation among Tier participants' monthly electricity consumption pre- and post- program, relative to the variation in a comparison group's electricity consumption during those times. Compared to an engineering analysis alone, billing analyses are more robust and provide more accurate savings estimates because they compare participants' and non-participants' actual (rather than estimated) energy use.

We used a Linear Fixed Effects Regression (LFER) model for this analysis. Each tier was analyzed in a separate regression model because the tiers provide different measures and thus are expected to provide different levels of per-home savings. LFER models for each tier used a series of explanatory variables designed to improve our estimate of the counterfactual (i.e., what participants might have done during the post-program period, had they not received weatherization). The relationship of interest is between the independent variable (monthly energy use) and a "dummy" variable that indicates whether an individual participated in each tier of the DEC Weatherization Program. Based upon Duke Energy requests to isolate savings from refrigerator replacements separately from the package of measures provided by Tier, we used a second dummy variable to control for those participants who also received a refrigerator replacement in addition to Tier measures. Participants who only received a refrigerator replacement were excluded from the billing analysis.

Billing analyses typically include a series of additional control variables to explain non-program variation in monthly energy use pre- and post- participation. Following best practice, we included variables that capture the net effect of household-specific characteristics[8] that do not vary over time (as individual model intercepts), as well as weather (heating degree days and cooling degree days). We also included a variable that represents the interaction between weather and the post-program period for the treatment group, to account for differences in weather across years. Finally, we also include dummy variables to control for changes in energy use associated with participants' receipt of other large energy-related measures through the Duke Energy Helping Home Fund during the study period, including additional appliance replacements and/or HVAC replacements (some of which were conversions to heat pumps).[9] After controlling for all of these outside influences, the final model results for the DEC Weatherization Program reflect savings associated with installed measures and any behavioral changes from energy efficiency knowledge gained during the State WAP weatherization assessments.

Comparison Group

Incorporating a comparison group into the billing analysis allows evaluators to control for changes in economic conditions and other non-program influences that might affect energy use during the study period. As the Weatherization program does not include a treatment/control format, we constructed a quasi-experimental

[8] This includes factors such as building square footage, appliance stock, habitual behaviors and preferences, household size, and others.

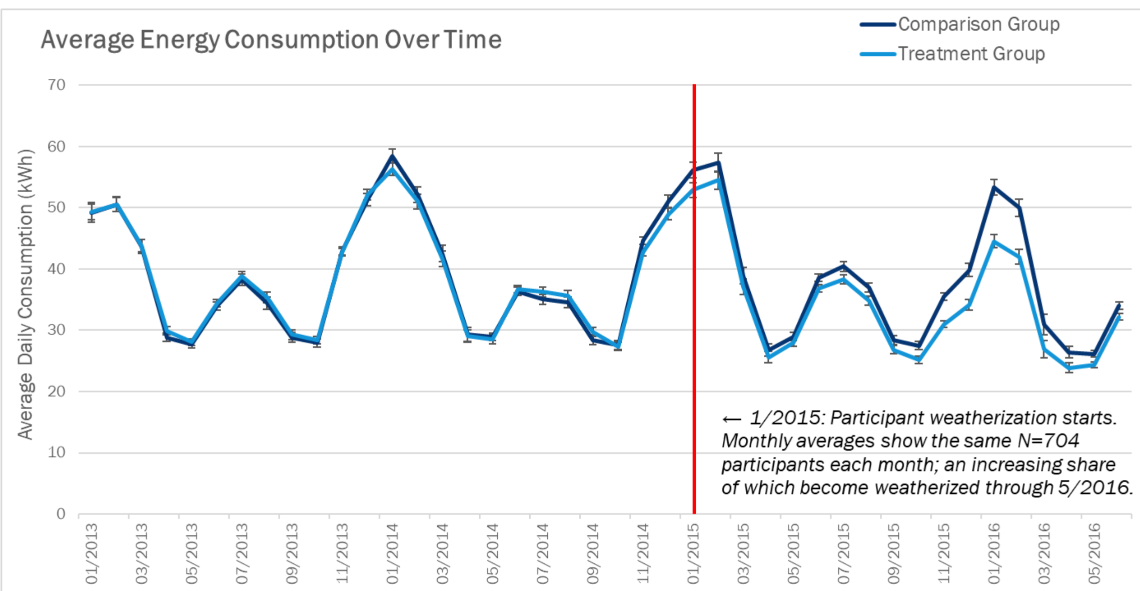
[9] 28% of billing analysis customers received appliance replacements, and 39% received HVAC replacements through the Duke Energy Helping Home Fund (Appendix F).

approach in which future program participants served as a comparison group. A comparison group based on future program participants offers an additional control for non-program influences (compared to using a sample of similar households in the general customer population), assuming that future participants possess many of the same attributes as the treatment group and have a similar propensity to participate in a low-income targeted energy efficiency program.

To increase statistical power for this analysis, we developed a treatment group using homes weatherized between January 1, 2015 and May 31, 2016. The remainder of participants from 2016, as well as all available participants through June 8, 2017, made up the comparison group.

Equivalency checks on the similarity of treatment and comparison groups were performed to confirm that the comparison group served as a valid baseline against which to measure participants' energy savings. We confirmed this by determining that the two groups had similar energy usage pre-participation and had experienced similar weather patterns during the evaluation period. Similar average daily energy usage before weatherization is a proxy for a variety of factors that could drive responsiveness to the program's treatment. Results presented in Appendix F show that the two groups were quite similar in terms of both pre-program energy usage, weather conditions during the analysis period, and measures received through the DEC Weatherization Program. Figure 4-3 illustrates the similarity of treatment and comparison group energy consumption pre-program, as well as the reduction in treatment group usage relative to comparison group post-program.

Figure 4-3. Energy Consumption Over Time, Among Treatment and Comparison Group



Combined, equivalency checks and the fact that customers in the comparison group eventually participate in the program lead us to the conclusion that the selected comparison group does in fact represent a solid basis for comparison. Table 4-6 shows the breakdown of participant counts in the treatment and comparison groups.

Table 4-6. Accounts Included in the DEC Weatherization Program Billing Analysis Model

	Treatment Group	Comparison Group	Total
Number of Accounts	704	550	1,254

Controlling for Participation in Other Programs

In order to avoid double-counting savings that are already claimed by other Duke Energy programs, we control for cross-participation. Because Duke Energy's Helping Home Fund is administered by the same agencies that administer the DEC Weatherization Program, we expect the highest cross-participation to be with the Helping Home Fund. The Helping Home Fund offers HVAC replacements and energy-efficient appliance replacement (refrigerators, clothes washers, and room air conditioners).[10] Table 4-7 shows the breakdown of DEC Weatherization Program participants in terms of receiving appliance replacements or HVAC replacements through the Helping Home Fund. We control for this cross-participation within the billing analysis model.

Table 4-7. DEC Weatherization Participants' Cross-Participation in the Duke Energy Helping Home Fund

Weatherization Billing Analysis Group	HVAC Replacement		Appliance Replacement	
	Count Receiving	Percent of Total	Count Receiving	Percent of Total
Treatment	210	30%	184	26%
Comparison	274	50%	163	30%
Total Cross-Participants	484	39%	347	28%

Note: Columns do not add up to total unique cross-participants as some weatherization participants received both HVAC and appliance measures through the Helping Home Fund.

Because the comparison group represents energy use in the absence of the program, results from the billing analysis are net, and the application of a separate net-to-gross ratio (NTGR) is unnecessary. As this is an income-qualified program, the common assumption is that the NTGR captured in the model is 1.0 because participants are unlikely to make the major, and expensive, equipment investments that drive the program's savings, outside of the programs we control for. A more detailed discussion of the billing analysis methodology, including data cleaning steps, the equivalency assessment for the comparison group (including cross-participation), and the final model, are provided in Appendix F.

4.3.2 Billing Analysis Results

This section provides per-participant billing analysis results and a comparison of these results to evaluations of the National WAP. Appendix F contains a detailed methodology for data cleaning and modeling used for this analysis, as well as complete results of the models.

Table 4-8 summarizes the results of the billing analysis models for Tier I and Tier II. The variable *Post* represents the main effect of the treatment, i.e., the change in average daily consumption (ADC) attributable to participation in the DEC Weatherization Program, controlling for whether or not the participant had also received a refrigerator replacement (*Fridge*) or Helping Home Fund measures (*Appliance, HVAC*), local weather (*CDD*, *HDD*), and the participants' sensitivity to changes in weather during the post-period (interaction terms).

Table 4-8. Results of Tier I and Tier II Billing Analysis Models

Variable	Tier I Coefficients	Tier II Coefficients
Post (Participation in DEC Weatherization Program)	-1.586	-4.021***
Fridge (Refrigerator Replacement from DEC Weatherization)	-2.494***	0.174

[10] The Helping Home Fund program also provides health and safety repairs, which are not expected to provide energy savings.

Appliance (Helping Home Fund Replacement)	-1.152	-0.283
HVAC (Helping Home Fund Replacement)	4.013*	-2.635***
HDD (Heating Degree Days)	0.0113***	0.0410***
CDD (Cooling Degree Days)	0.101***	0.112***
Post-Participation Period HDD (interaction of Post x HDD)	0.00220	-0.00870***
Post-Participation Period CDD (interaction of Post x CDD)	0.00644	-0.000761
Constant	13.98***	23.05***
Observations (Number of customer bills)	9,677	60,922
R-squared	0.575	0.609

* p<0.1, ** p<0.05, *** p<0.01.

Due to post-participation period interaction terms in the model, the coefficients for the *Post* variable do not indicate the full program effect by Tier. The *Post* coefficients in Table 4-8 represent only the reduction in daily consumption during the post-participation period, separate of any effect of the included interaction terms. To calculate the full program effect, savings implied by the *Post* coefficient must be combined with additional savings that accrue with more extreme weather, as represented in the two interaction terms. To evaluate the savings due to hotter and cooler periods, coefficients for each interaction term were multiplied by the average cooling- and heating-degree day values (CDD and HDD, respectively) observed in weather records during the post-participation period. Then, we added the resulting values to the savings represented by the *Post* coefficient. Equation F-2 in the Appendix provides details of these calculations.

Table 4-9 shows the resulting per-home and program-level savings for the program on an annual basis. As noted above, these results reflect the isolated effect due to the Weatherization program alone (any changes in energy use due to other programs are not included). The estimates of percentage savings per home are based on pre-participation period baseline usage of the participants (treatment group) included in the billing analysis. Customers who participated in Tier I of the program saved 262 kWh per year on average, or 3.3% of their overall usage (not including refrigerators). Customers who participated in Tier II saved an average of 2,241 kWh annually, or 15.5% of their usage (not including refrigerators).

Table 4-9. Annual Per-Participant Energy Savings from Billing Analysis

Program Component	N	Per-Participant Baseline Energy Use (kWh/yr)	Ex Post Annual Savings per Participant (kWh)		Average Annual Savings per Participant (% of Baseline Use)
			kWh Savings	90% Confidence Interval	
Tier I Weatherization	110	7,888	262[a]	-145 to 669	3.3%
Tier II Weatherization	532	14,487	2,241	1,929 to 2,552	15.5%

a: Savings for Tier I participants are not statistically significant at 90% confidence.

Comparison of Per-Participant Impacts to the National WAP Evaluation

Average annual savings for the DEC Weatherization Program are in line with savings achieved through the National WAP, on which the DEC Weatherization Program is based. A recent billing analysis of National WAP impacts in single-family homes (Oak Ridge National Laboratory, 2015) concluded that, at a national level, WAP projects save an average of 9% of homes' annual electric usage. This national result equates to the average of the Tier I and Tier II results presented in Table 4-9 above.

National results also support this evaluation's finding that homes receiving a more-extensive weatherization realize a higher rate of per-home rate of savings compared to those that received less-extensive weatherization. The National WAP evaluation found that homes that received a larger number of major measures[11] from National WAP saved more than those who received fewer. Specifically, National WAP projects in electrically-heated homes that did not provide any major measures saved an average of 2% of the home's baseline energy usage, while projects providing one (9%), two (10%), or three to four (23%) major measures achieved higher savings rates. Nearly all DEC Weatherization Program Tier I participants received at least one major measure (air sealing), and most Tier II participants received two to three major measures.

Several factors may help to explain why National WAP savings are slightly higher than the results from Duke Energy Carolinas service territory. Foremost, a larger share of customers in the National WAP analysis received major measures like attic insulation (70%, vs. 58% in the DEC program) and wall insulation (29% vs. 10% in the DEC program), and National WAP participants also received some measures that DEC participants did not, such as furnace replacements (22%) and water heater replacements (9%). WAP recipients also tended to have a higher baseline energy usage (about 20,000 kWh/year) compared to the DEC Weatherization Program participants (7,869 kWh/year for Tier I participants and 14,476 kWh/year for Tier II participants). With these added measures and greater baseline home energy usage, the National WAP analysis achieves larger per-participant kWh savings than the DEC program, and represents a larger share of home energy use. Additional factors may also relate to home vintage. Homes in the DEC Weatherization Program tend to be newer (60% built since 1970, compared to 25% nationally), which suggests that there may be less opportunity to save among the DEC homes based on their original construction quality and vintage, all else equal.

Overall, the National WAP still provides the best point of comparison for the DEC Weatherization Program results given the overall equivalency of eligibility requirements, customer demographic served, and general approach to assessing weatherization needs, completing upgrades, and the mix of measures offered.

4.4 Program Savings

This section brings together results of the engineering analysis, per-participant savings results from the billing analyses, and total program participation to provide ex post energy and demand savings for the DEC Weatherization Program as a whole. We also compare ex post results to ex ante assumptions and present the program's realization rate. Table 4-10 and Table 4-11 compile per-measure kWh and kW savings for refrigerator replacements (from the engineering analysis) and the per-participant savings from the billing analysis (Tier I and Tier II projects) and applies unit values to the total population of projects completed during the evaluation period (January 1, 2015 - March 31, 2016). Results of these calculations provide the program's total achieved savings. Ex post savings from Tier I measures are 28,820 kWh, 4.9 kW (summer), and 7.7 kW (winter). Tier II savings are 1,192,212 kWh, 94.8 kW (summer), and 484.8 kW (winter). Ex post refrigerator replacement savings are 103,878 kWh and 11.8 kW (winter and summer). Savings from Tier II weatherization projects drive the overall program's performance (90% of program kWh savings), followed by refrigerator replacements (8%) and Tier I weatherization (2%).

Table 4-10 also displays program realization rates. According to Duke Energy, ex ante savings were based upon an existing Duke Energy Kentucky (DEK) weatherization program; however, assumptions and methods used to calculate the DEK values are no longer available. Comparing ex post results to ex ante results produces an overall 146% realization rate, with varying rates by component (99% for refrigerators, 38% for Tier I, and

[11] Oak Ridge National Laboratory researchers developed a list of four major measures that drove a significant fraction of observed per-home savings. Major measures included heating system replacement, attic insulation, wall insulation, and major air sealing (leakage reduction of at least <1,000 CFM50 as measured by blower door testing).

164% for Tier II). Without the supporting details on the DEK analysis, we do not know why realization rates are smaller than 100% for Tier I and greater than 100% for Tier I. However, realization rates for Tier I and Tier II in particular reflect the process of updating savings assumptions to best reflect the nature of DEC-specific conditions that affect whole-home energy use and savings, including weatherization potential, measure mix per customer, climate, and customer characteristics.

Table 4-10. Program Energy Savings and Realization Rates by Program Component

Program Component	Number of Participants[a]	Ex Ante Assumptions Per Year[b] (kWh)		Ex Post Evaluated Savings Per Year (kWh)		Realization Rate (ex post/ ex ante)
		Per Participant	Program	Per Participant	Program	
Refrigerator Replacement	87	1,199	104,313	1,194	103,878	99.6%
Tier I Weatherization[c]	110	683	75,130	262	28,820	38.0%
Tier II Weatherization[c]	532	1,365	726,180	2,241	1,192,212	164.0%
Total Program Activity	651	n/a	905,623	n/a	1,324,910	146.3%

a: Program component participation does not add to the total because 78 of the 87 refrigerator recipients also received weatherization.
b: Obtained from DEC Weatherization Program staff.
c: Savings estimates do not include refrigerator replacements. Savings for customers who received weatherization services and a refrigerator replacement are equal to the sum of the weatherization and the refrigerator replacement savings.

Table 4-11. Program Demand Savings

Program Component	Number of Participants[a]	Summer Demand (kW)		Winter Demand (kW)	
		Per Participant	Program	Per Participant	Program
Refrigerator Replacement	87	0.136	11.8	0.136	11.8
Tier I Weatherization[b]	110	0.044	4.9	0.070	7.7
Tier II Weatherization[b]	532	0.178	94.8	0.911	484.8
Total Program Activity	651	n/a	111.4	n/a	504.3

a: Program component participation does not add to the total because 78 of the 87 refrigerator recipients also received weatherization.
b: Savings estimates do not include refrigerator replacements.

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5. Process Evaluation

5.1 Researchable Questions

Based on discussions with Duke Energy program staff and our over-arching research objectives listed above, the evaluation team developed specific process-related research questions for the evaluation:

- What are the major strengths of the program? Are there specific ways that the program could be improved to be more effective in the future?
- What are the barriers to program participation (i.e., are there limiting factors to achieving greater participation)?
- What is the current reimbursement process between Duke Energy and the implementing agencies, and do these processes enable the greatest possible program success?
- What is the incremental benefit of the DEC Weatherization Program, beyond other weatherization assistance opportunities, to DEC's low-income customers, and what process improvements can the program make to enhance its impact?

5.2 Methodology

Our process evaluation is informed by in-depth interviews with program staff (n=1), program administrator staff (n=1), and implementing agency staff (n=3 in 2016, n=9 in 2017), our analysis of the participant survey results (n=98), and our review and of materials and program-tracking data. Each of these activities is described in more detail in Section 3.

5.3 Key Findings

5.3.1 Program Design and Implementation Processes

The goal of the DEC Weatherization Program is to improve the health, safety, and energy efficiency of income-qualified Duke Energy customer households by leveraging weatherization funding from other federal, state, and local programs. Rather than competing against State WAP by running a stand-alone program, Duke Energy decided to use the existing State WAP as a framework that Duke Energy could use as a vehicle to distribute its own program funding. Specifically, Duke Energy pays agencies a fixed price (discussed above) to agencies per State WAP project completed at qualifying DEC customer homes and requires that agencies use the program funding to support future weatherization-related activities. A key question about the program's design is whether this payment process is influencing agencies to weatherize more homes than they would ordinarily be able to do with State WAP funding alone. To explore this question, we collected customer, agency, and implementer feedback about program elements and their suggestions for improving them in the future.

We compiled information about program implementation from in-depth interviews and program documentation. Table 5-1 summarizes key events in the process of income-qualified home weatherization through the DEC Weatherization Program. As outlined in the table, the DEC Weatherization Program functions within an existing group of programs and policies, including the State WAP. The Weatherization program enrollment and payment process is particularly closely linked with the State WAP. Notably, the DEC Weatherization Program provides program funding to agencies on the basis of homes that were already weatherized through the State WAP. Once the agency receives funding, it can use the money for any activity that directly or indirectly supports weatherization.[12]

Table 5-1. Weatherization Program Implementation Processes

Stage	Implementation Process
State WAP	• Customer applies for weatherization services at a participating local agency.
	• Agency staff or subcontractors conduct an audit of the home to identify savings opportunities and generate a Residential Energy Assessment (REA) report.
	• Agency staff review the REA report, the customer's household income, energy costs, homeownership, and heating fuel to determine the customer's level of need and eligibility for available funding (i.e., State WAP). Many customers are placed on a State WAP waiting list following the initial audit, and the agencies then prioritize wait-listed projects by level of need and available funding sources.
	• Agencies arrange a second visit to the home to deliver and install weatherization measures, after which they submit a request for State WAP reimbursement.
DEC Weatherization Funding	• For projects that are eligible for DEC Weatherization funding, agency staff request Duke Energy funds by entering customer and project information into the program-tracking database (LM Captures, maintained by Lockheed Martin).
	• NCCAA and Lockheed Martin review projects submitted through LM Captures to confirm eligibility and for quality assurance/quality control purposes. • NCCAA submits approved projects to Duke Energy on a monthly invoice.
	• Duke Energy issues approved weatherization funding to NCCAA, plus funding for each project's administrative costs that amount to 10% of the weatherization funding. • In turn, NCCAA distributes the funding and 50% of the administrative funding to the agency that requested it.
DEC Prospective Weatherization	• After receiving Duke Energy funding, agencies earmark the funds for future weatherization-related projects. • The funds can be combined with State WAP funding (beginning the State WAP cycle again) or used as the sole source of funding for a weatherization project. • Agencies can either apply funds directly to weatherization by paying for energy efficiency measures or apply funds indirectly to weatherization by sponsoring health and safety upgrades that must be completed at a home as a prerequisite for weatherization. • Agencies can apply the funds to Duke Energy customers' homes and/or to non-customer homes.

[12] Per State WAP regulations, weatherization can be completed only at homes that meet certain health and safety standards. According to agencies and NCCAA, lower-income housing stock may need significant health and safety upgrades, which are costly and often beyond a lower-income customer's budget. Thus, otherwise-needy customers face additional barriers to accessing State WAP or other weatherization assistance programs.

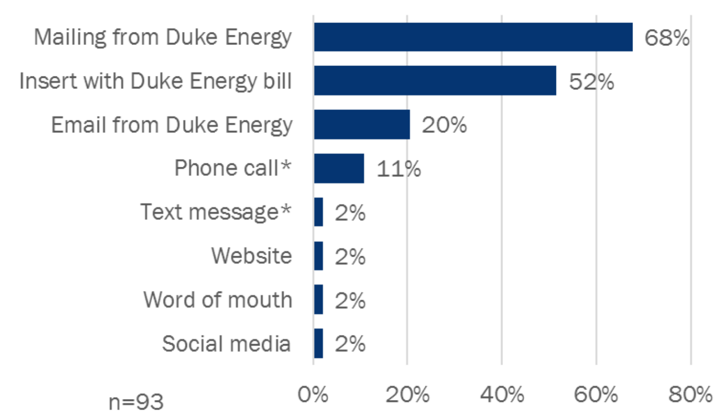
5.3.2 Marketing and Outreach

Duke Energy does not conduct marketing for the State WAP program; rather, the agencies complete all marketing and outreach. Of the agencies we interviewed in Summer, 2016 (n=3), each reported a unique method for marketing weatherization services to customers. Namely, these agencies recruit with some combination of door-to-door canvassing, TV ads, public service announcements, and cross-referrals with other social service programs. Most agencies accept State WAP applications in multiple formats: in-person, via mail, by phone, or online.

The participant survey also investigated outreach strategies and program awareness, including how participants learned about the State WAP program and how they would prefer to receive information about similar opportunities in the future.[13] Nearly half (47%) of participants learned about the weatherization program through word of mouth.

Only 10% of respondents were aware of other Duke Energy-sponsored energy efficiency programs. If Duke Energy wishes to market other income-qualified programs to this segment, 72% of respondents would prefer to hear about future Duke Energy-sponsored energy saving programs through the mail either as a bill insert, and/or as a separate mailing (32% said that they preferred both bill inserts and separate mailings). Figure 5-1 illustrates survey participants' preferred sources of program information.

Figure 5-1. Participants' Preferred Sources of Program Information



* Provided as open response (unprompted).

Note: Sum exceeds 100% because participants could each provide multiple responses

5.3.3 Program Participation

During the evaluation period, the DEC Weatherization Program credited funds to agencies for weatherization upgrades for 641 homes in North Carolina and 10 homes in South Carolina. All nine of the implementing agencies interviewed in 2017 reported they currently submit 100% of their eligible State WAP projects to the DEC Weatherization Program. One third of agencies (3 out of 9) mentioned that, earlier in the program, this was not always the case. These agencies did not immediately participate when the program was launched in 2015, recalling that they delayed participating because they were confused about program qualifications and

[13] During the survey, we referred generically to the "weatherization program" and indicated that Duke Energy had sponsored some of the upgrades.

accounting issues, such as how to handle Duke Energy payments in a way that did not jeopardize their State WAP funding. Overall, the eligible projects completed during the evaluation period represented about 42% of all weatherization activity happening at the participating agencies during that time (including eligible and ineligible projects), ranging from 5% to 89% by agency (n=8).[14] Agencies mentioned that, after getting clarity on the aforementioned issues, they feel the program has been exceptionally well-implemented and easy to participate in.

Program-eligible Duke Energy customers represent about 50% of each agency's weatherization-related clientele, ranging from a small share (15%) to a majority share (90%) by agency (n=9). Based on program-tracking data, nearly all of the homes credited through the DEC Weatherization Program were single-family detached homes (77%) or mobile homes (22%). Ninety-nine percent of these homes were owner-occupied, and 40% of them were built prior to 1970.

The DEC Weatherization Program credited agencies for a variety of measures installed at these State WAP projects. Fifteen percent of projects provided Tier I measures, and 73% provided both Tier I and Tier II measures. Table 5-2 shows the share of homes that received measures from each of six main categories: lighting, air filtration, hot water, HVAC, insulation, and refrigeration. The same table also shows the share of projects that received at least one of each measure and the average number of units installed in each project (among those that received the measure). Nearly all participating homes (97%) received air sealing measures, and about three-quarters received at least one HVAC measure (77%), one hot water measure (74%), and/or one type of insulation (73%). Sixty-five percent received CFLs, and 14% received a refrigerator.

Table 5-2. 2015 Measure Mix from Program-Tracking Data

Measure Category	% Receiving Measure Category (N=651)	Measure	Measure Unit	% Receiving Measure (n=651)	Average Unit Quantity[a]
Air Sealing and Weatherstripping	97%	Air Sealing	Home	96%	1.0
		Door Weatherstripping	Door	46%	2.0
HVAC	77%	Heating System Tune-Up	Heating system	33%	1.0
		Heating System Repair	Heating system	3%	1.0
		Dryer Vent Clean/Replace	Dryer vent	35%	1.0
		Duct Insulation	Linear feet	1%	86.8
		Duct Sealing	Ducts	63%	1.0
		Heat Pump Upgrade	Heat pump	0%	1.0
Hot Water	74%	Low-Flow Aerator	Aerator	61%	2.3
		Low-Flow Shower Head	Shower head	56%	1.2
		Domestic Water Heater Pipe Insulation	Water heater tank	50%	1.1
		Domestic Water Heater Tank Insulation	Water heater tank	47%	1.0
		Water Heater Temperature Adjustment	Water heater tank	24%	1.0
Insulation	73%	Attic Insulation	Sq. ft.	58%	1,052.8

[14] Based on agency-reported total annual State WAP participation and DEC program-tracking data. On an annual basis, agencies reported completing 83 State WAP projects per year between 2015 and 2017 (n=8, range 8 to 292 per agency).

		Belly Fiberglass Loose	Sq. ft.	14%	999.5
		Floor Insulation	Sq. ft.	37%	778.8
		Wall Insulation	Sq. ft.	10%	557.2
Lighting	65%	CFLs	Bulb	65%	6.1
Refrigeration	14%	15 cu. ft.	Refrigerator	1%	1.0
		18 cu. ft.	Refrigerator	5%	1.0
		21 cu. ft.	Refrigerator	8%	1.0

[a] Average number of units among homes that received the measure.

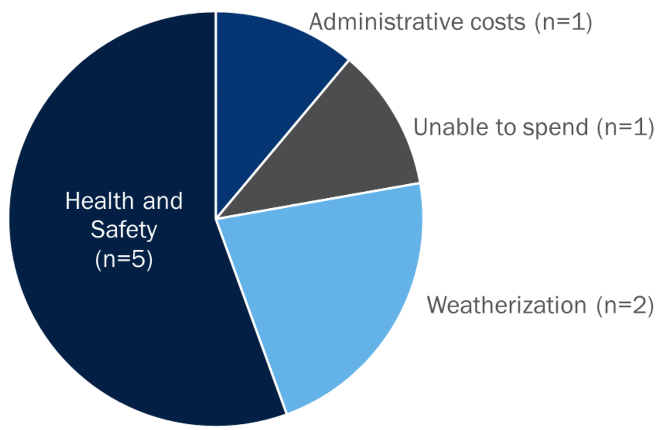
As noted above and in accordance with an agreement between WAP agencies and the evaluation team, Duke Energy claims credit for 100% of the energy and demand savings from State WAP projects for which agencies obtain DEC Weatherization Program funding. On a per-project basis, agencies report that the DEC Weatherization Program funds cover between 24% and 90% of a project's cost, or an average of 53% (n=9). While we did not ask agencies to explain their project cost structures to further explore this variation, Duke Energy program staff have suggested that, all else equal, the approach of offering fixed-price funds by measure covers a larger portion of total project costs for agencies that have lower labor costs (e.g., agencies that outsource field work to subcontractors may have lower labor costs than those which use their own internal staff).

Changes in Agency Weatherization Activity Enabled by DEC Weatherization Program Funds

As a side effect of the funding model that Duke Energy uses to claim savings, the DEC Weatherization Program funds serve as another form of weatherization funding for the agencies. Although Duke Energy does not claim any savings from activities that agencies may complete with the funds, the process and format around the funds are a significant process benefit that generates agency interest in participating in the program. Specifically, these funds allow for more flexible spending than most other weatherization funding available to agencies, enabling agencies to spend it on any expenses related to weatherization or pre-weatherization activities, including administrative expenses and health and safety upgrade costs. Process research that we conducted with agencies in 2016 (n=3) suggested that the cash funds provided by the program have been enabling agencies to expand their reach by serving more customers, harder-to-serve customers, or completing different types of projects (e.g., health and safety upgrades or larger-than-average weatherization projects).

Our interviews also explored how agencies are spending their program income, with major categories including weatherization time and materials, health and safety time and materials, office administrative costs, or something else. Figure 5-2 presents the results. One agency has been unable to spend their DEC Weatherization Program funds due to South Carolina restrictions on program income spending. The remaining eight of the nine interviewed agencies have spent some of their funds. Of these, most (5 out of 8) said that they use DEC Weatherization Program funds primarily for health and safety time and materials costs. Two of the seven primarily spent the funds on weatherization. The eighth agency put the funds exclusively towards administrative costs associated with data entry (n=1).

Figure 5-2. Agencies' Primary Use for DEC Weatherization Program Funds



It is notable that most agencies are spending DEC Weatherization Program funds on health and safety, because a lack of funding in this area has been a persistent barrier to achieving weatherization in Duke Energy Carolinas' territory. Specifically, State WAP guidelines require that health and safety issues (e.g., leaky roofs or broken plumbing) are addressed before a home can be weatherized with State WAP funds, yet the State WAP funds will not cover all costs of those upgrades.

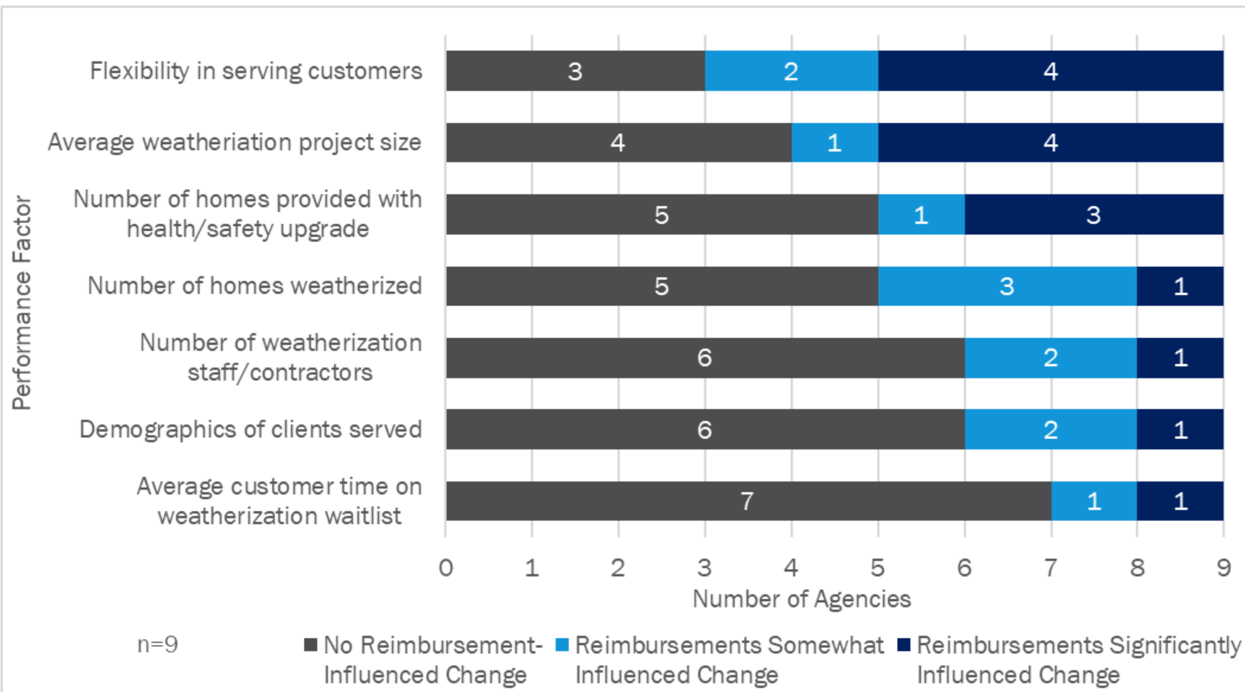
To further understand the influence of the DEC Weatherization Program, we asked agency staff to describe whether the Duke Energy funds had driven a change in any of seven areas (Figure 5-3). Agencies reported a change in their ability to serve customers in an average of three of these seven areas, with the two most-frequently reported outcomes including increased flexibility and the ability to complete larger weatherization projects (in terms of cost).

- **Flexibility:** The State WAP requires agencies to stay within an "average cost per home weatherized" over the course of the program year. This means that the agencies are less likely to fund expensive upgrades that increase their annual averages. With DEC Weatherization Program funding, agencies can keep State WAP spending within average cost targets. Additionally, homes with prohibitively expensive health and safety problems are delayed in receiving State WAP funding. In face of these restrictions, three-quarters of agencies who spent program funds (6 out of 8) noted that the DEC Weatherization Program funds have somewhat or significantly improved their flexibility in serving customers. Two of these six respondents affirmed that receiving funds for any type of weatherization-related work allows these agencies to fill in gaps left by other available funding sources.
- **Project Size:** Related to flexibility, one-half of respondents mentioned that the funds have enabled them to complete larger weatherization projects as measured by project cost (5 out of 8), more weatherization projects (4 out of 8), or more health and safety projects (4 out of 8) than they would

have otherwise been able to do. One of the two agencies spending most of their funds on weatherization supported this, noting that they have been able to scale up the size of projects without increasing cost by spending funds on bulk purchases of weatherization and health and safety materials.

Figure 5-3 also shows that few agencies reported that the funds resulted in hiring more full-time agency staff or outside contractors to do weatherization-related work for their agency (3 out of 8), a change in the types of customers served within the low-income demographic (3 out of 8), or the length of time that customers spend on their agency's wait-list (2 out of /8). Although agencies are funding-constrained, the influx of funding may not necessarily reduce wait-times across the board because some agencies spent their new income on health and safety needed to avoid the deferral of high-priority customers who were already at the top of the list.

Figure 5-3. Agency-Reported Influence of DEC Weatherization Program Funds on Key Factors of Agency Performance



5.3.4 Program Successes

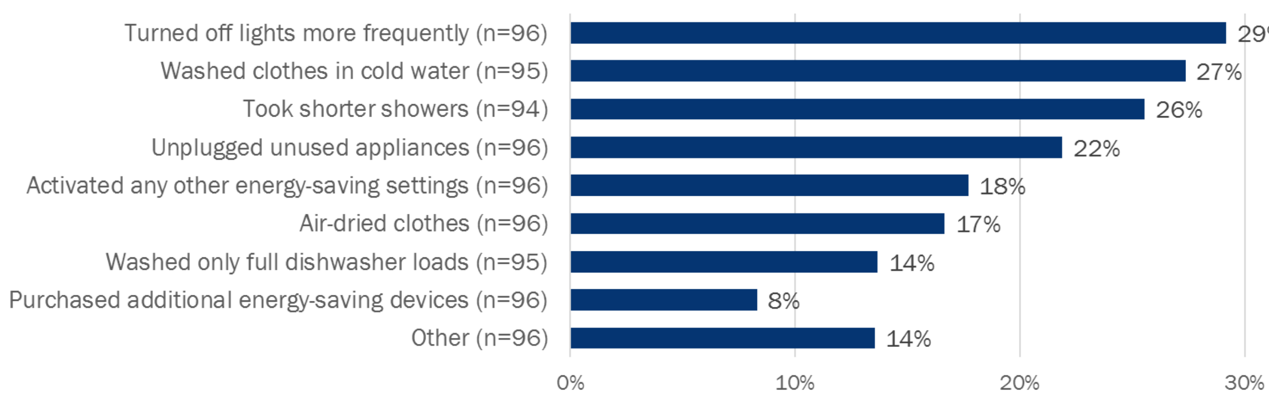
Duke Energy benefits from an existing framework in which many processes (e.g., customer outreach, customer enrollment, home audits, and provision of weatherization services) are completed with State WAP resources and/or based on agencies' past experience with these processes. The arrangement leverages agencies' existing experience while helping Duke Energy achieve energy savings while avoiding program overhead costs of guiding agencies through these steps.

Across the board, customers and implementers laud the DEC Weatherization Program for its support of community members in need of assistance. Agency staff reported long wait lists and a need to prioritize among many high-need customers and expressed great appreciation for the program, enabling them the flexibility to serve areas of greatest need as well as complete larger projects. As one agency staff member put it, "We've got a waiting list of twice as many as we're going to have funding to do this year … [the program] has been a godsend. It has allowed us to take care of a lot of problems that we just would have had no other way to deal with." Program implementers and agencies see this flexible funding as their main benefit of participating in the DEC Weatherization Program.

Agency staff are exceptionally satisfied with logistical elements of the program as well. Interviewees had exclusively positive feedback for program administrative staff at NCCAA and Lockheed Martin as well as the LM Captures tool used to record and track eligible projects. About one-half of the interviewed agencies (4 out of 9) provided unprompted praise for Lockheed Martin and NCCAA staff for their support, communication, and flexibility. One interviewee said, "99.9% of the time, if you email or call them, within 24 hours you've got an answer…that communication is just phenomenal with this program." As far as program payments, agencies emphasized the value of a timely and frequent payment schedule, which they praised for its reliability. One agency also mentioned an interest in moving from a monthly to biweekly payment schedule. When asked for recommendations, one agency suggested that the administrative allotment to agencies be bumped up from 5% to 10%, and another recommended allowing agencies to submit all labor costs for reimbursement.

Among customers who received the State WAP upgrades used to leverage DEC funding, 95% were highly satisfied with the program as a whole. Customers also reported non-energy benefits, including a more comfortable temperature in their home (100%), satisfaction with helping the environment (99%), and improved lighting in their home (85%). In addition, almost one in three participating customers (31%) reported engaging in some new energy-saving behaviors following program participation (see Figure 5-4). While recent research suggests that customers may over-report the degree to which they engage in energy-saving behaviors or misreport existing behaviors as new behaviors, these generally positive sentiments are promising for a program that has social welfare objectives in addition to energy-saving benefits. Overall, customer and implementer feedback suggests that the State WAP offering is operating smoothly and serves as a good template for delivering Duke Energy-sponsored upgrades moving forward.

Figure 5-4. Customer Self-reported New Energy-saving Behaviors Since Participating in Weatherization Program



Note: Sum exceeds 100% because participants could provide multiple responses.

5.3.5 Barriers to Participation

The DEC Weatherization Program has been successfully ironing out small speedbumps in program implementation over the course of its first two years based on early feedback provided by agencies and others. Enhancements completed so far have included providing additional information and trainings to agencies on program guidelines. Agencies in both states within DEC's jurisdiction (North Carolina and South Carolina) have faced barriers to participation tied to State WAP rulings. We discuss each state's policies below.

In 2015, DOE's policies in North Carolina required that agencies spend DEC funding within the same program year. This limited agencies' willingness to participate in the first year of the program because they were not certain that they could spend both the DEC and State WAP funding. This hesitancy led North Carolina agencies to request less than the full value of available funds. In 2016, DOE revised its policy, allowing North Carolina agencies to use DEC Weatherization funds as 'unrestricted' income beginning in 2016. Although 86% of identified North Carolina weatherization agencies did eventually request DEC Weatherization Program funds in the evaluation period, agencies collectively requested less funding than expected and available from the DEC Weatherization Program. As noted above, participating agencies are now requesting funding for 100% of their eligible projects. Barring changes in program design or agency activity levels, the North Carolina agencies' annual number of DEC program-eligible annual State WAP projects provides an upper bound to the amount of funding that Duke Energy can reasonably expect to distribute each year.

In South Carolina, agencies have struggled to participate in the DEC Weatherization Program. According to NCCAA, South Carolina has a relatively high need for weatherization services and could benefit greatly from DEC Weatherization funding. However, since 2015, South Carolina State WAP considers the Duke Energy payments as a true "reimbursement" of the grant funding that State WAP provided to the agency, and therefore requires South Carolina agencies to return to the State WAP the dollar amount of "reimbursed" funds. The DEC Weatherization Program team's understanding is that the South Carolina agencies either have not spent their annual DOE/LIHEAP grant from the South Carolina State WAP program or have not met their required annual quota of completed homes in that program. Since the South Carolina State WAP DOE/LIHEAP grant is the agencies' primary funding source, it is critical that the agencies first meet their completion quotas before taking on any additional programs, otherwise they are at the risk of possibly losing future funding. If the South Carolina agencies requested the DEC Weatherization Program incentive, South Carolina State WAP would require them to add the incentive back into the DOE/LIHEAP grant, to adhere to all DOE rules for the funding and to complete more homes.

Given agencies' reliance on State WAP funding, agencies are hesitant to participate in the DEC Weatherization Program. Two of the three eligible South Carolina agencies did not participate the program during the evaluation period, and the one agency that received DEC Weatherization Program funds during the evaluation period has not yet spent any of its funds. Given the South Carolina policy barriers, Duke Energy reports that engaging agencies—and, by extension, customers—throughout the DEC service area is an ongoing and primary concern of its program team.

6. Conclusions and Recommendations

Below, we present conclusions about program strengths and barriers, as well as recommendations. At this time, these conclusions and recommendations are limited to results of the process evaluation.

6.1 Conclusions

6.1.1 Program Strengths

Agency-Based Model

By using an existing agency-based model that agencies already use to provide community aid through the State WAP, the DEC Weatherization Program makes good use of implementers' ability to transfer and build on existing skills and experience. Program implementers and administrators use preexisting and customized record-keeping software (LM Captures) that they are already familiar with, allowing the program to seamlessly infuse additional funding into local agencies. Agencies note that the LM Captures system is easy to use and highly customizable, and for evaluation purposes it provided well-organized and complete program-tracking data. Adding refrigerator test-in results to LM Captures is the only addition that the evaluation team recommends insofar as tracking data are concerned.

Program's Level of Agency Support

Staff at implementing agencies expressed high satisfaction with the level of support provided by Duke Energy staff in working through early challenges that were typical of a new program, as well as support navigating regulatory hurdles. Agency and NCCAA staff described Duke Energy program staff as positive, responsive, and helpful.

Flexible Funding Model for Agencies

Although the program faced some challenges in getting agencies to participate early on (due to regulatory hurdles discussed below), interviews with agencies who did participate reveal that the program's funding is delivering a significant social welfare benefit. The additional funds are considered 'unrestricted income' in North Carolina, and thus provide welcome flexibility for agencies, allowing them to fund health and safety work where they see the greatest need. As of 2017, most agencies have been able to start spending their funds, and those who have are reporting that the main benefit of DEC Weatherization funds is the infusion of cash-on-hand for health and safety upgrades needed to expedite wait-listed customers. Other agencies have been using the funds to subsidize State WAP projects such that agencies can complete more involved, and/or expensive projects than they would have been able to do otherwise. This cost-share arrangement also helps agencies stay within the average per-home cap set for State WAP.

Strong Return-on-Investment for Duke Energy

DEC Weatherization Program funds cover, on average, 50% of agencies' original costs of completing weatherization at Duke Energy customer homes. These funds are provided on a per-measure basis up to a cap by Tier, meaning that the provided funds are spread across all measures installed at each home, from high-savings measures like insulation, air sealing, and duct sealing, to lower-savings measures like lighting, weather stripping, and tank wrap. Per agreement with State WAP and Federal WAP, however, the DEC Weatherization Program claims credit for 100% of the total savings of each weatherization projects it credits agencies for. This is a strong return on Duke Energy's investments in energy efficiency and is, by account from these other stakeholders, an acceptable arrangement that also benefits residential customers in need.

6.1.2 Program Barriers to Participation

South Carolina DOE/LIHEAP Guidelines Limit South Carolina Agency Interest

Despite the general benefit of enabling more social service benefits in DEC service territory, providing program income on the basis of State WAP activity poses some limits on the DEC Weatherization Program's potential impact. During the first year of the DEC Weatherization Program, DOE/LIHEAP guidelines in North Carolina and South Carolina had deterred agencies from participating to their expected potential. Guidelines in North Carolina were relaxed in 2016 such that North Carolina agencies can use the DEC Weatherization Program funding as unrestricted income. In South Carolina using the DOE applicable credit model, any rebate becomes part of the federal grant, and at the end of the program year any unspent dollars must be returned to DOE. As of this report, the South Carolina guidelines still stand and present an ongoing barrier to full participation by South Carolina agencies. Duke Energy may want to assess the feasibility of an alternative funding model for South Carolina that can work around policies to engage those agencies and customers.

More Time Needed for Agencies to Fully Realize Funding Benefits

A minor barrier to agency interest in the program (and thus, savings) relates to agencies' capacity to spend program funding once they receive it. No South Carolina agency has the capacity to spend funds at this time, due to their current challenges of meeting their DOE/LIHEAP grant requirements In North Carolina, agencies reportedly structure their administration based on expected State WAP funding amounts, such that agencies receiving DEC payments -- especially those who are newer to the program – may not be able to spend them as soon after receiving them as they might like to do, if they have initial capacity constraints. As the program matures, agencies may be able to better plan for this additional funding stream by bringing in additional resources to quickly put funds to use. Connecting agencies to one another so that they can share lessons-learned about putting dollars to use may speed this transition and boost agency interest.

6.2 Recommendations

Below we discuss our recommendations for program improvements in the DEC Weatherization Program.

- **Continue to expand training and informational resources for implementing agencies.** Agencies noted that in the first few months after the program kicked off, they had frequent communications with Duke Energy and NCCAA to clarify certain measure specifications and eligibility requirements. Agency staff expressed their satisfaction with the responsiveness and attentiveness of Duke Energy and NCCAA staff. This goodwill can be built on to provide additional resources that enable agencies to implement the program self-sufficiently in the future. For example, agency staff suggested that more detailed information upfront could have enabled them to address some issues on their own. To help them operate more self-sufficiently, some agencies suggested Duke Energy provide written materials like program implementation plans and decision-making tools (e.g., decision trees or flowcharts). Developing these or other written materials would be valuable to provide a smoother on-boarding for any agencies that join in the future.

- **Consider including existing refrigerator "test-in" results as part of the program enrollment records entered into LM Captures.** Auditors routinely collect baseline efficiency of inefficient refrigerators before they are replaced through State WAP. During the evaluation period, agencies did not report these data to Duke Energy when requesting DEC Weatherization Program funding. As savings from refrigerators are expected to provide about 10% of total program savings (on an ex ante basis), refrigerator test-in data are valuable inputs to the deemed savings analysis. In our evaluation, we found that refrigerators replaced by the program are considerably less energy efficient than industry-standard baselines for new refrigerators; thus, having project-specific data moving forward will enable the program to continue claiming savings based on the most accurate deemed savings estimate. As the parameters are already captured for State WAP reporting, the change may not represent a noticeable increase in reporting time for the agencies.

- **Consider including more detail on air sealing as part of the program records entered into LM Captures.** Based on the deemed savings review, air sealing drives the whole-home savings from Tier I projects and is one of the top drivers of whole-home savings from Tier II projects. To develop deemed savings for air sealing, the engineering review made industry-standard assumptions about the extent and type of air sealing conducted based on available program material, as the program-tracking data did not provide specific project-level details. If the program is interested in obtaining further updates to the air sealing deemed savings, it would be useful to record details of air sealing projects in tracking data, such as blower door test results or the specific air sealing activities completed.

- **If feasible from a Duke Energy standpoint, consider providing funding as biweekly payments instead of monthly payments.** Overall, the funding request and processing system works well in the eyes of the NCCAA and the implementing agencies, and the system received their praise for its consistency. Nonetheless, several agency staff suggested that biweekly payments would be helpful to ensure that agencies can avoid funding gaps that delay project implementation. Biweekly payments may particularly benefit smaller agencies that have less week-to-week funding available by improving the steadiness with which they receive funds. The shift would also bring the funding cycle into more sync with the Duke Energy Helping Home Fund, which is administered by the same organizations and implemented by some of the same agencies as DEC Weatherization.

7. Summary Form

Low-Income Weatherization Program

Completed EMV Fact Sheet

The DEC Weatherization Program purchases (reimburses) savings from local implementing agencies that have recently completed qualifying State Weatherization Assistance Program (WAP) projects at Duke Energy customer homes. Electric conservation measures are provided at no cost to the customer. A Tiered project structure is used to allocate reimbursements to agencies: Tier I (air sealing and low-cost energy efficiency upgrades), Tier II (Tier I plus HVAC), and Refrigerator Replacements.

Date	June 13, 2018
Region(s)	Duke Energy Carolinas
Evaluation Period	January 1, 2015 – March 31, 2016
Annual kWh Savings	1,324,910 kWh
Per Participant kWh Savings	1,194 (Refrigerator); 262 (Tier I); 2,241 (Tier II)
Coincident kW Impact	111.4 (Summer) 503.3 (Winter)
Measure Life	N/A
Net-to-Gross Ratio	N/A
Process Evaluation	Yes
Previous Evaluation(s)	None

Evaluation Methodology

The evaluation team performed a process and gross impacts evaluation.

The gross impact analysis included a review of deemed savings estimates, an engineering analysis of savings assumptions and calculations, and a participant survey to verify installation rates for each measure. The evaluation team also conducted a billing analysis to estimate energy savings and used a combination of billing analysis and engineering analysis results to estimate peak demand savings.

Impact Evaluation Details

- The engineering analysis applied deemed savings values to measures distributed and in service. ISRs were calculated based on information gleaned from a participant survey.
- Per-participant savings for Tier I projects and Tier II projects were determined through a billing analysis. Per-participant savings for Refrigerator Replacements were determined through the engineering analysis.
- Results from the billing analysis reflect savings associated with measures installed at Duke Energy customer homes through the State WAP program, and reimbursed by Duke Energy.

8. DSMore Table

DSMore Table

[DSMore Table provided in a separate file]

Appendix A. Survey Disposition Reports

Participant Survey Disposition and Response Rate

We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).[15] We chose to use AAPOR Response Rate 3 (RR3), which includes an estimate of eligibility for sample units that we were unable to reach. We present the formulas used to calculate RR3 below and display the definitions of each variable used in the formulas in the Survey Disposition tables that follow.

$$RR3 = I / ((I + R + NC + O) + (e * U))$$
$$e = (I + R + NC) / (I + R + NC + E)$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate is the percentage of participants with whom we spoke who subsequently completed an interview. To determine the cooperation rate we used AAPOR Cooperation Rate 1 (COOP1), which is calculated as:

$$COOP1 = I / (I + P + R)$$

Table A-1. Survey Response and Cooperation Rates

AAPOR Rate	Percent
RR3	23%
COOP1	39%

Table A-2. Disposition Report

Disposition Code	Number of Customers
Completed survey	98
DO NOT CONTACT	2
Callback to complete	1
Initial refusal	29
Mid-interview terminate - DO NOT CALLBACK	1
Answering machine	29
Not available	47
Non-specific callback	3
Respondent scheduled appointment	19
Language problems	3
No answer	18
Privacy line/number blocked	3
Busy	3
Disconnected phone	31
Duplicate contact	1
Wrong number	7
Computer tone	1
Business phone	3
Did not recall participating in program	1
Not contacted	295
Total	**595**

[15] *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2011. http://www.aapor.org/AAPORKentico/AAPOR_Main/media/MainSiteFiles/StandardDefinitions2011_1.pdf.

Appendix B. Survey Instruments and Detailed Survey Results

Participant Survey Instrument

[Participant Survey Instrument provided in a separate file]

Participant Survey Results

[Participant Survey Results provided in a separate file]

Appendix C. In-Depth Interview Guides

Program Manager Interview Guide

[Program Manager Interview Guide provided in a separate file]

NCCAA Staff Interview Guide

[NCCAA Staff Interview Guide provided in a separate file]

Agency Staff Interview Guide

[Community Action Agency Interview Guide provided in a separate file]

Agency Staff Follow-up Interview Guide

[Community Action Agency Follow-up Interview Guide provided in a separate file]

Appendix D. Impact Calculation Tables

Impact Calculation Tables

[Impact Calculation Tables provided in a separate file]

Appendix E. Deemed Savings Review Measure-Level Detail

This appendix presents measure-level algorithms, inputs, and results of the deemed savings review.

Appropriate Uses of the Deemed Savings Review

An engineering analysis to develop per measure deemed savings is valuable because it informs the breakdown of whole-home program savings across individual measures. However, estimating total household-level savings using the engineering analysis is challenging given the variety of assumptions that influence the engineering models for weatherization measures,[16] and given the interactive effects of installing multiple energy efficiency measures at one time. For example, a customer who performs air sealing, but also upgrades their heat pump, is not likely to achieve the sum of the two measures' deemed savings due to the interaction between a customer's heating and cooling loads and the air sealing measure.[17] Thus, to avoid over-estimating savings, we do not recommend calculating an average total per-home (or per-Program Tier) savings estimate using the engineering analysis.

A billing analysis can more accurately predict the total household level energy savings. Billing analyses examine changes in whole-home energy use recorded at the meter, and thus account for the energy-savings interactions among multiple weatherization measures. Therefore, billing analyses are typically better suited for verifying the energy impacts of a weatherization program. However, the deemed savings review provides a ratio between energy and demand savings that can then be applied to the energy savings from the billing analysis to estimate demand savings.

Ex Ante Savings Assumptions

Table E-1 presents the ex ante average per-home savings assumptions provided to Opinion Dynamics by Duke Energy program staff.

Table E-1. Program-Determined Ex Ante Savings Summary

Measure	Ex Ante Annual Gross Savings without Losses (kWh)
Low Income Refrigerator Replacement	1,199
Low Income Weatherization – Tier I	683
Low Income Weatherization – Tier II	1,365

Table E-2 presents measure-level results of the deemed savings review. Sections below the table provide additional detail on all algorithms and assumptions used to arrive at the deemed savings presented in the table. Where applicable, the sections also provide the estimated savings per measure by heating type, and per unit (e.g., per ton of capacity). These more detailed deemed savings values allow the option to estimate program impacts based on the known parameters of each home.

[16] In particular, it is difficult to accurately estimate HVAC capacity, efficiency, and usage characteristics in addition to R-values of insulation improvements.

[17] Other examples of interactive effects include domestic water heater pipe insulation and water heater temperature adjustments, or duct sealing and HVAC upgrades.

Table E.2. Deemed Savings Summary

Type	Measure	Unit of Measure	Δ kWh	Δ Summer kW	Δ Winter kW
Water Heating					
Tier I	Domestic Water Heater Pipe Insulation	Per 10 feet	122	0.014	0.014
Tier I	Domestic Water Heater Tank Insulation	Per tank	102	0.012	0.012
Tier I	Water Heater Temperature Adjustment	Per tank	76	0.009	0.009
Tier I	Low-Flow Shower Head	Per shower head	51	0.005	0.010
Tier I	Low-Flow Aerator	Per aerator	88	0.007	0.013
Lighting					
Tier I	13W CFL	Per bulb	13	0.002	0.001
Tier I	18W CFL	Per bulb	29	0.004	0.003
Air Sealing and Weatherstripping					
Tier I	Air Sealing	Per home	1,069	0.217	0.339
Tier I	Door Weatherstripping	Per door	33	0.007	0.011
Insulation					
Tier II	Attic Insulation - Cellulose, Blown - R-30	Per sq. ft.	1.8	0.0001	0.0009
Tier II	Attic Insulation - Cellulose, Blown - R-38	Per sq. ft.	1.9	0.0001	0.0009
Tier II	Attic Insulation - Fiberglass, Blown - R-30	Per sq. ft.	1.8	0.0001	0.0009
Tier II	Attic Insulation - Fiberglass, Blown - R-38	Per sq. ft.	1.9	0.0001	0.0009
Tier II	Belly Fiberglass Loose	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Floor Insulation - Fiberglass, Batts - R-19	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Wall Insulation - Fiberglass, Blown - R-13	Per sq. ft.	1.4	0.0001	0.0006
Tier II	Wall Insulation - Cellulose, Blown - R-13	Per sq. ft.	1.4	0.0001	0.0006
Tier II	Knee Wall Insulation	Per sq. ft.	1.6	0.0001	0.0008
Tier II	Manufactured Home Roof Cavity	Per sq. ft.	1.6	0.0001	0.0008
Heating System					
Tier I	Heating System Tune-Up	Per system	911	0.000	0.193
Tier II	Duct Insulation	Per system	415	0.022	0.197
Tier II	Duct Sealing	Per system	2,772	0.149	1.315
HVAC Upgrade/Replacement					
Tier II HVAC	Heat Pump Upgrade	Per heat pump	854	0.101	0.321
Tier II HVAC	Heat Pump Replacement	Per heat pump	2,837	0.343	1.066
Refrigerator					
Refrigerator	ENERGY STAR Refrigerator (15 cu. ft.)	Per refrigerator	1,229	0.140	0.140
Refrigerator	ENERGY STAR Refrigerator (18 cu. ft.)	Per refrigerator	1,206	0.138	0.138
Refrigerator	ENERGY STAR Refrigerator (21 cu. ft.)	Per refrigerator	1,182	0.135	0.135

Note: Table does not report savings from heating system repair or for dryer vent cleaning, which the evaluation team deems to be *de minimis*.

Tier I Measures

Air Sealing

Table E-3 documents the inputs and methodology for estimating air sealing savings. Opinion Dynamics estimated the existing and new cubic foot per minute (CFM) flow rates based on ENERGY STAR air sealing assumptions.

Table E-3. Algorithms and Inputs for Air Sealing

Algorithms Used		
kWh Savings	Cooling Savings = (CFM50Exist - CFM50New) / Nfactor * 60 * 24 * CDD * DUA * 0.018 / 1000 /SEER * AF * LM * %AC * ISR Heating Savings = (CFM50Exist - CFM50New) / Nfactor * 60 * 24 * HDD * 0.018 / 3,412 / nHeat * AF * %electric heat * ISR	
kW Savings (summer)	Cooling kWh Savings / FLHcool * CF (summer)	
kW Savings (winter)	Heating kWh Savings / FLHheat * CF (winter)	
Source of Algorithm: common to most TRMs. Used IL TRM and adjusted based on available information.		
Parameter	**Value**	**Source/Notes**
Baseline ACH50	17.4	ENERGY STAR® savings analysis assumptions for North Carolina (Climate Zone 4). Assume “Whole House Air Sealing” based on description from DEC NES Program Manager. https://www.energystar.gov/ia/home_improvement/home_sealing/ Measure_Upgrade_Assumptions.pdf?945a-eddc.
Upgrade ACH50	13.1	
Home volume (cu. ft.)	11,382	Average home size of 2015 participants was 1,422 sq. ft. Assume ceiling height of 8 ft.
CFM50Exist	3,301	Converts ACH50 to CFM50 (= ACH50 * Volume / 60 minutes). http://www.pureenergyaudits.com/docs/ Blower_Door_Handout_ACI_Baltimore.pdf. We could update the assumptions with actual data if the program provides baseline and upgraded blower door readings to Opinion Dynamics.
CFM50New	2,485	
N-factor	21.1	Lawrence Berkeley National Lab Study. http://www.waptac.org/data/files/Website_docs/Technical_Tools/Building%20Tightness%20Limits.pdf DEC is in Zone 3. Assume average of 1 and 1.5 stories based on 2015 participant data, which averaged 1.1 stories.
Conversion	1,440	Converts cu. ft./min to cu. ft./day.
CDD	1,596	ASHRAE Fundamentals 2013. Assume average of cities across DEC service territory available in ASHRAE (Charlotte, NC; Greensboro, NC; Greenville, SC).
DUA	0.75	Discretionary Use Adjustment for cooling. Common to most TRMs. Accounts for fact that not all cooling systems operate 100% of the time during which cooling is needed.
Heat capacity	0.018	Volumetric heat capacity of air.
SEER	13	Assume 13 SEER based on several TRMs (Table E-34. Key References). Assume equipment installed after 2006.
Latent multiplier (LM)	7.7	Most TRMs assume a LM to account for latent cooling demand. The LM converts the sensible cooling savings to a value representing both sensible and latent cooling loads. The value is derived from Harriman et al "Dehumidification and Cooling Loads from Ventilation Air", ASHRAE Journal, November 1997. We used Raleigh, NC as the city to represent DEC territory, as it was the closest of the listed cities. We calculate the multiplier by adding the latent (6.0) and sensible (0.9) and dividing by the sensible.
%AC	68%	2015 DEC LI Weatherization (Wx) participant data[18]. 68% of participants had either central AC or a heat pump.
HDD	3,250	ASHRAE Fundamentals 2013. Assume average of cities across DEC service territory available in ASHRAE (Charlotte, NC; Greensboro, NC; Greenville, SC).

[18] 2015 DEC Low Income Weatherization program participant data include participants included in the database through 3/15/2016.

nHeat	1.2	Calculated weighted average COP based on 2015 DEC LI Wx participant data.
% heat pump	17%	2015 DEC LI Wx program-tracking data.
% resistance	66%	
% gas heat	17%	
COP heat pump	2.26	Coefficient of Performance (ratio of useful energy output to the amount of energy input). Mid-Atlantic TRM.
COP electric resistance	1.0	
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
ISR	91%	In-service rate from 2015 participant survey.

Table E-4 provides the deemed savings for air sealing per home, based on the heating type and using the assumptions from Table E-3

Table E-4. Air Sealing Deemed Savings

Metric	Weighted Average Homes	Electric Resistance Homes	Heat Pump Homes	Gas Heat Homes
kWh per home	1,069	1,268	1,032	336
kW per home (summer)	0.217	0.201	0.327	0.170
kW per home (winter)	0.339	0.463	0.205	0.000

Door Weatherstripping

Table E-5 documents the inputs and methodology for estimating weatherstripping savings. We use the same algorithm used for air sealing, but make adjustments to consider only door weatherstripping.

Table E-5. Algorithms and Inputs for Door Weatherstripping

Algorithms Used		
kWh Savings	Cooling Savings = (CFM50Exist - CFM50New) / Nfactor * 60 * 24 * CDD * DUA * 0.018 / 1000 /SEER * AF * LM * %AC * ISR Heating Savings = (CFM50Exist - CFM50New) / Nfactor * 60 * 24 * HDD * 0.018 / 3,412 / nHeat * AF * %electric heat * ISR	
kW Savings (summer)	Cooling kWh Savings / FLHcool * CF (summer)	
kW Savings (winter)	Heating kWh Savings / FLHheat * CF (winter)	
Source of Algorithm: common to most TRMs. Used IL TRM and adjusted based on available information.		
Parameter	**Value**	**Source/Notes**
Baseline ACH50	17.4	

Upgrade ACH50	17.3	ENERGY STAR® savings analysis assumptions for North Carolina (Climate Zone 4). Assume air sealing for "Windows, Doors and Walls", but assume only 1/3 of the reduction since this measure is only door weatherstripping and does not include window or wall sealing. https://www.energystar.gov/ia/home_improvement/home_sealing/ Measure_Upgrade_Assumptions.pdf?945a-eddc.
Home volume (cu. ft.)	11,382	Average home size of 2015 participants was 1,422 sq. ft. Assume ceiling height of 8 ft.
CFM50Exist	3,301	Converts ACH50 to CFM50 (= ACH50 * Volume / 60 minutes). http://www.pureenergyaudits.com/docs/ Blower_Door_Handout_ACI_Baltimore.pdf.
CFM50New	3,275	
N-factor	21.1	Lawrence Berkeley National Lab Study. http://www.waptac.org/data/files/Website_docs/Technical_Tools/Building%20Tightness%20Limits.pdf DEC is in Zone 3. Assume average of 1 and 1.5 stories based on 2015 participant data, which averaged 1.1 stories.
Conversion	1,440	Converts cu. ft./min to cu. ft./day.
CDD	1,596	ASHRAE Fundamentals 2013. Assume average of cities across DEC service territory available in ASHRAE (Charlotte, NC; Greensboro, NC; Greenville, SC).
DUA	0.75	Discretionary Use Adjustment for cooling. Common to most TRMs. Accounts for fact that not all cooling systems operate 100% of the time cooling is needed.
Heat capacity	0.018	Volumetric heat capacity of air.
SEER	13	Assume 13 SEER based on several TRMs (Table E-34. Key References). Assume equipment installed after 2006.
Latent multiplier (LM)	7.7	Most TRMs assume a LM to account for latent cooling demand. The LM converts the sensible cooling savings to a value representing both sensible and latent cooling loads. The value is derived from Harriman et al "Dehumidification and Cooling Loads from Ventilation Air", ASHRAE Journal, November 1997. We used Raleigh, NC as the city to represent DEC territory, as it was the closest of the listed cities. We calculate the multiplier by adding the latent (6.0) and sensible (0.9) and dividing by the sensible.
%AC	68%	2015 DEC LI Wx participant data. 68% of participants had either central AC or a heat pump.
HDD	3,250	ASHRAE Fundamentals 2013. Assume average of cities across DEC service territory available in ASHRAE (Charlotte, NC; Greensboro, NC; Greenville, SC).
nHeat	1.2	Calculated weighted average COP based on 2015 DEC LI Wx participant data.
% heat pump	17%	2015 DEC LI Wx participant data.
% resistance	66%	
% gas heat	17%	
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.0	
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.

FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
ISR	92%	In-service rate from 2015 participant survey.

Table E-6 provides the deemed savings for door weatherstripping, based on the heating type and using the assumptions from Table E-5.

Table E-6. Door Weatherstripping Deemed Savings

Metric	Weighted Average Homes	Electric Resistance Homes	Heat Pump Homes	Gas Heat Homes
kWh per door	33	40	32	10
kW per door (summer)	0.007	0.006	0.010	0.005
kW per door (winter)	0.011	0.014	0.006	0.000

Domestic Water Heater Pipe Insulation

Table E-7 documents the proposed inputs and methodology for estimating domestic water heater pipe insulation savings.

Table E-7. Algorithms and Inputs for Domestic Water Heater Pipe Insulation

Algorithms Used		
kWh Savings	= (1/Rexist – 1/Rnew)*L*C*ΔT*8,766/nDHW/3,412*%Elec*ISR	
kW Savings	= kWh saved/8,766*CF	
Source of Algorithm: Illinois TRM v5.0. Volume 3. Page 161.		
Parameter	**Value**	**Source/Notes**
R-value of existing pipe (Rexist)	1	IL TRM. Assumed R-value of existing pipe. Navigant Consulting Inc., April 2009; "Measures and Assumptions for Demand Side Management (DSM) Planning; Appendix C Substantiation Sheets", p77.
R-value of pipe and insulation (Rnew)	3	ASHRAE Fundamentals Chapter 23 – Table 2: 1. For a fluid design operating temperature range of 105-140°F, the insulation conductivity is 0.22 – 0.28 Btu*in/h*ft2*°F. Assume midpoint (0.25). 2. To determine R-value, we need to divide the thickness of the insulation by the insulation conductivity (R-value = insulation thickness (inches) / thermal conductivity (Btu*in/h*ft2*°F). 3. Assume 0.5 inch insulation based on standard pipe insulation thickness. 4. R Value = 0.5 inch thickness / 0.25 Btu*in/h*ft2*°F = R-2. 5. This R-value is added to the existing (R-1) to get the total new R-value (R-3).
Length (L) in feet	10	According to program documentation, this measure consists of (2) 5 foot sections of insulation for each customer.
Circumference © in feet	0.131	Assume 0.5" diameter pipe. For 0.5" diameter pipe, circumference is 0.131 feet (C = 3.14*0.5/12)
Temperature difference (ΔT)	60 °F	From IL TRM. Assumes 125°F water leaving the hot water tank and average temperature of 65°F surrounding hot water tank.
Recovery efficiency of electric hot water heater (nDHW)	0.98	From IL TRM.

Coincidence Factor (CF)	1.0	Savings are realized 8,766 hours/year and through the full peak hours. There is no difference between summer and winter peak coincidence factors.
%Elec	93%	Percentage of 2015 DEC LI Wx participants using electric hot water.
ISR	96%	In-service rate from 2015 participant survey.

Table E-8 provides the deemed savings for domestic water heater pipe insulation, using the assumptions from Table E-7.

Table E-8. Domestic Water Heater Pipe Insulation Deemed Savings

Metric	Deemed Savings
kWh per 10 feet	122
kW per 10 feet (summer)	0.014
kW per 10 feet (winter)	0.014

Domestic Water Heater Tank Insulation

Table E-9 documents the proposed inputs and methodology for estimating domestic water heater tank insulation savings.

Table E-9. Algorithms and Inputs for Domestic Water Heater Tank Insulation

Algorithms Used		
kWh Savings	= (Abase/Rbase – Ainsul/Rinsul)*ΔT*8,766/nDHW/3,412*%Elec*ISR	
kW Savings	= kWh saved/8,766*CF	
Source of Algorithm: Illinois TRM v5.0. Volume 3. Page 195.		
Parameter	**Value**	**Source/Notes**
Surface area of tank before wrap (Abase)	24.99	IL TRM. Assume 50-gallon capacity tank and R-12 for baseline insulation, resulting in Abase of 24.99.
R-value of tank before wrap (Rbase)	12	Assumes 50-gallon capacity tank and R-12 for baseline insulation.
Surface area of tank after wrap (Ainsul)	27.06	Assumes 50-gallon capacity tank and R-12 for baseline insulation, resulting in Ainsul of 27.06.
R-value of tank after wrap (Rinsul)	20	Assumes 50-gallon capacity tank and R-12 for baseline insulation, resulting in Rinsul of 20.
ΔT	60 °F	IL TRM. Assumes 125°F water leaving the hot water tank and average temperature of 65°F surrounding hot water tank.
nDHW	0.98	Recovery efficiency of electric hot water heater (IL TRM).
CF	1	Adjustment is in place all hours of the year.
%Elec	93%	Percentage of 2015 DEC LI Wx participants using electric hot water.
ISR	96%	In-service rate from 2015 participant survey.

Table E-10 provides the deemed savings for domestic water heater tank insulation savings, using the assumptions from Table E-9.

Table E-10. Domestic Water Heater Tank Insulation Deemed Savings

Metric	Deemed Savings
kWh per tank	102
kW per tank (summer)	0.012
kW per tank (winter)	0.012

Water Heater Temperature Adjustment

Table E-11 documents the proposed inputs and methodology for estimating water heater temperature adjustment savings.

Table E-11. Algorithms and Inputs for Water Heater Temperature Adjustment

Algorithms Used		
kWh Savings	= (U*A*(Tpre-Tpost)*Hours)/(3,412*RE_electric)*%Elec*ISR	
kW Savings	= kWh saved/8,766*CF	
Source of Algorithm: Illinois TRM v5.0. Volume 3. Page 191.		
Parameter	**Value**	**Source/Notes**
U-value of tank (U)	0.083	IL TRM. Assumes R-12 or U-0.083.
Surface area of tank (A)	24.99	IL TRM. Will vary based on tank size. Currently assumes 50-gal tank but will be adjusted if additional data becomes available.
Tpre (°F)	135	IL TRM.
Tpost (°F)	120	IL TRM.
Hours	8,766	Hours in a year that the savings occur, assumed to be constant over the year (IL TRM).
Conversion	3,412	Conversion of Btu/kWh.
RE_electric	0.98	Recovery efficiency of electric hot water heater (IL TRM).
Coincidence Factor (CF)	1	Savings are realized 8,766 hours/year and through the full peak hours. There is no difference between summer and winter peak coincidence factors.
%Elec	93%	Percentage of 2015 DEC LI Wx participants using electric hot water.
ISR	100%	In-service rate from 2015 participant survey.

Table E-12 provides the deemed savings for water heater temperature adjustments, using the assumptions from Table E-11.

Table E-12. Water Heater Temperature Adjustment Deemed Savings

Metric	Deemed Savings
kWh per tank	76
kW per tank (summer)	0.009
kW per tank (winter)	0.009

Low-Flow Shower Heads

Table E-13 documents the proposed inputs and methodology for estimating low-flow shower head savings.

Table E-13. Algorithms and Inputs for Low-Flow Shower Heads

Algorithms Used		
kWh Savings	= (Baseline GPM – Efficient GPM)*(Mins/shower)*(Showers/person)*(People/household)/(Shower fix/household)*365*(Tmix-Tinlet)*8.33/3,412/RE*%Elec*ISR	
kW Savings	= (Baseline GPM – Low-flow GPM)*60*8.33*(Tmix-Tinlet)/RE/3,412*CF*%Elec*ISR	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 74.		
Parameter	**Value**	**Source/Notes**
Baseline GPM	2.3	Tennessee Valley Authority (TVA) TRM. Takes the average base flow rate from the following two references: • 2003, Mayer, Peter, William DeOreo. Pg 38. • 2008 Schuldt. Table 3, Pg 1-260.
Efficient GPM	1.9	Use value from participant database if available. In the absence of a database value, use the value from the TVA TRM (1.9 GPM), which takes the average of two studies. Through discussions with the Duke Energy program team, we confirmed that the program requires efficient shower heads to be 2.0 GPM or less.
Mins/shower	7.8	Michigan Evaluation Working Group Showerhead and Faucet Aerator Meter Study. June 2013 (Michigan Showerhead/Faucet Aerator Study). This 2013 estimate is a more recent study than the studies used in the TVA TRM for this parameter (2003 to 2011).
Showers/person	0.6	Michigan Showerhead/Faucet Aerator Study. This is a more recent study than the study used in the TVA TRM for this parameter (from 1999).
People/household	2.1	2015 DEC LI Wx participant data.
Shower fixtures/household	1.6	Michigan Showerhead/Faucet Aerator Study. This is a more recent study than the study used in the TVA TRM for this parameter (from 2011).
Tmix	101 °F	Michigan Showerhead/Faucet Aerator Study. This is a more recent study than the study used in the TVA TRM for this parameter (from 1984).
Tinlet	65.1 °F	NREL Domestic Hot Water Event Generator calculator for cities across DEC service territory. Used average for: Charlotte, NC; Greensboro, NC; Greenville, SC.
RE	0.98	Recovery efficiency for standard electric resistance water heaters (consistent assumption across IL TRM, IN TRM, ARK TRM). TVA TRM applies the overall efficiency of the water heater (0.89) as opposed to the recovery efficiency.
%Elec	93%	Percentage of 2015 DEC LI Wx participants using electric hot water.
Summer Coincidence Factor (CF)	0.00371	IN TRM. Aquacraft Water Engineering and Management "Disaggregated Hot Water Use"; assumes 9% of showers take place during the summer peak hour (4 to 5 pm).
Winter CF	0.00742	Duke Energy's winter peak is from 7-8 AM. Reliable data does not exist for winter coincidence factors for showers during the 7-8 AM hour. Customers are expected to use showers more frequently during the winter peak hour than the summer peak hour (4-5 PM). We estimate the frequency is approximately double and, therefore, double the summer CF to estimate winter CF.
ISR		In-service rate from 2015 participant survey.

Table E-14 provides the deemed savings for low-flow shower heads, using the assumptions from Table E-13.

Table E-14. Low-Flow Shower Head Deemed Savings

Metric	Deemed Savings
kWh per shower head	51
kW per shower head (summer)	0.005
kW per shower head (winter)	0.010

Low-Flow Aerators

Table E-15 documents the proposed inputs and methodology for estimating low-flow aerator savings. We estimate savings for bathroom faucet aerators and kitchen faucet aerators separately because the two measures are used differently and perform differently. For example, households tend to use kitchen faucets more than bathroom faucets throughout the day and kitchen faucets typically have a higher flow rate than bathroom faucets. We take the average of the bathroom and kitchen aerator savings to calculate a deemed value for the program measure. Implicitly, this averaging assumes that 50% of aerators are installed in kitchens, and that 50% are installed in bathrooms.

Table E-15. Algorithms and Inputs for Low-Flow Aerators

Algorithms Used		
kWh Savings	= (Baseline GPM – Efficient GPM)*(Mins/person/day)*(people/household)/(faucets/household)* 365*(Tmix-Tinlet)*8.33/3,412/RE*DF*%Elec*ISR	
kW Savings	= (Baseline GPM – Efficient GPM)*60*8.3*(Tmix-Tinlet)/RE/3,412*CF*DF*%Elec*ISR	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 68.		
Parameter	**Value**	**Source/Notes**
Baseline GPM (bathroom)	2.25	IL TRM.
Baseline GPM (kitchen)	2.75	
Efficient GPM (bathroom)	1.0	IN TRM.
Efficient GPM (kitchen)	1.5	
Minutes/person/day (bathroom)	1.6	Michigan Showerhead/Faucet Aerator Study
Minutes/person/day (kitchen)	4.5	
People/household	2.1	2015 DEC LI Wx participant data.
Faucets/household (bathroom)	2.0	TVA TRM. Assumes two bathroom and one kitchen.
Faucets/household (kitchen)	1.0	
Tmix (bathroom)	86 °F	Michigan Showerhead/Faucet Aerator Study
Tmix (kitchen)	93 °F	

Tmix (if location unknown)	91 °F	The Tmix average is applied if installation location is unknown. It assumes that 70% of household water runs through kitchen faucet and 30% through the bathroom faucet.
Tinlet	65.1 °F	NREL Domestic Hot Water Event Generator calculator for cities across DEC service territory. Used average for: Charlotte, NC; Greensboro, NC; Greenville, SC.
RE	0.98	Recovery efficiency for standard electric resistance water heaters (consistent assumption across IL TRM, IN TRM, ARK TRM). TVA TRM applies the overall efficiency of the water heater (0.89) as opposed to the recovery efficiency.
%Elec	93%	Percentage of 2015 DEC LI Wx participants using electric hot water.
Summer Coincidence Factor (CF)	0.00262	IN TRM
Winter CF	0.00524	Duke Energy's winter peak is from 7-8 AM. Reliable data does not exist for winter coincidence factors for aerators during the 7-8 AM hour. We expect customers to use sinks more frequently during the winter peak hour than the summer peak hour (4-5 PM). We assume the frequency is approximately double, and therefore double the summer CF to estimate winter CF.
Drain Factor (DF) (bathroom)	90%	IL TRM. DF represents the portion of the water that could be conserved by installing an aerator, i.e., the portion which flows directly down the drain, and is not collected for another purpose. If the water is collected from a tap (e.g., for cooking or cleaning), aerators do not save any energy, as the same volume of water is used regardless of the flow rate.
Drain Factor (DF) (kitchen)	75%	
ISR	74%	In-service rate from 2015 participant survey.

Table E-16 provides the deemed savings for low-flow aerators, based on the assumptions from Table E-15.

Table E-16. Low-Flow Aerator Deemed Savings

Metric	Weighted Average	Kitchen Aerator	Bathroom Aerator
kWh per aerator	88	153	24
kW per aerator (summer)	0.007	0.007	0.006
kW per aerator (winter)	0.013	0.014	0.013

CFLs

Table E-17 documents the proposed inputs and methodology for estimating CFL savings.

Table E-17. Algorithms and Inputs for CFLs

Algorithms Used		
kWh Savings	= (Baseline Watts – CFL Watts)/1,000*Hours*WHFe*ISR	
kW Savings	= (Baseline Watts – CFL Watts)/1,000*CF*WHFd*ISR	
Source of Algorithm: Standard lighting savings equation.		
Parameter	**Value**	**Source/Notes**
Baseline Watts	29	From ENERGY STAR website, converts CFL wattage to equivalent incandescent wattage and then adjusts based on EISA requirements.
	53	
CFL Watts	13	Actual program installed CFL wattage.
	18	

Hours	1,097	DEP PY2013 Low-Income Neighborhoods Evaluation. Appendix B. Page B-7. Average hours of use collected during PY2012 and PY2013 Evaluation of DEP's Low Income Neighborhoods Evaluation. Note, this HOU is in line with values from other residential lighting evaluations across the U.S.
WHFe	0.90	Applied weights to the AR TRM waste heat factors based on presence of central AC and heating fuel type from the 2015 DEC LI Wx participant data.
WHFd (summer)	1.17	
WHFd (winter)	1.00	Winter peak demand waste heat factors currently not available in secondary sources. Assumed 1.00.
Summer Coincidence Factor (CF)	0.1138	2013 Evaluation of DEP's Energy Efficient Lighting Program.
Winter CF	0.096	
ISR	84%	In-service rate from 2015 participant survey.

Table E-18 provides the deemed savings CFLs, based on the assumptions from Table E-17.

Table E-18. CFL Deemed Savings

Metric	13W	18W
kWh per CFL	13	29
kW per CFL (summer)	0.002	0.004
kW per CFL (winter)	0.001	0.003

Heating System Tune-Up

Table E-19 documents the proposed inputs and methodology for estimating heating system tune-up savings. Opinion Dynamics currently assumes this measure applies to heat pump and electric resistance heating equipment. Because this is a heating system tune-up only, we exclude any potential cooling savings.

Table E-19. Algorithms and Inputs for Heating System Tune-Up

Algorithms Used		
kWh Savings (heat pump)	= Btuheat*EFLHheat*1/COPhp*Mfe/3,142*ISR	
kWh Savings (furnace)	= Btuheat*EFLHheat*1/COPer*Mfe/3,142*ISR	
kW (summer)	= 0 (assume this is a heating-only measure)	
kW winter (heat pump)	= Btuhheat*1/COPhp*Mfd*CF/3412*ISR	
kW winter (furnace)	= Btuhheat*1/COPer*Mfd*CF/3412*ISR	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 89.		
Parameter	**Value**	**Source/Notes**
Btuhheat	49,794	Assume 35 Btu/sf required based on climate zone: https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/ Used average square footage from 2015 DEC LI Wx participants.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
COP heat pump	2.26	Mid-Atlantic TRM.

COP electric resistance	1.0	
Mfe	0.05	Maintenance energy savings factor. Consistent with IN and IL TRM. References Energy Center of Wisconsin, May 2008 study.
Mfd	0.02	Maintenance demand savings factor. Consistent with IN and IL TRM. References Energy Center of Wisconsin, May 2008 study.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
ISR	90%	In-service rate from 2015 participant survey.

Table E-20 provides the deemed savings for heating system tune-ups, based on the heating type and using the assumptions from Table E-19. We weight the average homes savings assuming 18% of these participants had gas heat and therefore achieved no electrical heating savings, but that 66% of homes had an electric furnace, and that 17% had a heat pump (based on 2015 DEC LI Wx participant data).

Table E-20. Heating System Tune-Up Deemed Savings

Metric	Weighted Average Homes	Electric Furnace	Heat Pump
kWh per system	911	1,244	550
kW per system (summer)	0.000	0.000	0.000
kW per system (winter)	0.193	0.264	0.117

Tier II Measures

Duct Insulation

Table E-21 documents the proposed inputs and methodology for estimating duct insulation savings.

Table E-21. Algorithms and Inputs for Duct Insulation

Algorithms Used		
kWh (cooling)	= (DEafter – DEbefore)/(DEafter)*FLHcool*Btuhcool/SEER/1000*%AC*ISR	
kWh (heating)	= (DEafter – DEbefore)/(DEafter)*FLHheat*Btuhheat/nheat/3412*ISR	
kW (summer)	= kWh (cooling) / FLHcool*CF(summer)	
kW (winter)	= kWh (heating) / FLHheat*CF(winter)	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 54.		
Parameter	**Value**	**Source/Notes**
DEafter	79%	Improved duct distribution efficiency. From duct distribution efficiency table: http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Assume average of all distribution efficiencies > R-4.
Debefore	77%	Baseline duct distribution efficiency. From duct distribution efficiency table: http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Assume average of all conditioned space possibilities for all distribution efficiencies < R-4
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhcool	34,800	Currently not available for DEC customers. Assume average cooling capacity based on installed capacity through a similar program for a confidential utility

		in the same region (n=992). Will update with actual DEC customer data if it becomes available. Applying a generic value from other sources (e.g., ASHRAE or ENERGY STAR) would decrease the accuracy of this savings assumption.
SEER	13	Assume 13 SEER based on several TRMs (Table E-34. Key References). Assume equipment installed after 2006.
%AC	68%	2015 DEC LI Wx participant data. 68% of participants had either central AC or a heat pump.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhheat	49,794	Assume 35 Btu/sf required based on climate zone: https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/ Used average square footage from 2015 DEC LI Wx participants.
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.0	
nHeat	1.2	Calculated weighted average COP based on 2015 DEC LI Wx participant data.
EER	11.18	Converted from SEER based on standard conversion.
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
ISR	100%	In-service rate from 2015 participant survey.

Table E-22 provides the deemed savings for duct insulation, based on the heating type and using the assumptions from Table E-21. We provide the deemed savings per system and per ton. Opinion Dynamics recommends applying the per ton savings if Duke Energy can provide actual tonnage of the equipment at the home.

Table E-22. Duct Insulation Deemed Savings

Metric	Weighted Average Homes	Electric Resistance Homes	Heat Pump Homes	Gas Heat Homes
kWh per system	415	563	228	34
kW per system (summer)	0.022	0.021	0.034	0.017
kW per system (winter)	0.197	0.277	0.086	0.000
kWh per ton	143	194	79	12
kW per ton (summer)	0.008	0.007	0.012	0.006
kW per ton (winter)	0.068	0.096	0.030	0.000

Duct Sealing

Table E-23 documents the proposed inputs and methodology for estimating duct sealing savings.

Table E-23. Algorithms and Inputs for Duct Sealing

Algorithms Used		
kWh (cooling)	= (DEafter – DEbefore)/(DEafter)*FLHcool*Btuhcool/SEER/1000*%AC*ISR	
kWh (heating)	= (DEafter – DEbefore)/(DEafter)*FLHheat*Btuhheat/nheat/3412*ISR	
kW (summer)	= kWh (cooling) / FLHcool*CF(summer)	
kW (winter)	= kWh (heating) / FLHheat*CF(winter)	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 54.		
Parameter	**Value**	**Source/Notes**
DEafter	87%	Improved duct distribution efficiency. From duct distribution efficiency table: http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Assume average of all conditioned space possibilities for ducts sealed with mastic.
Debefore	76%	Baseline duct distribution efficiency. From duct distribution efficiency table: http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf Assume average of all conditioned space possibilities for all non-sealed duct possibilities.
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhcool	34,800	Currently not available for DEC customers. Assume average cooling capacity based on installed capacity through a similar program for a confidential utility in the same region (n=992). Will update with actual DEC customer data if it becomes available. Applying a generic value from other sources (e.g., ASHRAE or ENERGY STAR) would decrease the accuracy of this savings assumption.
SEER	13	Assume 13 SEER based on several TRMs (Table E-34. Key References). Assume equipment installed after 2006.
%AC	68%	2015 DEC LI Wx participant data. 68% of participants had either central AC or a heat pump.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhheat	49,794	Assume 35 Btu/sf required based on climate zone: https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/ Used average square footage from 2015 DEC LI Wx participants.
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.0	
nHeat	1.2	Calculated weighted average COP based on 2015 DEC LI Wx participant data.
EER	11.18	Converted from SEER based on standard conversion.
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
ISR	100%	In-service rate from 2015 participant survey.

Table E-24 provides the deemed savings for duct sealing, based on the heating type and using the assumptions from Table E-23. We provide the deemed savings per system and per ton. Opinion Dynamics recommends applying the per ton savings if Duke Energy can provide actual tonnage of the equipment at the home.

Table E-24. Duct Sealing Deemed Savings

Metric	Weighted Average Homes	Electric Resistance Homes	Heat Pump Homes	Gas Heat Homes
kWh per system	2,772	3,761	1,522	230
kW per system (summer)	0.149	0.138	0.224	0.117
kW per system (winter)	1.315	1.852	0.573	0.000
kWh per ton	956	1,297	525	79
kW per ton (summer)	0.051	0.047	0.077	0.040
kW per ton (winter)	0.453	0.639	0.197	0.000

Insulation

Table E-25 documents the proposed inputs and methodology for estimating insulation savings.

Table E-25. Algorithms and Inputs for Insulation

Algorithms Used		
kWh (cooling)	= CDD*24*DUA/SEER/1,000*(1/Rexisting – 1/Rnew)*ADJcool*ISR	
kWh heating (heat pump)	= HDD*24/1,000/HSPF*(1/Rexisting – 1/Rnew)*ADJheat*ISR	
kWh heating (electric resistance)	= HDD*24/3,412 *(1/Rexisting – 1/Rnew)*ADJheat*ISR	
kW (summer)	= kWh (cooling) / FLHcool*CF(summer)	
kW (winter)	= kWh (heating) / FLHheat*CF(winter)	
Source of Algorithm: Pennsylvania TRM. PA PUC. June 2016 with adjustments based on IL TRM V5. Vol 3. Page 293.		
Parameter	**Value**	**Source/Notes**
CDD	1,596	ASHRAE Fundamentals 2013. Assume average of cities across DEC service territory available in ASHRAE (Charlotte, NC; Greensboro, NC; Greenville, SC).
HDD	3,250	
DUA	0.75	Discretionary Use Adjustment for cooling. Common to most TRMs. Accounts for fact that not all cooling systems operate 100% of the time cooling is needed.
SEER	13	Assume 13 SEER based on several TRMs (Table E-34. Key References). Assume equipment installed after 2006.
HSPF	7.75	Per the IL TRM, the average SEER/HSPF ratio from the AHRI directory data is 0.596. Applied this ratio to the assumed SEER value.
%AC	68%	2015 DEC LI Wx participant data. 68% of participants had either central AC or a heat pump.
% heat pump	17%	2015 DEC LI Wx participant data.
% resistance	66%	
% gas heat	17%	
COP heat pump	2.26	Mid-Atlantic TRM.

COP electric resistance	1.0	
ADJcool	80%	IL TRM. Adjustment for cooling savings from insulation to account for engineering algorithms overclaiming savings. As demonstrated in two years of metering evaluation by Opinion Dynamics for homes in Illinois. From Memo: "Results for Ameren Illinois Corporation PY6 Home Performance with ENERGY STAR Billing Analysis", dated February 20, 2015.
ADJheat	60%	
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
Rexisting	5	Assume existing R-value is at least R-5 based on framing and potential for other existing insulation.
Rnew	Table E-26	Varies based on installation location and type of insulation.
ISR	98%	In-service rate from 2015 participant survey.

Table E-26 provides the new R-value assumptions based on location and type of insulation installed.

Table E-26. Existing and New Assumed R-values for Insulation Measures

Insulation Type	R-Existing	R-New	Source/Notes
Attic Insulation - Cellulose, Blown - R-30	5	30	None.
Attic Insulation - Cellulose, Blown - R-38	5	38	None.
Attic Insulation - Fiberglass, Blown - R-30	5	30	None.
Attic Insulation - Fiberglass, Blown - R-38	5	38	None.
Belly Fiberglass Loose	5	19	No R-New given in program materials. Likely a constrained space so assume R-19, similar to floor.
Floor Insulation - Fiberglass, Batts - R-19	5	19	None.
Wall Insulation - Fiberglass, Blown - R-13	5	13	None.
Wall Insulation - Cellulose, Blown - R-13	5	13	None.
Knee Wall Insulation	5	19	No R-New given in description. Assume R-19 based on typical code requirements for knee wall insulation.
Manufactured Home Roof Cavity	5	19	No R-New given in description. Likely a constrained space so assume R-19, similar to floor.

Table E-27 provides the deemed savings for insulation, using the assumptions from Table E-25 and Table E-26.

Table E-27. Insulation Deemed Savings

Metric	kWh Savings/square foot	kW Savings/square foot (summer)	kW Savings/square foot (winter)
Attic Insulation - Cellulose, Blown - R-30	1.8	0.0001	0.0009

Metric	kWh Savings/square foot	kW Savings/square foot (summer)	kW Savings/square foot (winter)
Attic Insulation - Cellulose, Blown - R-38	1.9	0.0001	0.0009
Attic Insulation - Fiberglass, Blown - R-30	1.8	0.0001	0.0009
Attic Insulation - Fiberglass, Blown - R-38	1.9	0.0001	0.0009
Belly Fiberglass Loose	1.6	0.0001	0.0008
Floor Insulation - Fiberglass, Batts - R-19	1.6	0.0001	0.0008
Wall Insulation - Fiberglass, Blown - R-13	1.4	0.0001	0.0006
Wall Insulation - Cellulose, Blown - R-13	1.4	0.0001	0.0006
Knee Wall Insulation	1.6	0.0001	0.0008
Manufactured Home Roof Cavity	1.6	0.0001	0.0008

Heat Pump Upgrade

Table E-28 documents the proposed inputs and methodology for estimating heat pump upgrade savings.

Table E-28. Algorithms and Inputs for Heat Pump Upgrade

Algorithms Used		
kWh (cooling)	= FLHcool*Btuhcool*(1/SEERbase – 1/SEERee)/1,000*ISR	
kWh (heating)	= FLHheat*Btuhheat*(1/HSPFbase – 1/HSPFee)/1,000*ISR	
kW (summer)	= Btuhcool*(1/EERbase – 1/EERee)/1,000*CF*ISR	
kW (winter)	= kWh (heating) / FLHheat*CF(winter)	
Source of Algorithm: Illinois TRM. V5. Vol_3. Page 58.		
Parameter	**Value**	**Source/Notes**
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhcool	34,800	Currently not available for DEC customers. Assume average cooling capacity based on installed capacity through a similar program for a confidential utility in the same region (n=992). Will update with actual DEC customer data if it becomes available. Applying a generic value from other sources (e.g., ASHRAE or ENERGY STAR) would decrease the accuracy of this savings assumption.
SEERbase	13	Program claims savings from an upgrade from base SEER 13 to SEER 14.
SEERee	14	
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhheat	34,800	Capacity of heating and cooling assumed to be the same for a heat pump (consistent with assumptions from IL and IN TRM).
HSPFbase	7.75	Per the IL TRM, the average SEER/HSPF ratio from the AHRI directory data is 0.596. Applied this ratio to the assumed SEER value.
HSPFee	8.34	
EERbase	11.18	Conversion from SEER.
EERee	11.76	
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
ISR	100%	In-service rate from 2015 participant survey.

Table E-29 provides the deemed savings for a heat pump upgrade, using the assumptions from Table E-28. We provide the deemed savings per system and per ton. Opinion Dynamics recommends applying the per ton savings if Duke Energy can provide actual tonnage of the equipment at the home.

Table E-29. Heat Pump Upgrade Deemed Savings

Metric	Deemed Savings
kWh per system	854
kW per system (summer)	0.101
kW per system (winter)	0.321
kWh per ton	294
kW per ton (summer)	0.035
kW per ton (winter)	0.111

Heat Pump Replacement

Table E-30 documents the proposed inputs and methodology for estimating heat pump replacement savings.

Table E-30. Algorithms and Inputs for Heat Pump Replacement

Algorithms Used		
kWh (cooling)	= FLHcool*Btuhcool*(1/SEERbase – 1/SEERee)/1,000*ISR	
kWh (heating)	= FLHheat*Btuhheat*(1/HSPFbase – 1/HSPFee)/1,000*ISR	
kW (summer)	= Btuhcool*(1/EERbase – 1/EERee)/1,000*CF*ISR	
kW (winter)	= kWh (heating) / FLHheat*CF(winter)	
Source of Algorithm: Illinois TRM. V5. Vol_3. Page 58.		
Parameter	**Value**	**Source/Notes**
FLHcool	1,305	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhcool	34,800	Currently not available for DEC customers. Assume average cooling capacity based on installed capacity through a similar program for a confidential utility in the same region (n=992). Will update with actual DEC customer data if it becomes available. Applying a generic value from other sources (e.g., ASHRAE or ENERGY STAR) would decrease the accuracy of this savings assumption.
SEERbase	11.15	IN TRM. TecMarket Works, et al. Residential Baseline Report Final. November 2, 2012.
SEERee	14	Keep consistent with HP Upgrade measure.
FLHheat	1,884	EPA Calculator. Assume average of cities in or near DEC service territory: Charlotte, NC; Greensboro, NC; Greenville, SC.
Btuhheat	34,800	Capacity of heating and cooling assumed to be the same for a heat pump (consistent with assumptions from IL and IN TRM).
HSPFbase	6.65	Per the IL TRM, the average SEER/HSPF ratio from the AHRI directory data is 0.596. Applied this ratio to the assumed SEER value.
HSPFee	8.34	
EERbase	10.0	Conversion from SEER.
EERee	11.76	
Summer CF	0.66	Mid-Atlantic TRM. PJM CF for central AC.

Winter CF	1.0	Review of several TRMs (Table E-34. Key References). Assume heating operates during peak winter hour.
ISR	100%	In-service rate from 2015 participant survey.

Table E-31 provides the deemed savings for a heat pump replacement, using the assumptions from Table E-30. We provide the deemed savings per system and per ton. Opinion Dynamics recommends applying the per ton savings if Duke Energy can provide actual tonnage of the equipment at the home.

Table E-31. Heat Pump Replacement Deemed Savings

Metric	Deemed Savings
kWh per system	2,837
kW per system (summer)	0.343
kW per system (winter)	1.066
kWh per ton	978
kW per ton (summer)	0.118
kW per ton (winter)	0.368

Refrigerator Replacement

Table E-32 documents the proposed inputs and methodology for estimating refrigerator replacement savings. We based baseline refrigerator energy consumption on metered data provided by the program (n=87). The data did not distinguish between refrigerator sizes, so we assumed the same average baseline consumption for all three sizes. We based efficient refrigerator energy consumption on updated Federal standards (effective starting in September 2014) and the current ENERGY STAR requirement that ENERGY STAR refrigerators be 10% more efficient than the current federal standard.

Table E-32. Algorithms and Inputs for ENERGY STAR Refrigerators

Algorithms Used		
kWh	= (Baseline Energy – ENERGY STAR Energy)*ISR	
kW	= kWh/8,766	
Source of Algorithm: Federal standards and ENERGY STAR requirements.		
Parameter	**Value**	**Source/Notes**
Baseline Energy Consumption (kWh/year)	1,654	Based on average participant level test result metered data provided by the program (n=87).
Current Federal Standard (kWh/year)	472 (15 cu. ft.) 498 (18 cu. ft.) 524 (21 cu. ft.)	Calculated maximum energy use per refrigerator based on size using the current Federal requirements (since 2014) and took average of all potential refrigerator layouts. http://www.ecfr.gov/cgi-bin/text-idx?SID=48f64e166fe3561666f871e521996e13&mc=true&node=se10.3.430_132&rgn=div8
ENERGY STAR Energy Consumption	425 (15 cu. ft.) 448 (18 cu. ft.) 472 (21 cu. ft.)	ENERGY STAR standards require 10% reduction from current federal standard. https://www.energystar.gov/products/appliances/refrigerators/key_product_criteria
Annual hours of use	8,766	Assume refrigerators are plugged in throughout the year.
ISR	100%	In-service rate from 2015 participant survey.

Table E-33 provides the deemed savings for refrigerator replacement, using the assumptions from Table E-32.

Table E-33. Refrigerator Replacement Deemed Savings

Metric	15 cu. ft.	18 cu. ft.	21 cu. ft.
kWh per refrigerator	1,229	1,206	1,182
kW per refrigerator (summer)	0.140	0.138	0.135
kW per refrigerator (winter)	0.140	0.138	0.135

Key References

Table E-34. Key References

Reference	Source
AR TRM	Arkansas Technical Reference Manual Version 4.0. Volume 1. August 29, 2014.
ASHRAE Fundamentals 2013	ASHRAE Fundamentals. Appendix: Design Conditions for Selected Locations. Chapter 14.
EPA Calculator	ENERGY STAR Air Source Heat Pump Calculator. Full-load cooling and heating hours cite EPA 2002 in calculator.
IL TRM	Illinois Technical Reference Manual. Version 4.0. February 24, 2015.
IN TRM	Indiana Technical Reference Manual. Version 2.2. July 28, 2015.
Michigan Showerhead/Faucet Aerator Study	Michigan Evaluation Working Group Showerhead and Faucet Aerator Meter Study Memorandum. June 2013.
Mid-Atlantic TRM	Mid-Atlantic Technical Reference Manual. Version 4.0. June 2014.
RECS Data	U.S. Energy Information Administration, 2009 Residential Energy Consumption Survey (RECS), North Carolina and South Carolina.
Refrigerator Test Data	Baseline refrigerator energy consumption based on test measurement data provided by Duke. File name: DEC WX 2015-16 Refrigerator Replacement kWh 11.1.16_2016-11-02
Tennessee Valley Authority (TVA) TRM	Tennessee Valley Authority Technical Reference Manual Version 3.0. January 2015.

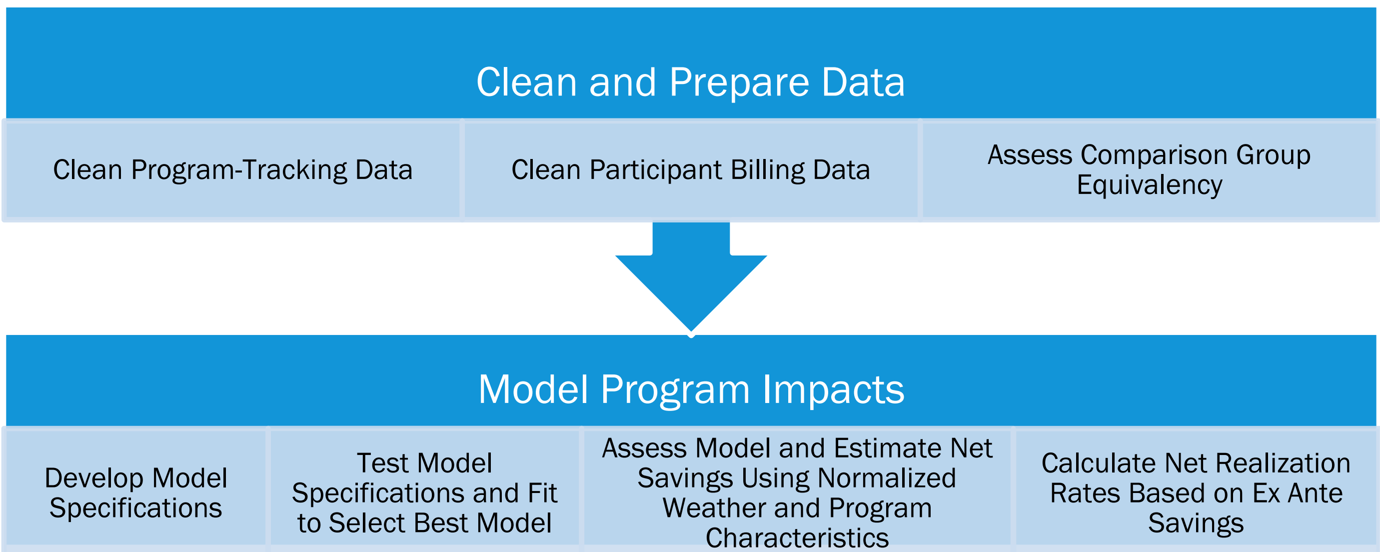
Appendix F. Detailed Methods: Billing Analysis

The evaluation team conducted a billing analysis using a Linear Fixed Effect Regression (LFER) model, with the goal of determining the overall ex post net program savings of the DEC Weatherization Program. The model allows all household factors that do not vary over time to be absorbed by (and therefore controlled for) the individual constant terms in the equation. Specifically, this method uses home-specific intercepts.

Data Cleaning and Preparation

As part of the billing analysis of LI Weatherization program participants, the evaluation team followed a standard series of steps for data collection, model specification, and analysis. Figure F-1 provides a summary of our billing analysis approach.

Figure F-1. Billing Analysis Approach



Program-Tracking Data

As a first step in preparing the necessary data, the evaluation team prepared a master participant dataset that combined the program-tracking data, from each year, for the LI Weatherization program with dates of participation in other Duke Energy energy-efficiency programs. This master dataset is composed of customer information that includes:

- **Participation date:** The date of participation determines the program year for each account. We also checked to see if there were any discrepancies in LI Weatherization program participation dates, in relation to previous program-tracking data.
- **Program Tier:** Since the program is set up in distinct tiers, our master dataset includes flags for participation in each tier, as well as a flag indicating the replacement of a refrigerator.
- **Participation in other programs:** Customers who participated in another energy efficiency program (Helping Home Fund) during the time period being analyzed were identified and accounted for to properly isolate the observed effect of the DEC Weatherization Program.

- **Location:** We used the address and zip code of each customer to incorporate regional weather data in a later step.

Participant Billing Data

The participant billing data used in the billing analysis come from monthly billing data from January 2012 to July 2017, obtained directly from Duke Energy. To develop the final dataset used for statistical analysis, we used a multi-step approach to combine and clean these data. We describe each billing data-cleaning step below.

- **Clean individual billing periods:** After adjusting billing periods based on flags in the data indicating "estimated" or "adjusted" meter reads, we removed billing periods with a duration of 0 days or missing information. Usage records for these billing periods recorded either 0 kWh or positive kWh; many were the first meter read in the available billing history or a "turn-on" read. Nearly all accounts had typical billing periods of around 30 days. Additionally, we:
  - **Determined average daily usage for each observation** (based on usage and number of billing days in the period).
  - **Removed all duplicate billing records:** Duplicate records represented less than 0.1% of the records in the data pulled from the data warehouse.
  - **Combined participant data with billing records:** We merged usage data with the customer-specific (account-level) data, including measure installation dates. We then assigned pre- and post-participation treatment billing periods based on those dates. We assigned billing periods before the first measure installation date to the pre-participation period, all bills following the last measure installation date as the post-participation period, and any bills occurring between installation dates (or in the month of the audit and measure installations) to a "dead-band" period that was not included in the analysis.

After individual billing records are cleaned and all data are combined, we remove accounts that do not meet certain criteria. We use these criteria to ensure that all accounts in the final analysis file have sufficient data to allow for robust analysis. Customers who do not meet the criteria necessary for accurate modeling are dropped.

- **Extremely high or low ADC:** We removed customers with entire pre- or post-participation periods having very high or very low usage. We dropped households with ADC at or below 2 kWh/day on average (across their billing history in both the pre- and post-participation periods). We also dropped customers with extremely high usage (over 300 kWh/day). These households with odd usage patterns are likely to be the result of factors that cannot easily be controlled for and could bias the results.
- **Inadequate billing history before or after program participation:** The primary savings measures are expected to generate energy savings throughout the year. To be able to fully assess changes in consumption due to program measures before and after installation, we included participants with a billing history covering, at a minimum, 12 months of billing data before the first day of program participation, and the same amount of time after participation for our treatment group.

Table F-1 shows the number of accounts removed from the analysis for each reason.

Table F-1. Accounts Removed from Analysis

Reason for Dropping Account	Accounts	Percent of Total
Total Unique Accounts	1,365	
Fewer Than 12 Months in Post Period Days (Treat)	23	1.68%
Fewer Than 12 Months in Pre Period Days	18	1.32%
Fewer Than 2 Summer Billing Post Period (Treat)	4	0.3%
Fewer Than 2 Summer Billing Pre Period	4	0.3%
Fewer Than 6 Pre Billing Periods	6	0.4%
Less Then 6 Post Billing Periods (Treat)	55	4.0%
Low Overall Post ADC < 2 kWh	1	0.1%
Accounts Remaining for Analysis	1,254	92%

Weather

To include weather patterns in our model, we used daily weather data from numerous weather stations across the DEC territory, utilizing the site closest to each account's geographic location. By using multiple sites, we increase the accuracy of the weather data being associated with each account. We obtained these data from the National Climatic Data Center (NCDC).

The daily data are based on hourly average temperature readings from each day. We calculated CDD and HDD for each day (in the analysis and historical periods) based on average daily temperatures, using the same formula used in weather forecasting.[19] We merged daily weather data into the billing dataset so that each billing period captures the HDD and CDD for each day within that billing period (including start and end dates[20]). For analysis purposes, we then calculated average daily HDD and average daily CDD, based on the number of days within each billing period.

Comparison Group

A key challenge for estimating energy savings via a billing analysis is the identification of an appropriate comparison group or "counterfactual" to represent a baseline for what participants would have done (and how much energy they would have consumed) in the absence of the program. There are two key considerations in the design of a comparison group. A comparison group must: 1) have similar energy usage patterns (compared to participants) before participation (i.e. pre-participation period) and 2) effectively address self-selection bias (the correlation between the propensity to participate in a program and energy use). In an ideal experimental design, a control group would be equivalent to the treatment group in all aspects, save for the treatment being evaluated (participation in the LI Weatherization Program in our case). A perfect post-participation match is impossible when studying the effects of energy efficiency programs, since we cannot know if any group of non-participants is equivalent to the participant group, especially on the dimension of what the participants would

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[19] *A "degree-day" is a unit of measure for recording how hot or how cold it has been over a 24-hour period. The number of degree-days applied to any particular day of the week is determined by calculating the mean temperature for the day and then comparing the mean temperature to a base value of 65 (HDD) and 75 (CDD) degrees F. (The "mean" temperature is calculated by adding together the high for the day and the low for the day, and then dividing the result by 2.) If the mean temperature for the day is 5 degrees higher than 75, then there have been 5 cooling degree-days. On the other hand, if the weather has been cool, and the mean temperature is, say, 55 degrees, then there have been 10 heating degree-days (65 minus 55).* http://www.srh.noaa.gov/ffc/?n=degdays.

[20] Daily weather data are merged based on the given dates of the billing period. Assigning weather this way provides a more accurate representation of the weather experienced during the billing period than does using weather for the calendar month of the bill.

have done absent the program. We generally aim to use a comparison group that, on average, exhibits very similar usage patterns prior to participation. Achieving this ensures that estimates from our quasi-experiment are representative on usage patterns at least, which reflects not only a household's level of use but its energy-related responses to changes in the environment. It is more difficult to assure that the comparison group represents what the participants would have done absent the program, i.e. whether they capture who would have been a free rider if they had participated. Another way to put it is that it is difficult to know whether we have captured factors involved in customers' self-selection into the program, some of whom would have installed program-qualified measures outside of the program.

We use future participants as a comparison group for this analysis. The energy use patterns of the members of this type of comparison group, during their pre-participation period, reflect equipment installations and behavioral changes that treatment group participants might have performed in the absence of the program. Using a group of later actual participants mitigates self-selection bias that may be present when comparing the treatment group participants to some non-participating group of customers in the same time-period. The appropriate use of the future-participant comparison group design depends on the two groups and the program being equivalent on as many dimensions as possible. Substantial differences between the treatment and comparison groups could lead to a misrepresentation of the counterfactual.

Pre-participation energy usage of our potential comparison group follows a nearly identical pattern as that of the treatment. We also found that participants from each year experienced the same weather.

Based on the information at our disposal, we analyzed three criteria to determine if treatment participants were equivalent to the potential comparison participants, and therefore whether the potential comparison customers could be used as a valid comparison group. These criteria are:

- **Weather:** We compared average monthly HDD and CDD and found that participants in the treatment group and the potential comparison group experienced nearly identical weather over time. We do not believe that the few, minor differences in weather over time have any noticeable effect on the outcome of our model. Figure F-2 and Figure F-3 show the comparison of HDD and CDD respectively.

Figure F-2. Average Heating Degree Days Experienced by Treatment and Comparison Group

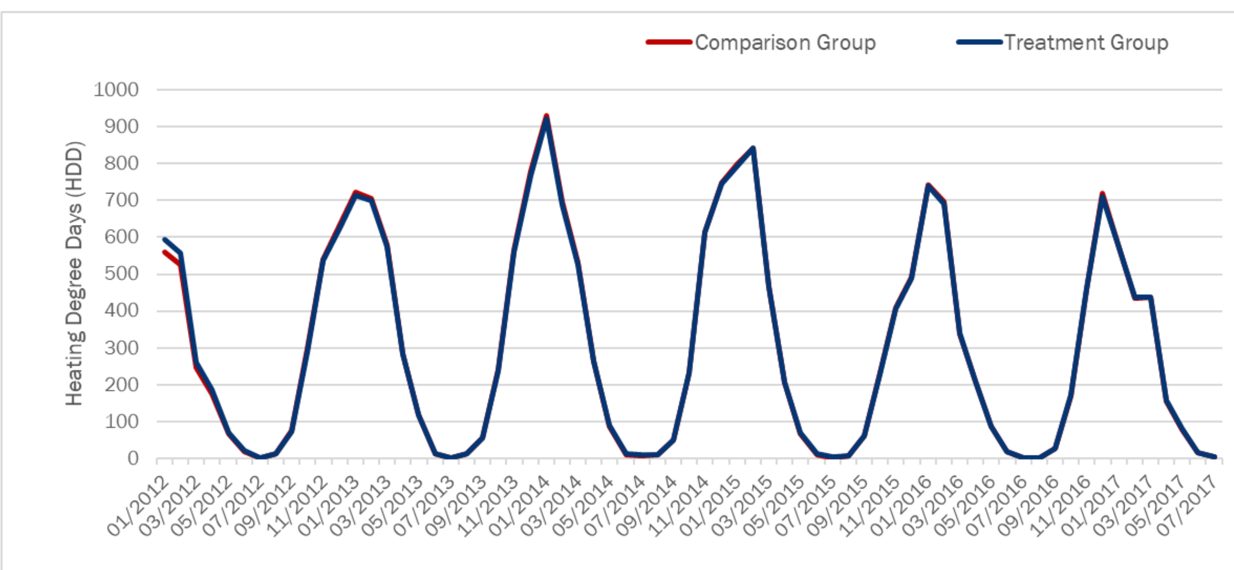
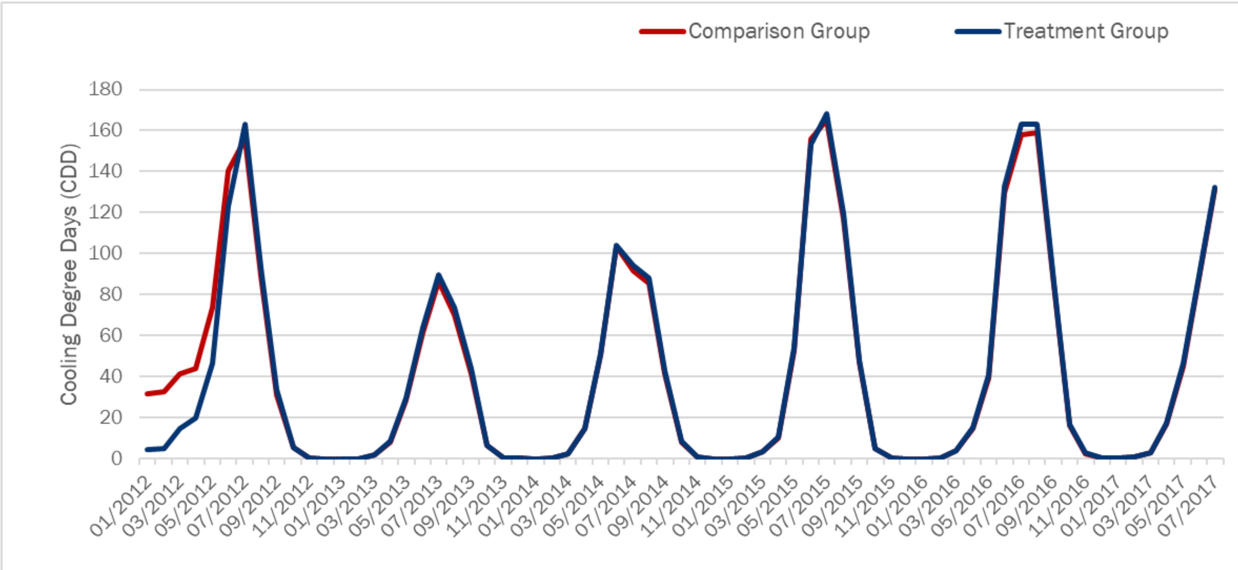
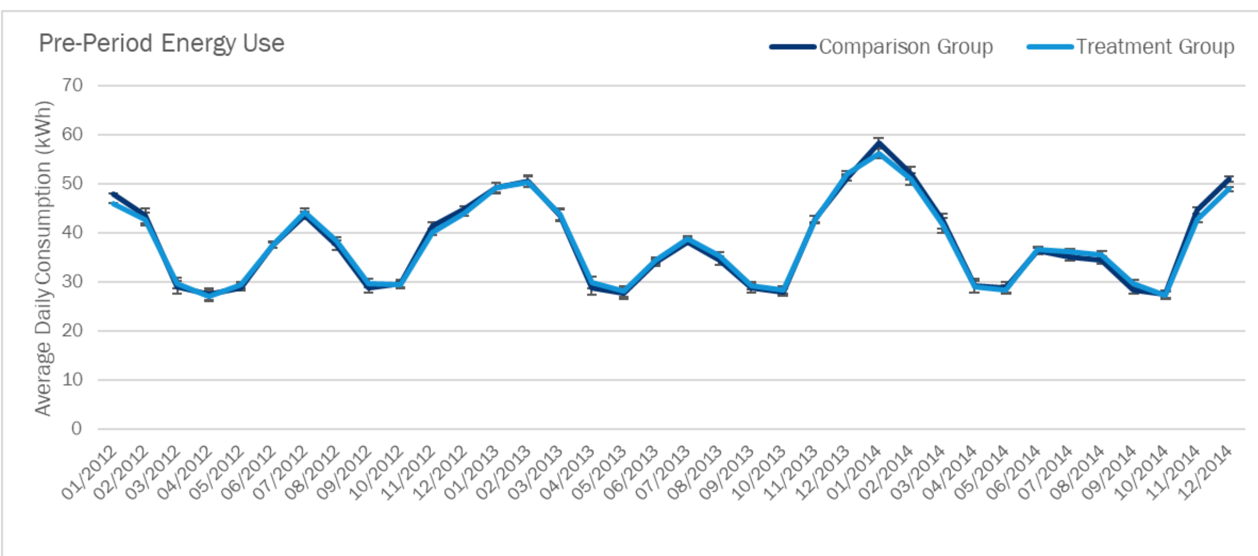


Figure F-3. Average Cooling Degree Days Experienced by Treatment and Comparison Group



- **Baseline period ADC:** Similarity in average daily consumption (ADC) before engaging with the program is a general proxy for behavioral similarities. We examined the ADC for months during each participant's pre-participation period and compared energy consumption patterns across treatment and comparison groups. As shown in Figure F-4 pre-participation energy usage for the comparison group follows a nearly identical pattern as the treatment group. This degree of similarity in baseline usage supports using baseline period ADC as the proxy for behavioral similarities.

Figure F-4. Comparison of Average Baseline Monthly kWh Consumption Between Treatment and Comparison Groups



- **Measure Mix:** The shares of treatment and comparison group customers receiving each measure are largely consistent. This is especially true for measures that account for the highest percentage of program savings in each tier, notably air sealing (Tier I), and duct dealing and insulation measures (Tier II). There are some more noticeable differences in the prevalence of CFL installations and domestic hot water temperature setbacks across the treatment and comparison groups, but, in our judgement, these are unlikely to impact the effectiveness of the comparison group as a reliable counterfactual, due to the relatively small contributions those measures make to overall savings (based on the deemed savings review).

Table F-2. Percentage of Homes Which Received Measures

Measure	Treatment Group (2015- May 2016)	Comparison Group (May 2016 - August 2017)	Pct-Point Difference (Treatment - Comparison)
Tier I Measures			
Air Sealing	96%	93%	3%
CFL 13W	63%	28%	35%
Low-Flow Aerator	60%	47%	13%
Low-Flow Showerhead	57%	45%	12%
DWH Pipe Insulation	51%	52%	-1%
Door Weather-stripping	49%	58%	-9%
DWH Tank Insulation	47%	45%	2%
Dryer Vent	41%	53%	-12%
CFL 18W	33%	21%	12%
Heat System Tune Up	33%	31%	2%
DHW Temperature Adjustment	22%	6%	16%
Tier II Measures			
Duct Sealing	63%	63%	0%
Floor Insulation Fiberglass Bts R19	38%	36%	2%
Attic Insulation Fiberglass Blown R30	26%	27%	-1%
Attic Insulation Fiberglass Blown R38	19%	23%	-4%
Loose Insulation	15%	12%	3%
Attic Insulation Cell R30	8%	3%	5%
Attic Insulation Cell R38	8%	5%	3%
Roof Cavity Insulation	7%	7%	0%
Wall Insulation Cell R13	5%	2%	3%
Heat system Repair	3%	2%	1%
Knee Wall Insulation	2%	3%	-1%
Wall Insulation Fiberglass Bln R13	2%	2%	0%
Duct Insulation	1%	1%	0%
Heat Pump Replacement	0%	3%	-3%
Heat Pump Upgrade	0%	1%	-1%
Refrigerator Replacements (Not Captured in Weatherization Model Coefficient)			
Refrigerator 15 Cft	1%	1%	0%
Refrigerator 18 Cft	5%	6%	-1%
Refrigerator 21 Cft	8%	10%	-2%

Duke Energy Helping Home Fund Participation

In addition to the three main criteria for comparison group equivalency, we completed a cross-participation assessment to determine whether participants and the comparison group had similar enrollment rates in other Duke Energy programs likely to have affected energy use during the evaluation period. Based on our review, the Helping Home Fund (HHF) is the only Duke Energy program that is both designed to reach the same customer segment (i.e., income-qualified). All of these program similarities are important in assessing probable sources of cross-participation given the DEC Weatherization's program delivery model focuses on a specific income-eligible segment and offers comprehensive whole-home savings from many direct-install and envelope measures. Thus, we examined the rate at which DEC Weatherization Program participants received either appliance replacements, or HVAC repair or replacements from the HHF program.

DEC Weatherization Program tracking data indicated the date and type of each HHF upgrade, but did not specify details of the HVAC replacement or appliances received. For purposes of controlling for energy savings from other types of programs during the analysis period, these date and categorical data are sufficient. A smaller share of treatment group participants received Duke Energy HHF program upgrades compared to the control group. We account for these differences in the model, using regression terms to mark any participation in the appliance replacement or HVAC components of HHF.

Table F-3. Cross-Participation in Duke Energy HHF Program

HHF Program Component	DEC Weatherization Treatment Group	DEC Weatherization Comparison Group	DEC Weatherization Overall
Appliance Replacement	26%	30%	28%
HVAC System Repair or Replacement	30%	50%	39%
Received no Energy Saving Measures from Duke Energy HHF	55%	38%	48%

Model Specifications

To estimate savings for the LI Weatherization, Opinion Dynamics utilized a LFER model in a pre/post design that incorporates weather and interaction terms that show the effect of weather in the post-participation period. The fixed effect for the model is set at the account level, which allows us to control for all household factors that do not vary over time. In the process of determining the appropriate model for the analysis, we tested a multitude of possibilities, all of which utilized the comparison group.

Our final models were judged by several criteria. Primarily, we aimed to use a model that explained as much about changes in the dependent variable as possible. The most direct measure of this is the overall R-squared, which gives an estimate of how much the model explains. An R-squared of 1.0 would represent a model that explains 100% of the variance in the dependent variable, and an R-squared of 0.5 would explain 50%. In our quasi-experiment, R-squared will appear low because of our use of fixed effects. A higher R-squared relative to other potential models will still be a significant factor in selection of a final model. We also compared Akaike Information Criterion (AIC) values of each model specification within the same dataset. The AIC provides a measure of relative quality between models; a lower value indicates a relatively more efficient model.

Our final method utilizes a comparison group to construct a counterfactual baseline (what participants would have done during the post-program period absent the program) for the treatment group in the post-program period. In the development of our model, we investigated average energy consumption before and after participation, how changes in weather affected the amount of energy used, and differences in energy use in each month. In this investigation, we found a clear linear relationship between energy use and weather, and expected fluctuations in energy use through the year. We included interaction terms of weather and the post-participation period to account for the relationship between weather and consumption following treatment. The inclusion of these terms is meant to account for differences in how changing weather affects customers' energy use post-participation. Failure to control for these potential changes could undervalue the treatment effect. We also included terms for Duke Energy HHF Program participation to account for the energy savings some customers achieved outside of the DEC Weatherization Program during the modeling timeframe.

Final Model for DEC Weatherization Program Participants

Of all the models we tested, we found the model in Equation F-1 to have the best overall fit. The model accounts for changes in weather (heating and cooling degree-days), before and after participation, and includes interaction terms of weather with the post period, to measure differences in the impact that weather had on energy use after participation. To address any potential effect on energy usage of appliance and/or HVAC installations associated with some customers' cross-participation in the Helping Home Fund program, we include terms in the model that delineate the installation of said measures.

Equation F-1. Model Specification

$$ADC_{it} = B_h + B_1Post_{it} + B_2Fridge_{it} + B_3HHF\_App_{it} + B_4HHF\_HVAC_{it} + B_5HDD_{it} + B_6CDD_{it} + B_7Post \cdot HDD_{it} + B_8Post \cdot CDD_{it} + \varepsilon_{it}$$

Where:

ADC_{it} = Average daily consumption (in kWh) for the billing period

$Post$ = Indicator for treatment group in post-participation period (coded "0" in the pre-participation period, coded "1" in post-participation period)

$Fridge$ = Indicator for the customer receiving a refrigerator replacement

HFF_App = Indicator for the customer receiving an appliance replacement from the HHF program

HHF_HVAC = Indicator for the customer receiving an HVAC replacement from the HHF program

HDD = Average daily heating degree days from NCDC

CDD = Average daily cooling degree days from NCDC

B_h= Average household-specific constant

B_1= Main program effect (change in ADC associated with being a participant in the post-participation program period)

B_2= Effect of Refrigerator Replacement

B_2= Effect of HHF appliance installation

B_2= Effect of HHF appliance installation

B_5= Increment in ADC associated with one-unit increase in HDD

B_6= Increment in ADC associated with one-unit increase in CDD

B_7= Increment in ADC associated with each increment increase of HDD for participants in the post-participation program period (the additional program effect due to HDD)

B_8= Increment in ADC associated with each increment increase of CDD for participants in the post-participation program period (the additional program effect due to CDD)

ε_{it} = Error term

Estimated Savings and Realization Rate

This section contains the observed net savings and realization rates resulting from the billing analysis PY1 participants. The results here do not specifically account for free-ridership, but do reflect savings associated with installed measures, spillover, and potential behavioral changes from energy efficiency knowledge gained during the assessment. Free ridership is assumed to be 0.

Estimated Savings

The regression model results presented in Table F-4 show a reduction in electricity use after customers participated in the LI Weatherization program, controlling for weather, time, and the household characteristics for each participant (reflected in the household-specific constant terms).

Table F-4. Final Model

Variable	Tier I Coefficient	Tier II Coefficient
Post (Participation in DEC Weatherization Program)	-1.586	-4.021***
Fridge (Refrigerator Replacement)	-2.494***	0.174
Appliance (Helping Home Fund Replacement)	-1.152	-0.283
HVAC (Helping Home Fund Replacement)	4.013*	-2.635***
HDD (Heating Degree Days)	0.0113***	0.0410***
CDD (Cooling Degree Days)	0.101***	0.112***
Post-Participation Period HDD (interaction of Post x HDD)	0.00220	-0.00870***
Post-Participation Period CDD (interaction of Post x CDD)	0.00644	-0.000761
Constant	13.98***	23.05***
Observations (Number of customer bills)	9677	60922
R-squared	0.575	0.609

* p<0.1, ** p<0.05, *** p<0.01.

Due to the post-period weather interaction terms in the model, it is necessary to calculate the treatment effect by multiplying the average degree-day value with the coefficient for each interaction term and adding that to the coefficient for the main effect term (Post) in the model. Using the equation shown in Equation F-2, we can estimate the overall savings associated with the program. Note that we do not include the fridge term, allowing us to see savings that are attributable only to the customers' experience with the program and the installation of tier specific measures absent savings associated with the replacement of a refrigerator.

Equation F-2. Model Evaluation

$$\Delta ADC = B_1 Post + AvgPostHDD_t \cdot (B_2 Post \cdot HDD) + AvgPostCDD_t \cdot (B_3 Post \cdot CDD)$$

ΔADC = Change in average daily consumption
$AvgPostHDD_t$ = Average number of HDD during month *t* of the post period
$AvgPostCDD_t$= Average number of CDD during month *t* of the post period

Table F-5. Adjusted Estimate of Daily Program Savings

LI Weatherization	Savings Estimate	Standard Error	T	P>|t|	90% Confidence Interval	
					Lower	Upper
Tier I	0.72	0.677	1.06	0.291	-0.40	1.84
Tier II	6.14	0.519	11.84	0.000	5.28	6.99

* Daily savings estimate is the inverse of the coefficient for LI Weatherization program participation in each respective equation.

The value of the DEC Weatherization Program tier-specific estimates seen in Table F-5 represent the reduction in ADC associated with moving from pre-participation treatment to post-participation treatment. These savings estimates are extrapolated to the overall net program savings for DEC Weatherization program participants (Table F-6). We estimate that the average realized annual savings are 262 kWh for customers who participated in Tier I of the LI Weatherization program during the evaluation period. Tier II customers realized an average of 2,241 kWh annually. To better facilitate comparisons of program performance across program years, and territories, we also show savings here as a percentage of energy saved with respect to the treatment group's baseline. The baseline usage is calculated using the coefficients from the model that do not feed into the treatment effect. This calculation shows the energy that customers would have used on average if they did not participate, i.e., the counterfactual. To estimate the percent savings from participant's baseline energy consumption, we divide the change in daily electricity use for LI Weatherization by the mean baseline ADC to arrive at the percentage of savings.

Table F-6. Estimated Annual Savings from Billing Analysis

Program Component	N	Baseline Energy Use (kWh/yr)	Ex Post Annual Savings	90% CI		Average Annual Savings (%)
Tier I Weatherization	110	7,888	262	(144.5)	668.7	3.3%
Tier II Weatherization	532	14,487	2,241	1,929.0	2,552.1	15.5%

Complete Model Results

Tier 2

Linear regression, absorbing indicators

Number of obs	60,922
F(6, 1054)	281.9
Prob > F	0.0000
R-squared	0.6087
Adj R-squared	0.6018
Root MSE	13.9601

(Std. Err. Adjusted for 1,055 clusters in acct)

ADC	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
Participation	-4.02096	0.686257	-5.86	0.0000	-5.36755	-2.674376
Fridge	0.17430	1.133174	0.15	0.8780	-2.04924	2.397832
HHF_App	-0.28294	0.9637827	-0.29	0.7690	-2.17409	1.608213
HHF_HVAC	-2.63540	0.8078406	-3.26	0.0010	-4.22056	-1.050245
HDD	0.040955	0.001173	34.91	0.0000	0.03865	0.04326
CDD	0.111718	0.004916	22.73	0.0000	0.10207	0.12136
Post-Period HDD	-0.008701	0.001265	-6.88	0.0000	-0.01118	-0.00622
Post-Period CDD	-0.000761	0.005431	-0.14	0.8890	-0.01142	0.00990
Constant	23.04974	0.4554311	50.61	0.0000	22.15609	23.9434

Account absorbed (1055 categories)

Tier 1

Linear regression, absorbing indicators

Number of obs	9,677
F(5, 165)	41.39
Prob > F	0.0000
R-squared	0.5755
Adj R-squared	0.5677
Root MSE	8.7098

(Std. Err. Adjusted for 166 clusters in acct)

ADC	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
Participation	-1.58641	0.9835359	-1.61	0.1090	-3.52834	0.3555326
Fridge	-2.49393	0.9396021	-2.65	0.0090	-4.34912	-0.6387367
HHF_App	-1.15159	0.9790627	-1.18	0.2410	-3.08470	0.7815127
HHF_HVAC	4.01342	2.099797	1.91	0.0580	-0.13251	8.159357
HDD	0.011340	0.001637	6.93	0.0000	0.00811	0.01457
CDD	0.101257	0.010324	9.81	0.0000	0.08087	0.12164
Post-Period HDD	0.002201	0.002357	0.93	0.3520	-0.00245	0.00685
Post-Period CDD	0.006444	0.011064	0.58	0.5610	-0.01540	0.02829
Constant	13.98337	0.7751286	18.04	0.0000	12.45292	15.51382

Account absorbed (166 categories)

For more information, please contact:

Ann Collier
Principal Consultant

617 492 1400 tel
617 497 7944 fax
aspeers@opiniondynamics.com

1000 Winter Street
Waltham, MA 02451

EM&V Report for the Small Business Energy Saver Program

Duke Energy Progress and Duke Energy Carolinas

Prepared for:

Duke Energy

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

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TABLE OF CONTENTS

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 (up to 180 kilowatts demand service, up from 100 kW demand service in previous years) 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 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 covering the period between March 1, 2016 through June 30, 2017, referenced simply as PY2016.

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 150 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.

The evaluation team verified gross energy savings at 102 percent of deemed reported energy savings for DEP and 101 percent for DEC, and gross peak demand reductions at 77 percent for DEP and 76 percent for DEC. A net-to-gross (NTG) ratio was estimated at 0.98, yielding total verified net energy savings of

53,302 megawatt-hours (MWh) for DEP and 90,923 MWh for DEC, and net summer peak demand reductions of 9.4 megawatts (MW) for DEP and 16.6 MW 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	53,490	54,390	1.02
Gross Energy Impacts (MWh)	DEC	92,079	92,779	1.01

Source: Navigant analysis and Duke Energy tracking data, totals subject to rounding.

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

	Jurisdiction	Claimed	Evaluated	Realization Rate
Gross Summer Peak Demand Impacts (MW)	DEP	12.5	9.6	0.77
Gross Winter Peak Demand Impacts (MW)	DEP	12.5	8.7	0.69
Gross Summer Peak Demand Impacts (MW)	DEC	22.3	17.0	0.76
Gross Winter Peak Demand Impacts (MW)	DEC	22.3	15.5	0.69

Source: Navigant analysis and Duke Energy tracking data, totals subject to rounding.

Table 1-3. Program Net Energy Impacts

	Jurisdiction	MWh
Net Energy Impacts	DEP	53,302
Net Energy Impacts	DEC	90,923

Source: Navigant analysis, totals subject to rounding.

Table 1-4. Program Net Peak Demand Impacts

	Jurisdiction	MW
Net Summer Peak Demand Impacts	DEP	9.4
Net Winter Peak Demand Impacts	DEP	8.5
Net Summer Peak Demand Impacts	DEC	16.6
Net Winter Peak Demand Impacts	DEC	15.2

Source: Navigant analysis, totals subject to rounding.

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 ± 2.4 percent for energy savings, 6.8 percent for summer and 3.1 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	1. Inside spillover (at same facility as program measures) 2. Outside spillover (at different facility as program measures)

Source: Navigant analysis

This evaluation covers program participation from March 2016 through June 2017. 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	September 18, 2017	November 30, 2017
Participant Phone Surveys	October 1, 2017	November 30, 2017

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, PY2014, and PY2015) SBES program evaluations in the DEP and DEC jurisdictions. The sample quotas were met as planned, and the final precision was different due to natural variation in individual site level characteristics.

1.4 Recommendations

The evaluation team recommends four 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 PY2016 SBES Recommendations

Increasing Program Participation and Satisfaction
1. **Continue to focus on quality, clear communication, and depth of energy efficiency retrofits.** The most common suggested improvements were post-installation equipment issues and a perceived lack of coordination between the various parties involved in delivering the SBES program. There was also a minority of customers reporting that the program was unable to provide all the energy efficiency equipment they wanted. There are opportunities for continued improvement and channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.
2. **Consider effects of increased program eligibility rules**. With a 180 kW demand limit, there is likely significant overlap between the SBES program and other business programs in Duke Energy's portfolio. The largest project is almost 2 GWh, which is larger than typical large business prescriptive projects seen in other utility offerings. Larger businesses typically have additional resources that small businesses do not, and often do not require the high incentive levels that the SBES program offers. Duke Energy should consider whether the SBES incentive levels are appropriate for these very large projects, or if a different program channel would be sufficient. For example, the Smart $aver program offers LED incentives that are capped at a lower percentage of incremental costs.
Improving Accuracy of Reported Savings
3. **Track burnout lamps and fixtures during the initial audit.** It is likely that some burnouts were present and tolerated by customers, and may contribute to customers not realizing expected savings on their energy bills. Burnouts found during the initial audit are no longer included in tracking data. While not generally required in the industry, customers with many burnouts will not achieve the expected energy savings.
4. **Ensure that the IC has access to up-to-date and accurate customer billing records.** There are several (2706) instances where project deemed savings exceed annualized site data, likely due to incomplete annualized energy usage estimates. Since this is used as an overridable QC check, more accurate data could help reduce the need for such overrides.

Source: Navigant analysis

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 Carolinas (DEC) jurisdiction in August 2014. Since 2015, the program showed continued growth measured by participant count, claimed energy savings, and peak demand reductions.

2.1 Program Design

The SBES Program is available to qualifying commercial customers with less than 180 kilowatts (kW) demand service, up from 100 kW demand service in previous years. After completing the program application to assess participation eligibility, customers receive a free energy assessment to identify equipment for upgrade. Lime Energy reviews the energy assessment results with the customer, who then chooses which equipment upgrades to perform. Qualified contractors complete the equipment installations at the convenience of the customer.

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 PY2016, the SBES Program achieved most program savings from lighting measures, which tend to be the most cost-effective and easiest to market to potential participants. The SBES program also achieved program savings from refrigeration measures at a similar level to previous years.

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 PY2016 Navigant reviewed the IC database as the basis for deemed energy savings. Duke Energy ensured that the IC database savings accurately represents all claimed program savings, and further defined demand ratios that are used to derive final deemed demand impacts.

Table 2-1 provides a summary of the gross reported energy and demand savings and participation for PY2013 through PY2016. Note the growth of average savings per project, especially in PY2016 in the DEC jurisdiction, driven by an increase in maximum customer size eligible for participation in the program (up to 180 kW demand).

Table 2-1. Reported Participation and Gross Savings Summary

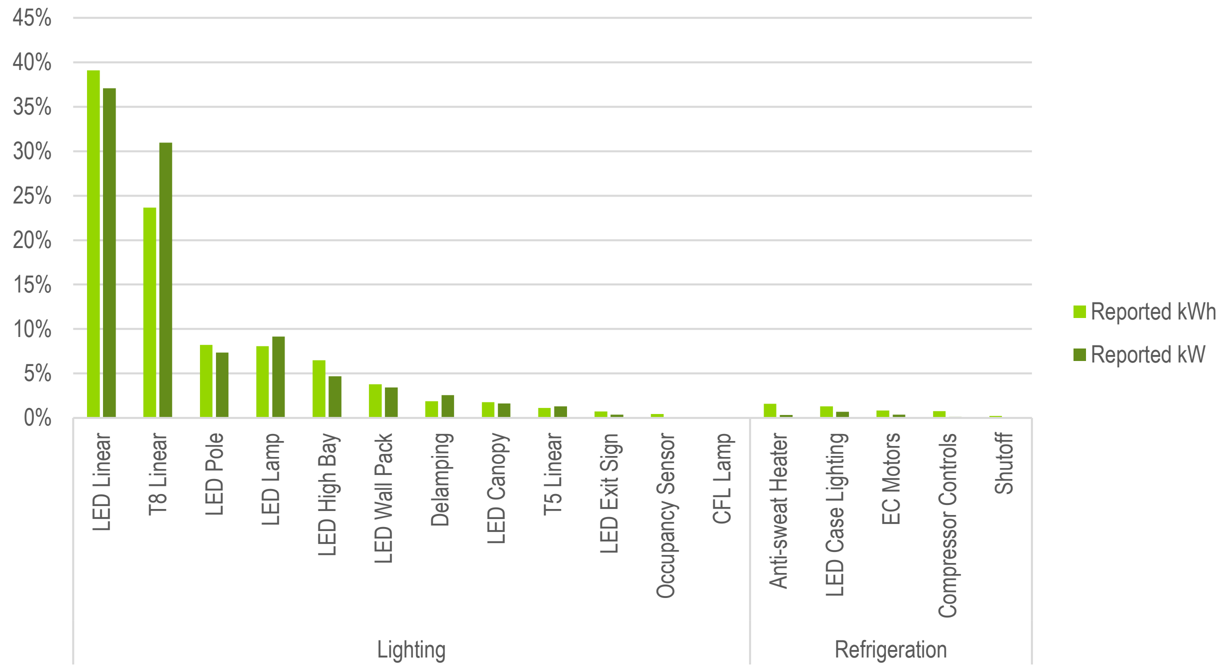
Reported Metrics	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP)	PY2015 (DEC)	PY2016 (DEP)	PY2016 (DEC)
Participants	675	1,759	1,790	3,080	1,829	2,435
Measures Installed	42,537	108,816	132,977	234,788	121,181	210,775
Gross Annual Energy Savings (MWh)	14,242	38,665	48,772	77,269	53,490	92,079
Average Quantity of Measures per Project	63	62	74	76	66	87
Average Savings Per Project (MWh)	21.1	22	27.2	25.1	29.2	37.8

Source: SBES Tracking Database

2.2.1 Program Summary by Measure

Efficient LED linear lighting retrofits were the highest contributor to program energy savings in PY2016 across both jurisdictions, followed by T8 linear fluorescent retrofits and a variety of LED lighting measures. In addition, refrigeration measures, T5 linear retrofits and LED exit signs also contributed to savings. The SBES program has rapidly adopted LED lighting products in PY2016, although T8 lighting still contributed over 20% of energy savings. Program staff have indicated that T8 retrofits are actively being phased out of the current SBES program. 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

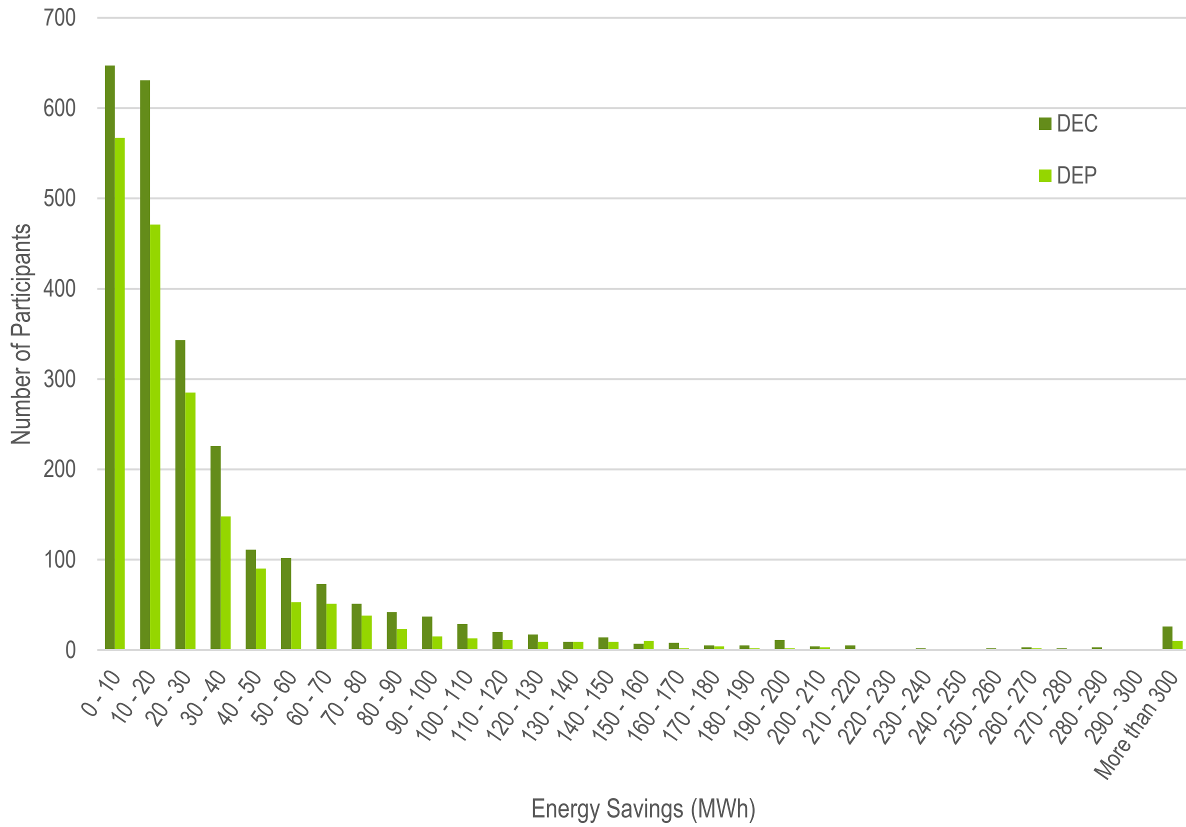


Source: SBES Tracking Database

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. Along with the increase for participant eligibility to 180 kW, however, several very large projects are now part of the program. Figure 2-2 shows the distribution of project sizes. The largest site reported savings of over almost 2 GWh per year, which is nearly four times the value of 500 MWh found during the PY2015 evaluation when eligibility was limited to 100 kW or less.

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



Source: SBES Tracking Database

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 PY2016. 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

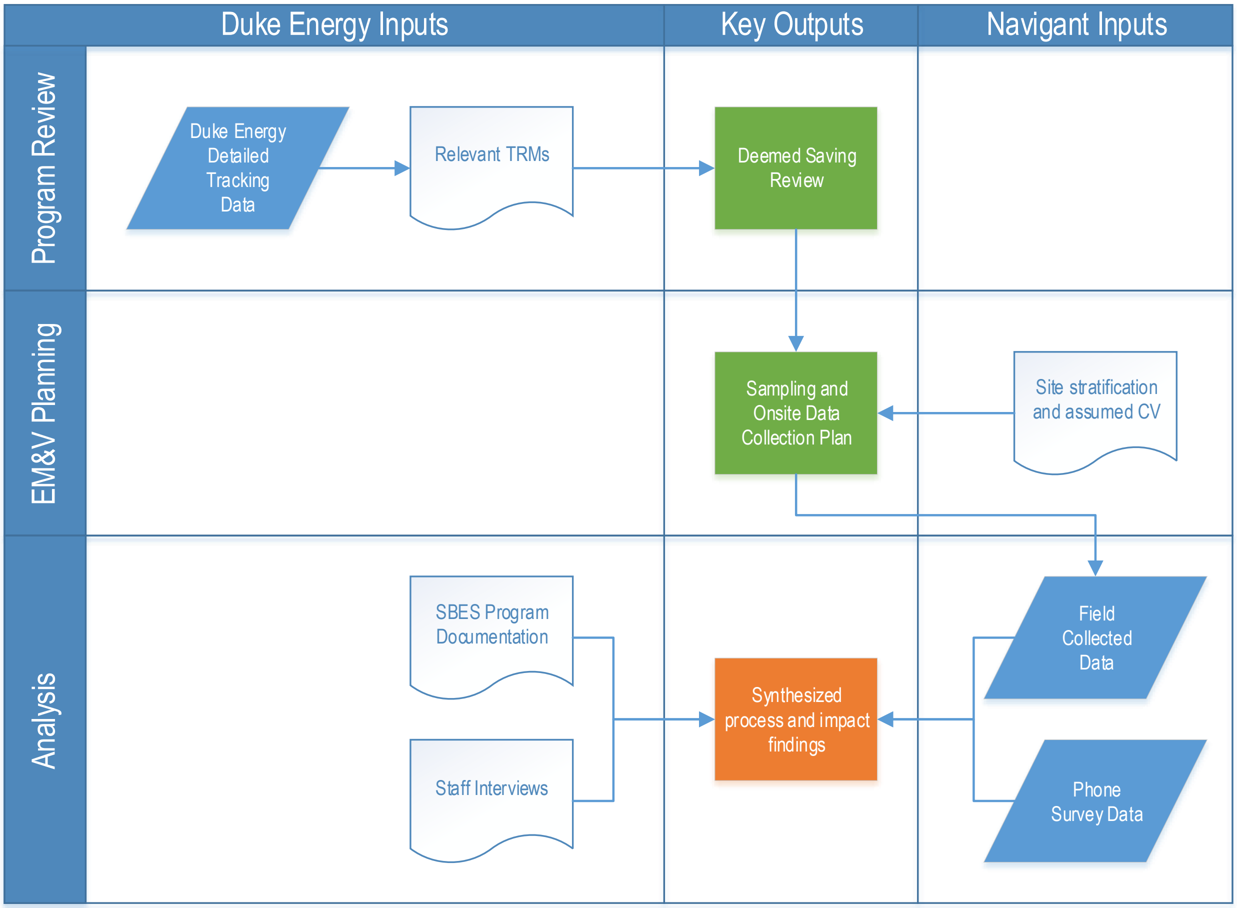
The process evaluation focuses on the program implementation and the customer experience. Objectives include:

- 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.

Figure 3-1. Evaluation Process Flow Diagram



Source: Navigant

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 for planning purposes.

Table 4-1. PY2016 SBES Summary of Program Impacts for DEP

DEP	Energy Savings (MWh)	Summer Peak Demand Reductions (MW)	Winter Peak Demand Reductions (MW)
Reported Gross Savings	53,490	12.5	12.5
Realization Rate	1.02	0.77	0.69
Verified Gross Savings	54,390	9.6	8.7
NTGR	0.98	0.98	0.98
Verified Net Savings	53,302	9.4	8.5

Source: Navigant analysis, totals subject to rounding.

Table 4-2. PY2016 SBES Summary of Program Impacts for DEC

DEC	Energy Savings (MWh)	Summer Peak Demand Reductions (MW)	Winter Peak Demand Reductions (MW)
Reported Gross Savings	92,079	22.3	22.3
Realization Rate	1.01	0.76	0.69
Verified Gross Savings	92,779	17.0	15.5
NTGR	0.98	0.98	0.98
Verified Net Savings	90,923	16.6	15.2

Source: Navigant analysis, totals subject to rounding.

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)[2]. This involved an engineering-based approach for estimating savings, supplemented by key parameter measurements. This also included using time-of-use lighting loggers to directly measure operating hours and coincidence factors for program-incented lighting measures. Note that for the 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:

[2] International Performance Measurement & Verification Protocol Concepts and Options for Determining Energy and Water Savings Volume I. http://www.nrel.gov/docs/fy02osti/31505.pdf

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 based on reported energy savings (small, medium, and large lighting, and refrigeration) to ensure that a variety of different businesses and measures were captured in the site visits. A subset of each strata was selected for more detailed data logger deployment (23 of 62 total sites visits were logged). The sample was designed to utilize double-ratio techniques to meet a precision target of 90/10 at the program level while attempting to minimize sample sizes.
2. **Pull Sample** – Next, the team pulled a sample from the four strata and scheduled site visits, including several backup sites if 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. 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.
    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 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 four weeks and then returned to retrieve the logging equipment.
    d. Coincidence factors and HVAC interactive effects were taken from prior Duke Energy program (EEB) evaluation findings[3] and previous SBES reports[4] 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; no further adjustments were made to HVAC interactive effects, however.
4. **Calculate Project-Level Savings** – The team calculated project-level energy and demand savings for each site in the sample based on operational characteristics found on site and engineering-based parameter estimates. The project-level savings represent the total of all the individual measure-level savings at each site.
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

[3] PY2013 DEP EEB EM&V Report

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

savings for each sampled site. Next, the team calculated stratum-level realization rates, consisting of the sum of the verified savings divided by the deemed reported savings. Last, the team applied the stratum-level realization rates to the deemed reported savings for each respective strata, and arrived at final program-level realization rates. Note that for demand savings, final program-level realization rates were calculated by comparing verified demand savings to reported demand savings using the demand ratios outlined in Section 2.2.

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 105,000 kWh reported savings;
    - Lighting Medium – between 35,000 kWh and 105,000 kWh reported savings;
    - Lighting Small – less than 35,000 kWh savings;
    - Refrigeration – all projects with refrigeration savings.

Note that the stratum cutoff points for PY2016 are higher than in PY2015 due to the larger average per-project savings in this evaluation. The limits in PY2014 were 25,000 kWh and 65,000 kWh.

To achieve a 10 percent relative precision at a 90 percent confidence interval, the evaluation team targeted 62 total sites, which were spread roughly equally among the three lighting strata and the refrigeration stratum. Among the 62 sites, a subsample of 23 sites were selected for additional lighting metering to more accurately measure lighting hours of use. Sample sizes were based on coefficients of variations (CV) of 0.45 for verification and 0.2 for metering, which were derived from previous work on SBES evaluations on behalf of Duke Energy in other jurisdictions. Additional detail on the sampling and analysis methodologies are included in APPENDIX A.

Navigant conducted on-site verification at 62 sites during the fall of 2017. 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. For the subsample of sites that received onsite metering, Navigant conducted logging on key retrofit fixtures to estimate hours of use and coincidence factors. The adjustments to savings based on logged data were extrapolated to the full 62 site sample. 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 is used for each site's savings estimate.

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	207	15	6
Lighting Medium	744	19	6
Lighting Small	3088	21	9
Refrigeration	226	7	2
Total	**4,265**	**62**	**23**

Source: Navigant analysis

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.

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. Future evaluations will consider updating the HVAC interactive effects specifically for the climate zones in North Carolina and South Carolina within the Duke Energy service territory based on energy simulation modelling.

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. This methodology is based on measure-specific characteristics and is not dependent on the climate in New York. The assumptions and parameters used to estimate reported energy savings and peak demand reductions were therefore considered 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. The total realization rate for each strata is calculated by multiplying the verification realization rate by the metering realization rate adjustment. This method in effect extrapolates the project-specific results to the stratum-level, which implicitly assumes that these findings in aggregate are representative of other sites within their stratum. In addition, the weighted final realization rate for the program is shown, which represents the total program savings as a weighted result of each stratum. 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. Additional information specific to the metering realization rate adjustments is provided in Section 4.5.

During review of individual project savings, Navigant identified one project within the large stratum that contained a considerable discrepancy between the reported hours of use and the logged hours of use. Upon further investigation, this particular customer had recently opened their business and anticipated a specific operational schedule. This was not realized at the time of the evaluation, however, and the customer was operating significantly fewer hours per week. Navigant's opinion is that this discrepancy was unique to this particular project and not representative of the broader program, and therefore created a separate stratum just for this project. In effect, the low project realization rate is still included in the final program verified savings, but the results are not extrapolated to the rest of the large stratum.

Table 4-5. Energy Impacts by Strata

Strata	Verification Realization Rate (kWh)	Metering Realization Rate Adjustment (kWh)	Total Realization Rate (kWh)
Lighting Large	1.00	1.00	1.00
Lighting Medium	1.02	0.92	0.94
Lighting Small	1.10	1.02	1.12
Refrigeration	1.00	0.93	0.94
Total	**1.02**	**0.97**	**1.01**

Source: Navigant analysis, totals subject to rounding.

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 rate due to application of measure-specific coincidence factors based on logger data for both the summer and winter periods. Navigant notes that these realization rates are calculated by comparing verified savings with the Duke Energy reported savings calculated from demand ratios rather than reported in the detailed measure database.

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	0.83	0.98	0.81
Lighting Medium	0.91	0.64	0.59
Lighting Small	1.12	0.80	0.90
Refrigeration	0.69	1.02	0.71
Total	**0.87**	**0.86**	**0.76**

Source: Navigant analysis, totals subject to rounding.

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	0.90	0.95	0.85
Lighting Medium	0.90	0.60	0.54
Lighting Small	0.89	0.77	0.69
Refrigeration	0.94	0.98	0.93
Total	**0.90**	**0.85**	**0.69**

Source: Navigant analysis, totals subject to rounding.

Overall, the verification realization rates are slightly below 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.

4.5 Detailed Impact Findings

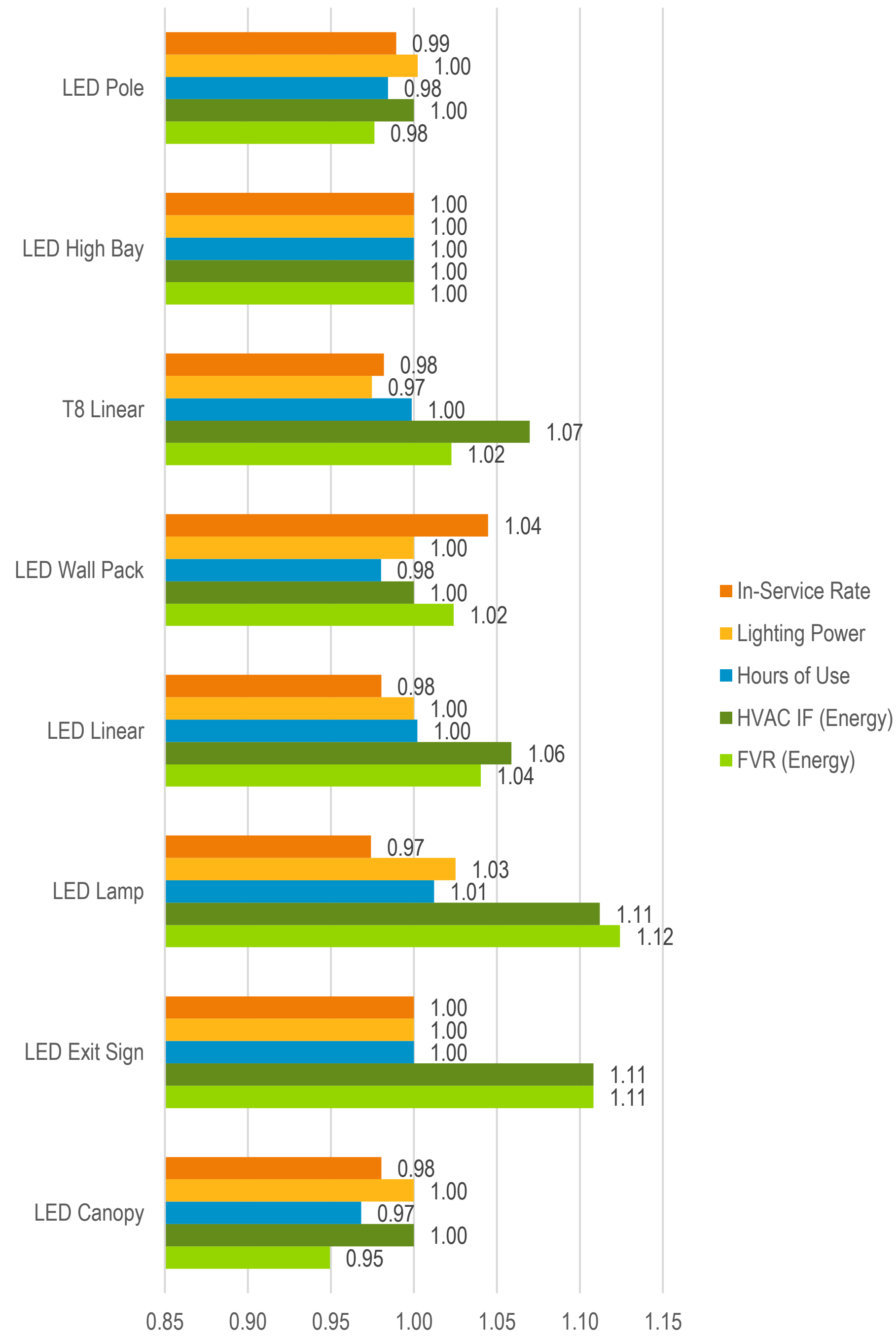
This section examines findings from the evaluation of lighting measures in order to identify the main drivers of the verified savings values. The evaluation team uses the Field Verification Rate (FVR) to describe the overall verified savings relative to the reported savings for each measure. FVRs reflect 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**[5] **(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 caused by 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.

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

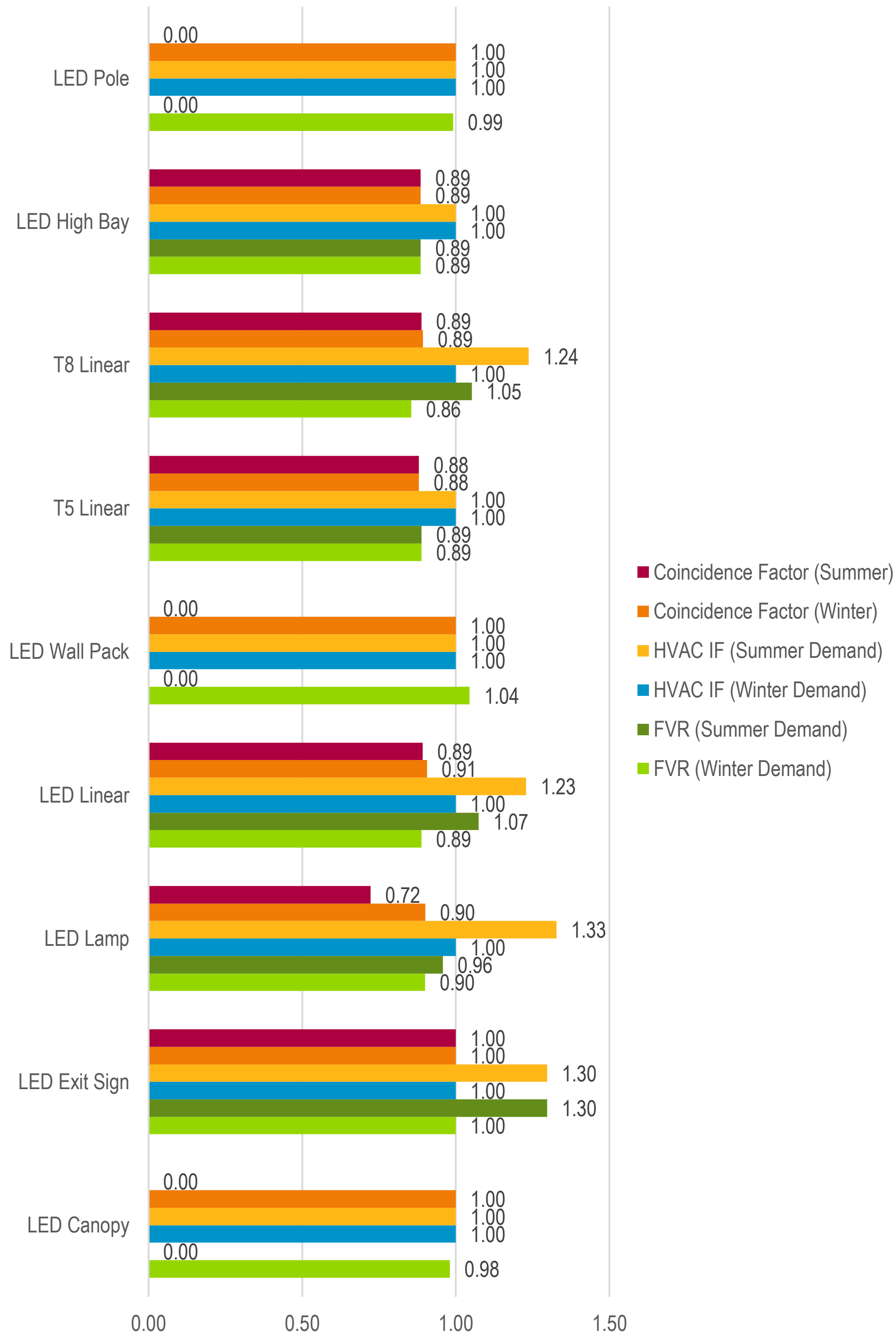
Figure 4-1. Gross Energy Savings Field Verification Rates



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.

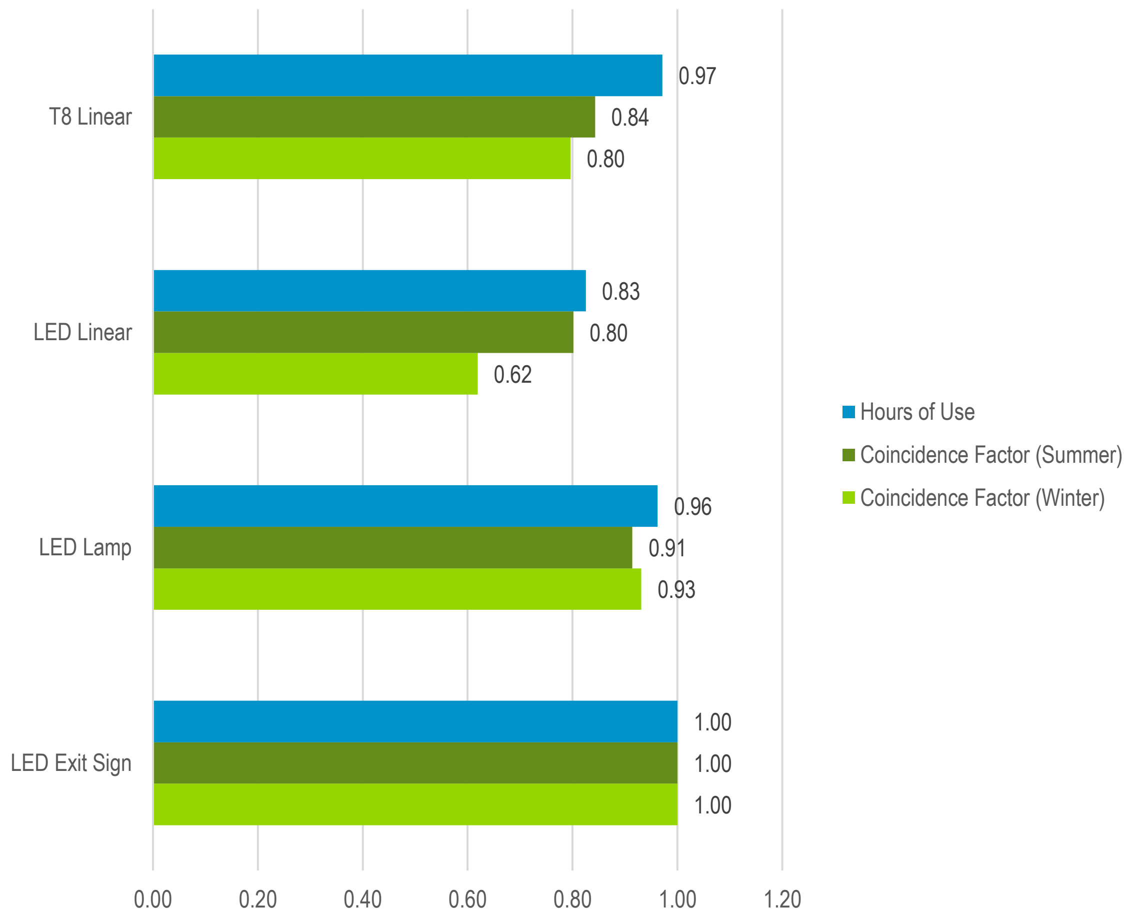
Figure 4-2. Gross Peak Demand Reductions Field Verification Rates



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.

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 0.97 for LED screw-in lamps and 1.04 for LED wall packs.

4.5.2 Hours-of-Use Adjustments

The EM&V team performed customer interviews and installed data loggers to make adjustments to hours of use to estimate final verified impacts. Measure-level annual operating hours were determined from confirmation of operation hours with the SBES participant, similar to the approach taken by the IC. For all sample sites, the EM&V team performed interviews with customers using a similar approach as the IC. This relies on the customer to self-report hours used on a daily or weekly basis, and were rolled up to an annual hours of use basis which is also corrected for holidays, seasonal variations in use, and any other change in operating characteristics. The purpose of validating the self-reported hours of use is to confirm whether the estimates provided by the customer during implementation is what actually makes it into the tracking database. The EM&V also installed data loggers at a nested sample of sites to measure the accuracy of the self-reported hours. For logged sites, the team extrapolated the time of use logger data to develop annual hours of operation.

During the on-site participant interviews, the EM&V team found that the hours of use that site technicians reported was close to the HOU reported in the tracking database, with adjustment values ranging from 0.97 for LED canopy fixtures and 1.01 for LED lamps. Overall, these findings suggest that the tracking data is accurately reflecting what customers estimate their operating hours to be. However, it is well-known that estimating operation hours for lighting is difficult, and many evaluations have found that customers tend to overestimate operation hours for lighting. Therefore, the EM&V team used results from the data loggers to adjust impacts.

Additional adjustments based on logger data range from 0.83 for LED linear retrofits and 0.97 for T8 linear retrofits (excluding LED exit signs), as shown in Figure 4-3. This demonstrates that although the IC team notes that overall the IC is reasonably characterizing hours of use based on both customer interviews, and logger data, but the data loggers show that customers tended to overestimate hours of use for both LED and T8 linear lighting measures.

4.5.3 Lighting Power

The evaluation team based the lighting power parameter on the best estimates available for 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 very minor across the measure categories, between 0.97 for T8 fixtures and 1.03 for LED lamps. Note that the evaluation team found slightly lower than reported lighting power values for T8 lamp and ballast configurations, which resulted in a slight increase in energy savings.

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 and T8 retrofits are phased out.

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 PY2016, as in previous evaluations. This adjustment is between 1.00 and 1.11 for energy and 1.00 and 1.33 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 previous Duke Energy program evaluations. This factor takes into account that not all lights are on for the duration of the peak demand period. Coincidence factors range from 0 and 1.0, based on building type, and are detailed in Section 9. The metered data further validates the deemed coincidence factors. Note that although the detailed IC database does not include a coincidence factor, the demand ratios provided by Duke Energy and used as the final reported deemed savings implicitly include these assumptions.

LED exit signs that are on all day receive a CF on 1.0, while exterior lights receive a CF of 0 (summer) and 1.0 (winter). For logged sites, the team extrapolated the time of use logger data to develop coincidence factors. As shown in Figure 4-3, the CF adjustments based on metered data range from 0.80 to 1.0 for summer, and 0.62 to 1.0 for winter. The overall effect on demand savings from metering was a decrease in both summer and winter savings compared to the coincidence factors applied in the verification phase. The overall effect of applying coincidence factors is a decrease from reported savings, and is the primary driver of the demand realization rates.

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 SBES evaluations. The estimated NTG ratio shown for PY2016 is lower than the findings from the 2015 evaluation, but consistent with 2013.

Table 5-1. Net-to-Gross Results

	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP & DEC)	PY2016 (DEP & DEC)
Estimated Free Ridership	0.04	0.04	0.06	0.06
Estimated Spillover	0.02	0.07	0.09	0.04
Estimated NTG	0.98	1.03	1.03	0.98

Source: Navigant analysis, totals subject to rounding.

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.

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

$$NTG = 1 - \text{Free Ridership} + \text{Spillover}$$

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

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[6] 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

[6] 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).

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 150 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	50	86	136
Refrigeration	5	9	14
Total	**55**	**95**	**150**

Source: Navigant analysis

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 7 percent of participants to install additional energy efficiency measures on-site (down from 15 percent in PY2015) and influenced 7 percent of participants (down from 12 percent in PY2015) to install additional measures at other locations. Spillover values are consistent with those found in previous evaluations, such as PY2014, however. Based on the survey findings, the evaluation team estimates the overall program spillover to be 4 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 4 percent, the NTG ratio is 1 – 0.06 + 0.04 = 0.98. The estimated NTG ratio of 0.98 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 98 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	0.04	0.98

Source: Navigant analysis

6. 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 PY2016, 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.

6.1 Process Methodology

The evaluation team conducted customer journey mapping and customer participant surveys as part of the process evaluation. In addition, the team gathered information from interactions with participants during the site verification visits and maintained regular communication with Duke Energy program staff, which 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:

- Customer journey mapping with 13 program participants;
- Participant surveys with 150 program participants;
- Onsite visits at 62 program participant sites;
- Discussions with the Duke Energy Program Manager;
- A review of the program documentation.

6.2 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 energy efficiency on their own. In PY2016 the program increased the eligibility limit from 100 kW to 180 kW demand, resulting in an increase of average project size.
- **Program Implementation** – A third-party contractor, Lime Energy 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-measure basis, taking into account existing equipment, proposed equipment, and operational characteristics unique to each customer.

6.3 Customer Journey Mapping

The Customer Journey Mapping analysis aimed to gather qualitative data about customer experiences with the SBES Program to understand customer sentiments and perspectives on program performance and establish a deeper understanding of customer satisfaction throughout the program process. Key aspects of journey mapping involved the development of a process map and the identification of the journey mapping lenses. In conversations with program staff, Navigant explored staff perceptions concerning the use of a variety of potential journey mapping lenses. Journey mapping lenses included a set of overarching questions and potential customer satisfaction concerns as the core focus of this research effort and were included in participant interviews. To conduct the customer journey analysis, Navigant completed seven steps, working closely with Duke Energy staff:

1. Program document review and conversations with program staff
2. Development of a process map and identification of journey mapping lenses
3. Development of a sampling plan, recruitment strategy and interview guide
4. Fielding of interviews
5. Analysis of interview notes
6. Development of Journey Map and other findings

In total, Navigant interviewed 13 Duke Energy Carolinas and Duke Energy Progress SBES Program customers across various building types and measures. The final participant sample included a diverse mix of office, retail, and restaurant owners or managers, who participated in upgrading their lighting or lighting and refrigeration equipment through the SBES Program. All interviewees installed lighting measures and two installed refrigeration measures in addition to the lighting measure. Most participants conducted business in North Carolina (11) as compared to South Carolina (2); however, participants were evenly split between Duke Energy Carolinas (8) and Duke Energy Progress (5). **Table 6-1** shows specific customer characteristic information.

Table 6-1. SBES Interviewee Characteristics

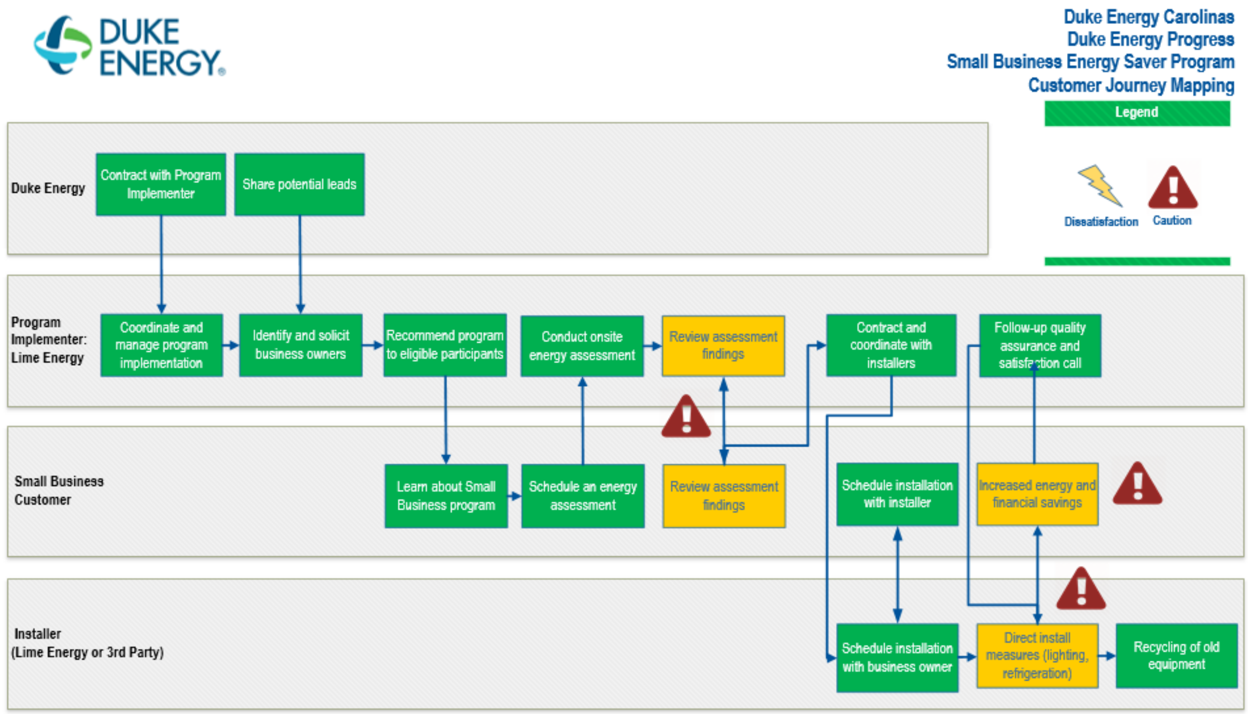
Building Type	Business Type	Lighting	Refrigeration	Lighting KWh*	Utility	Location
Office	Real Estate Office	X	--	Low	DEC	NC
Office	Textile Mill	X	--	Low	DEC	NC
Office	Printing Store	X	--	Low	DEP	NC
Office	Warehouse	X	--	Medium	DEP	NC
Office	Law Office	X	--	Low	DEC	NC
Retail	Materials Distributor	X	--	High	DEC	NC
Retail	Gas Station	X	--	Low	DEP	NC
Retail	Grocery Store	X	--	High	DEC	NC
Retail	Retail Store	X	--	Low	DEP	SC
Restaurant	Multi-Sector**	X	X	High	DEC	NC
Restaurant	Restaurant & Catering	X	--	Low	DEC	NC
Restaurant	Restaurant	X	X	Low	DEC	SC
Restaurant	Diner	X	--	Low	DEP	NC

**Low = <10,000 KWh; Medium = 10,000-30,000 KWh; High = >30,000 KWh*
***Includes convenience stores, restaurants, and car dealerships*
Source: Navigant analysis

6.4 Customer Journey Map Findings

Navigant developed a process map detailing the journey of the customer's experience through the SBES program (see Figure 6-1). Findings depicted in the process map below indicate isolated instances of dissatisfaction with the measure installation and recycling of old equipment processes. Potential customer dissatisfaction and areas of concerns are seen in the presentment onsite energy assessment findings and savings outcomes.

Figure 6-1. DEP and DEC SBES Process Map



Source: Navigant analysis

More specifically, participant interviews offered insight into the overall customer satisfaction with the SBES program and certain steps in the program participation process. Navigant examined the six process customer journey phases within the SBES program: 1) the Initial Contact; 2) the Energy Assessment; 3) the Installation Process; 4) Equipment Performance; 5) Energy Savings Expectations & Perceptions; and 6) Quality Assurance & Satisfaction. The list below outlines the key findings for each of these customer journey phases.

1. **Initial Contact** – Respondents felt highly satisfied with their initial contact and introduction into the program overall. Interviewees cited knowledgeable and professional sales representatives and Duke Energy's reputation as trustworthy as major reasons for their participation in the program and high satisfaction in this phase. Many felt particularly excited about the opportunity to save money and energy.
2. **Energy Assessment** – Similar to the Initial Contact phase, respondents reported high satisfaction with the Energy Assessment process overall. Many thought the assessments were simple and easy to understand. Participants were also pleased to hear about the number of lighting alternatives and customizations available through the program. Despite the high satisfaction overall, some interviewees felt that the representatives did not present the assessment clearly, indicating inconsistencies in presentation.
3. **Installation Process** – Similar to the previous two phases, participants expressed high satisfaction ratings for the Installation Process. In general, respondents were relieved that installers worked around employees and customers, minimizing disruption to the business. Many felt the process went more smoothly and quickly than expected. While respondents generally

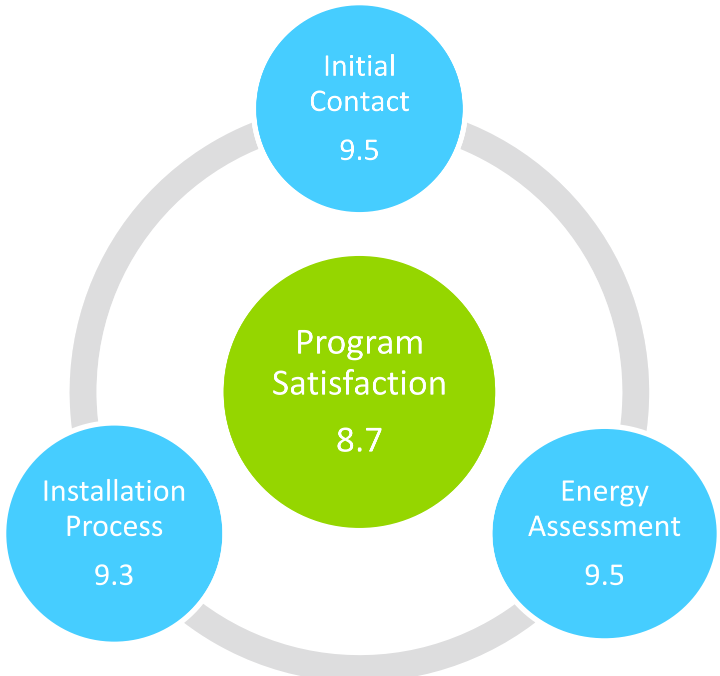
praised installers, a couple felt displeased that crews changed their product order (sometimes necessary due to facility conditions) and communicated poorly about installation timing.

4. **Equipment Performance** – In general, equipment worked as expected and most respondents felt pleased with the enhanced lighting quality, ambiance, and lifespan of the new bulbs. Some even expressed doing additional lighting replacements. However, there were isolated issues in equipment performance, including concerns about equipment quality, performance, and lifespan.
5. **Energy Savings Expectations & Perceptions** – The perceived achievement of energy savings received mixed responses: the majority felt satisfied or unconcerned about bill savings while some felt dissatisfied with savings, especially as compared to the initial energy assessment.
6. **Quality Assurance & Satisfaction** – Customers felt positive about post-program quality assurance and satisfaction. Respondents were particularly pleased that customer representatives remained engaged throughout the program process and followed-up post-installation.

Although respondents provided positive feedback overall, the findings indicate isolated problems throughout the process. This fact indicates inconsistencies in the program participation process, mostly as a result of poor performances from program subcontractors in the energy assessment and installation phases.

In general, interviewees reported high satisfaction ratings with the SBES program despite program inconsistencies. Out of a 1-10 rating scale, customer program satisfaction averaged 8.9, although scores ranged from as high as “10” to as low as “2.” Overall customer satisfaction with the initial contact and energy assessment was a 9.5. Interviewee satisfaction of equipment installation was 9.3. In general, most customers felt that the program process went smoothly and enhanced their business. Figure 6-2 below shows the average satisfaction ratings from interviewees by program component through the installation process.

Figure 6-2. Overall Program Satisfaction



Source: Navigant analysis

6.5 Participant Survey Sampling Plan

The participant survey targeted a random sample of all PY2016 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 150 customers, of which 135 were participants that only installed lighting measures and 15 were participants that installed some refrigeration measures. The survey targets were designed to achieve 90/10 confidence and precision, with significant oversampling due to the relatively inexpensive per-survey cost.

6.6 Participant Survey Findings

The following sections detail the process findings from the customer surveys, organized by topic. The feedback received indicates that the SBES Program continues to be a successful program in PY2016 and is a mature program in the Duke Energy portfolio.

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

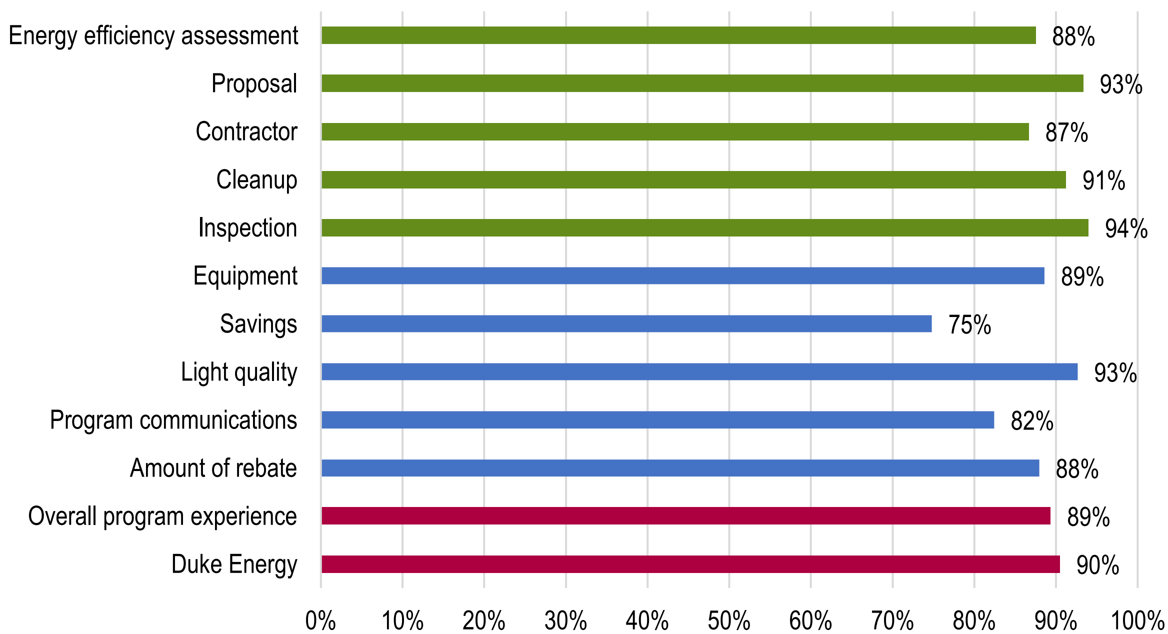
1. Customer Satisfaction;
2. Program Challenges;
3. Marketing and outreach; and
4. Suggested improvements.

6.6.1 Customer Satisfaction

Participants report high levels of satisfaction with the program overall: 89% of participants rated their satisfaction with the program at an 8 or higher, on a scale from 0 to 10. Satisfaction with Duke Energy was high at 90%. Satisfaction with the equipment installed is *most* strongly correlated with overall program satisfaction. Satisfaction with the rebate amount is *least* correlated with overall program satisfaction.

Participants are most satisfied with the inspection they received, the light quality, and the energy efficiency proposal. Participants are less satisfied with energy savings, program communications, and their installation contractor. Detailed top box (8 or higher out of 10) satisfaction scores are shown below in Figure 6-2.

Figure 6-3. Detailed Satisfaction Scores (n=150)



Source: Navigant analysis

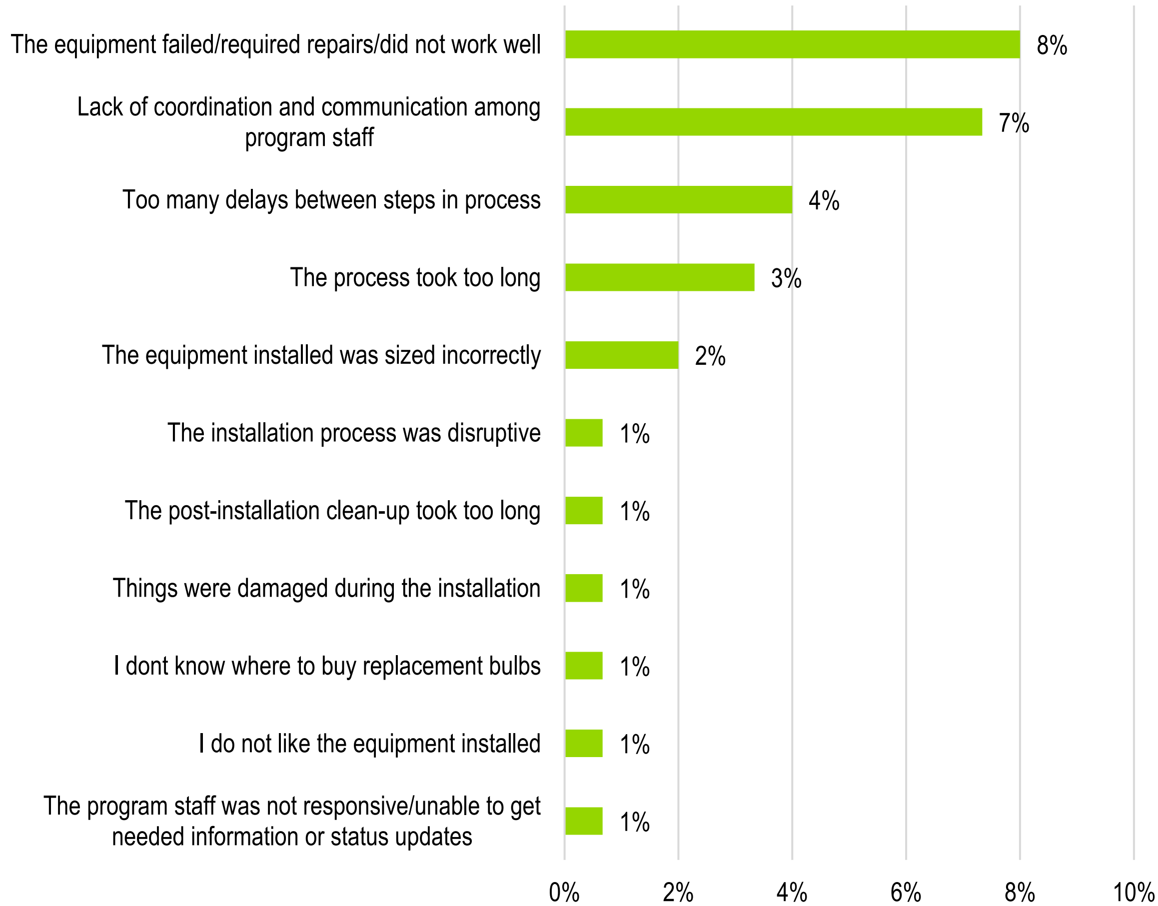
6.6.2 Program Challenges

Despite the high overall satisfaction scores, some customers had minor complaints or identified drawbacks of the program. Figure 6-4 below shows the responses when customers were asked program challenges or drawbacks. The most common challenges were:

- Issues with the equipment after installation
- Perceived lack of coordination and communication between program implementation staff
- Impatience with delays or the length of the process

Looking at total responses to this question, 75% of all customers did not mention *any* of the complaints shown.

Figure 6-4. Detailed Program Challenges (n=38)

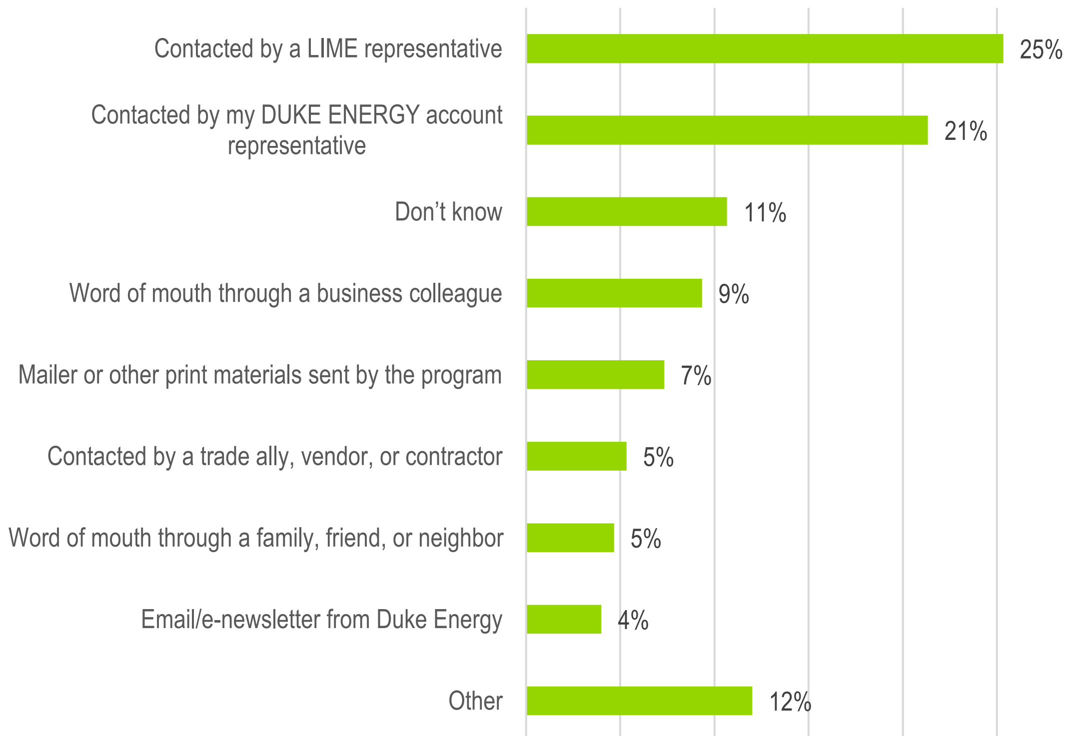


Source: Navigant analysis

6.6.3 Marketing and Outreach

Duke Energy markets the program to eligible customers primarily through direct contact that both Lime Energy and Duke Energy initiate. Participants were asked to indicate all the sources through which they learned about the program. One quarter of the participants indicated that they learned about the program directly from the IC staff (either through direct contact or outreach materials), and almost an additional quarter indicated they had learned about the program through Duke Energy themselves. Figure 6-5 shows the range of ways in which customers found out about the program. Compared to PY2015, less customers reported that they learned about the program through Duke Energy directly (25 percent in PY2016 compared to 38 percent in PY2015), indicating that the IC is generating a larger share of program participation.

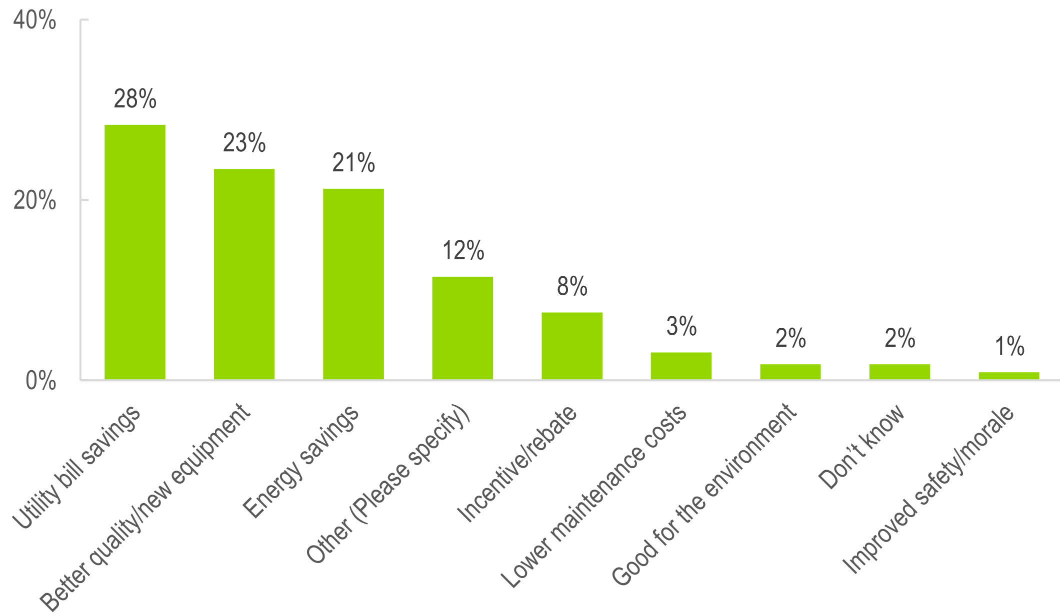
Figure 6-5. How Program Participants First Learned About the SBES Program (n = 150)



Source: Navigant analysis

When asked about the main benefits of participating in the program, over one quarter of respondents cited utility bill savings, compared to over 50 percent of survey respondents in PY2015 that cited energy savings as a reason they decided to participate in the program (see Figure 6-6 below). There was an increase in the percentage that reported better quality equipment as a primary driver (23% in PY2016 compared to 14% in PY2015). This indicates that the program marketing and sales communications have likely shifted towards bill savings and quality equipment. 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.

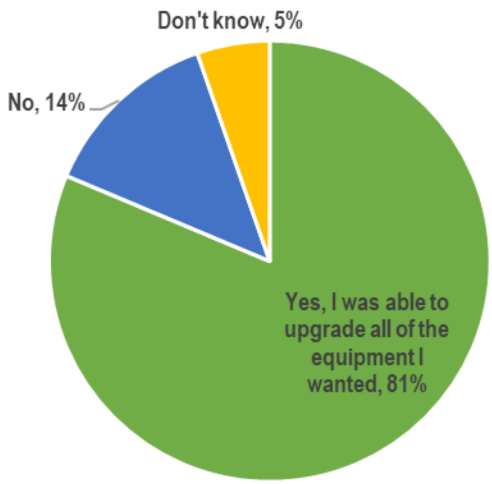
Figure 6-6. Primary Reasons for Deciding to Participate in the Program (n = 150)



Source: Navigant analysis

Another important survey finding was that 81 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 6-7 below). This is a decrease from 89 percent in PY2015, which indicates that there may be opportunity to increase the depth of energy efficiency measures available to participants.

Figure 6-7. Participants Who Stated that Equipment Offered Through the Program Allowed Them to Upgrade All of the Equipment They Wanted at the Time (n = 150)



Source: Navigant analysis

6.6.4 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.

Summary of Improvements Mentioned by Customers

- Better communication/improved program information
- Greater program publicity
- More equipment offered through the program.

7. SUMMARY FORM

SBES Program

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	September 10, 2018
Region(s)	Duke Energy Progress; Duke Energy Carolinas
Evaluation Period	DEP 3/1/16 – 6/30/17 DEC 3/1/16 – 6/30/17
Annual kWh Savings (net)	DEP 53,302,070 kWh DEC 90,923,371 kWh
Per Participant kWh Savings	DEP 29,143 DEC 37,340
Coincident kW Impact	DEP 9,207 DEC 16,308
Net-to-Gross Ratio	0.98
Process Evaluation	Annual
Previous Evaluation(s)	2013, 2014, 2015

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 62 participant sites, while 23 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 0.97 for LED screw-in lamps to 1.04 for exterior LED wall packs.
- **Participants achieved an average of 29,143 kWh of energy savings per year in DEP, and 37,340 kWh in DEC.** The program is accurately characterizing energy and demand impacts.

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 and DEC jurisdictions. The key to continued success is working through quality control issues as they arise and ensuring that the program continues to offer leading energy efficiency equipment.

- **Participants continue to be overwhelmingly satisfied with the SBES Program and Duke Energy**, including overall service, pricing, installation, and efficient equipment quality. Participants were excited about the opportunity to save money and energy, and expressed limited, minor pain points with the program.
- **Duke Energy has successfully increased the eligibility limit** in PY2016. The program had no apparent issues adapting to larger projects, and there are no meaningful differences in the EM&V team's findings between different project sizes. The higher eligibility limit also increased the average project size, and the ability of the program to generate substantial energy savings.
- The **installation of high–efficiency lighting equipment continues to be the key selling point**. The SBES Program continued to expand the LED lighting offerings. LED measures have grown considerably as a share of total program savings, while refrigeration has remained stable from PY2015 at under 10 percent.
- The **energy savings realization rate is 1.02 for DEP and 1.01 for DEC,** and is driven by several EM&V adjustments. The key adjustments the EM&V team made were the hours of use based on metering and HVAC interactive effects. The **peak demand realization rate is lower at 0.77 for DEP and 0.76 for 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 4 percent**, which drives an **NTG ratio of 0.98**. 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 decreased from PY2015, while free-ridership has remained the same.

8.2 Recommendations

The evaluation team recommends four actions for improving the SBES Program, based on insights gained through the comprehensive evaluation effort for PY2016. These recommendations provide Duke Energy with a roadmap to fine-tune the SBES Program for continued success and include the following broad objectives:

Increasing Program Participation and Satisfaction

1. **Continue to focus on quality, clear communication, and depth of energy efficiency retrofits.** The most common suggested improvements were post-installation equipment issues and a perceived lack of coordination between the various parties involves in delivering the SBES program. There was also a minority of customers reporting that the program was unable to

provide all the energy efficiency equipment they wanted. There are opportunities for continued improvement and channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.

2. **Consider effects of increased program eligibility rules**. With a 180 kW demand limit, there is likely significant overlap between the SBES program and other business programs in Duke Energy's portfolio. The largest project is almost 2 GWh, which is larger than typical large business prescriptive projects seen in other utility offerings. Larger businesses typically have additional resources that small businesses do not, and often do not require the high incentive levels that the SBES program offers. Duke Energy should consider whether the SBES incentive levels are appropriate for these very large projects, or if a different program channel would be sufficient. For example, the Smart $aver program offers LED incentives that are capped at a lower percentage of incremental costs.

Improving Accuracy of Reported Savings

3. **Track burnout lamps and fixtures during the initial audit.** It is likely that some burnouts were present and tolerated by customers, and may contribute to customers not realizing expected savings on their energy bills. Burnouts found during the initial audit are no longer included in tracking data. While not generally required in the industry, customers with many burnouts will not achieve the expected energy savings.

4. **Ensure that the IC has access to up-to-date and accurate customer billing records.** There are several (2706) instances where project deemed savings exceed annualized site data, likely due to incomplete annualized energy usage estimates. Since this is used as an overridable QC check, more accurate data could help reduce the need for such overrides.

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 PY2016 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
Manufacturing	DK	DK	1.14	1.36
Medical	Electric	Electric Resistance	1.05	1.44

[7] PY2013 DEP EEB EM&V Report

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
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

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

The Duke Energy DSMore table is embedded below for reference.

DSMore table
template - DEC DEP

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

APPENDIX A. **STATISTICS DETAIL**

This appendix is intended to provide additional context around Navigant's sampling approach and impact findings for the PY2016 SBES evaluation for the DEP and DEC jurisdictions. Overall, Navigant believes that the evaluation results represents the program impacts in accordance with the evaluation approach and sample design. This is evidenced by the calculated statistical confidence and precision values, which were in line with expectations.

A.1 Sampling Approach

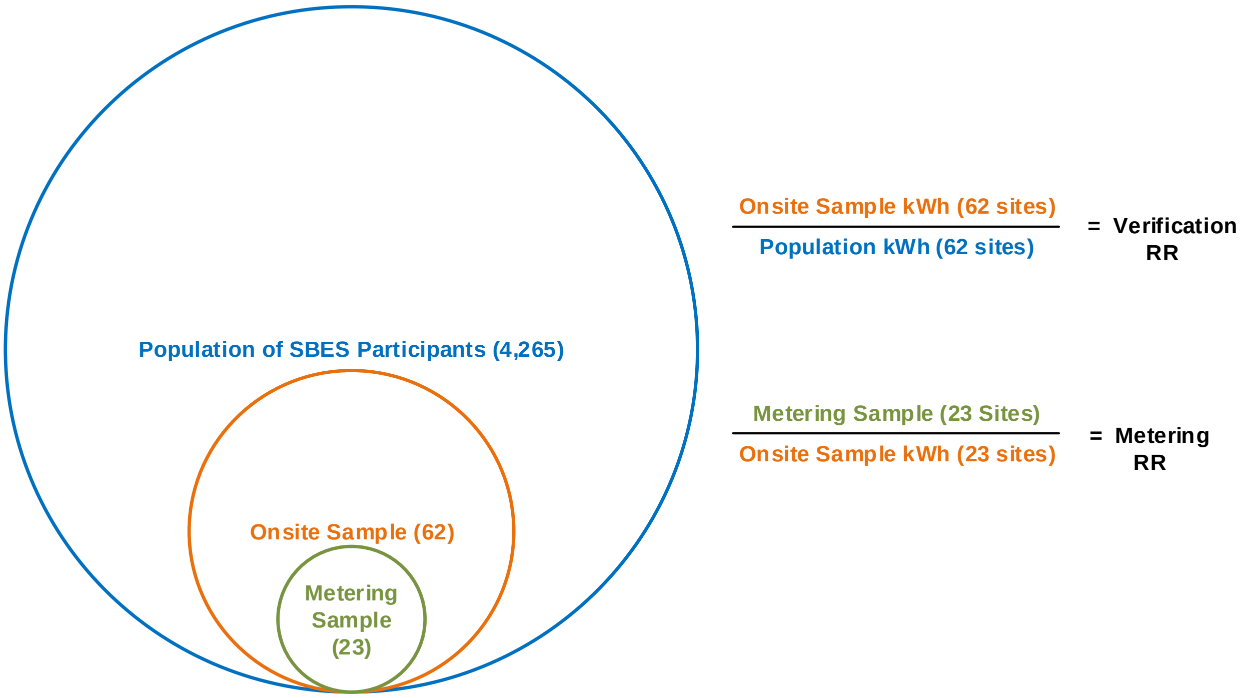
Navigant's methodology includes a double-ratio (nested) sampling approach. This approach is designed to efficiently utilize resources for primary data collection while minimizing sampling error. For the SBES program, Navigant chose a relatively large sample of sites to perform onsite verification activities, and a relatively smaller subsample of these sites for more detailed data collection with data loggers. The underlying assumption is that the larger verification sample represents the larger *population*, while the smaller metering sample represents the larger verification *sample*. This allows Navigant to perform high-rigor evaluation at lower cost for a given assumed sampling error.

For this evaluation, Navigant targeted 90/10 sampling and relative precision for the entire program. Sample sizes are ultimately driven by assumptions related to the variability of Navigant's verified savings compared to the Duke Energy deemed savings values. This is represented by the coefficient of variation, or CV. Less variation results in a lower CV value, which in turn results in lower sample sizes.

Based on previous evaluation work with the SBES program, Navigant designed a sample with 62 sites selected for verification, with a subsample of 23 of these sites for additional metering. Figure 9-1 illustrates the sample design and analysis plan.

Navigant will also note that the population split into four separate strata – large, medium, and small lighting, and one strata for refrigeration. The underlying assumption is that similar projects will tend to exhibit similar variations, so by grouping like projects (e.g. all refrigeration projects) we can further reduce sampling error and draw more meaningful conclusions from our onsite data collections efforts.

Figure 9-1. Illustration of Nested Sampling Concept



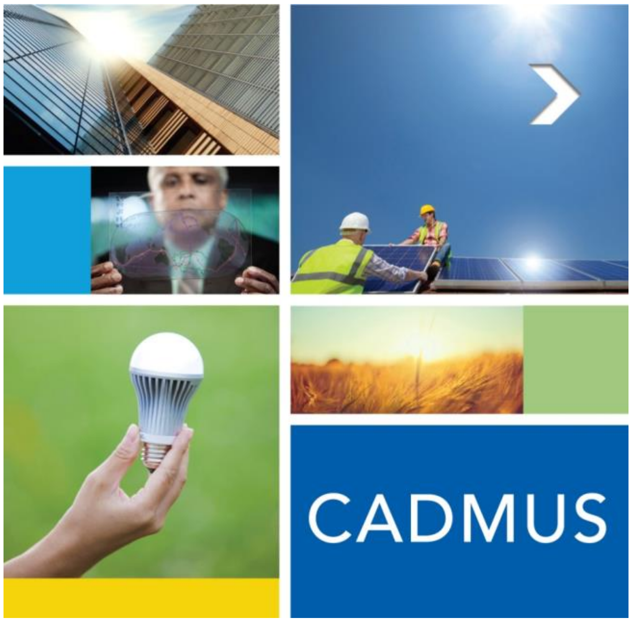
A.2 Analysis Approach

After performing the site visits, the next step is to analyze the measure-level data to develop project-level verification and metering estimates for each site. Because there are three sets of savings estimates, two ratios (hence double-ratio) are required to compare results.

1. The first ratio compares the onsite verification findings to the population for 62 sites. The onsite verification findings include all of Navigant's adjustments performed onsite, such as any adjustments due to in-service rate, HVAC interactive effects, wattage, or customer-reported hours of operation.
2. The second ratio compares the metering findings to the onsite findings for 23 sites. The only adjustment made here is due to hours of use adjustments (or for demand savings, the coincidence factor).

With these ratios, final program-level savings and realization rates are calculated. First, for each stratum, a total realization rate is calculated by multiplying the verification and metering realization rates together (ratios 1 and 2 outlined above). The total realization rate is then multiplied by the stratum deemed savings resulting in the verified savings. The verified savings for each of the four strata are then added together resulting in total program verified savings.

The last step of the analysis includes a statistical analysis to assess whether or not the precision targets were met. In some cases, if there is larger than expected variation between the claimed savings and the verified savings, it is possible that the precision target of 10% is not met. It is also possible that the "true" savings value will be outside of the confidence interval calculated from the statistics. This occurs on average 10% of the time at the 90% confidence level.



Evaluation of the Smart $aver® Custom Incentive Program in North and South Carolina

September 27, 2018

Deleted: February 13, 2017

Duke Energy
550 South Tryon Street
Charlotte, North Carolina 28202

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Prepared by:
Sahar Abbaszadeh
Sara Wist
Christie Amero
M. Sami Khawaja

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Table of Contents

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Executive Summary

Duke Energy Carolinas (DEC) engaged Cadmus, along with NORESCO and BuildingMetrics (the evaluation team), to perform an impact evaluation of the Smart $aver® Custom Incentive Program (Custom Program). The team evaluated 374 program participant applications that were paid an incentive from January 2014 through December 2015.

The evaluation team performed the impact analysis by conducting site measurement and verification (M&V) for a sample of 29 program participant applications. We calculated average electric energy savings and demand reduction realization rates for sampled applications. We used the realization rates to extrapolate the M&V results to the entire population of participants.

The team conducted verification site visits in three phases. TecMarket Works (along with NORESCO and BuildingMetrics) completed phase 1 site visits and prepared M&V reports for eight program participant applications in the winter of 2014. In March 2015, the contract was transferred to Cadmus. Cadmus completed phase 2 site visits at 11 projects during the winter of 2016, and phase 3 site visits at 10 projects during the summer of 2016. This report describes the results of the evaluation based on combined verification efforts.

Impact Evaluation Results

Table 1 shows the program's expected energy savings (those claimed prior to applying the realization rate from the previous Evaluation, Measurement, and Verification study), evaluated gross and net energy savings by project type.

Table 1. Total Program Expected, Evaluated Gross, and Net Energy Savings by Project Type

Project Type	Population Size**	Expected kWh Impact	Realization Rate*	Gross Evaluated kWh Impact	Net-to-Gross Ratio	Net Evaluated kWh Impact
HVAC	41	59,740,357	59%	35,377,874	84%	29,717,414
Lighting	300	75,226,538	101%	75,950,346	91%	69,114,814
Process	36	35,500,097	77%	27,237,074	69%	18,793,581
Total* **	**377**	**170,466,992**	**81%**	**138,565,294**	**85%**	**117,625,810**

* Expected impact multiplied by the realization rate will not equal gross evaluated savings due to rounding.
** The total number of applications evaluated is 374. However, three applications included multiple project types.
*** The row values may not add up to the totals due to rounding.

Table 2 and Table 3 show the expected, evaluated gross, net non-coincident peak (NCP, average annual demand reduction) and summer coincident peak (CP, the average summer peak demand reduction in July, Monday through Friday, 4:00 p.m. to 5:00 p.m.) demand reductions for the program.

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Table 2. Total Program Expected, Evaluated Gross, and Net NCP Demand Reduction by Project Type

Project Type	Population Size*	Expected NCP kW Impact	Realization Rate**	Gross Evaluated NCP kW Impact	Net-to-Gross Ratio	Net Evaluated NCP kW Impact
HVAC	40	11,327	57%	6,452	84%	5,420
Lighting	300	9,167	88%	8,075	91%	7,348
Process	36	5,052	94%	4,748	69%	3,276
Total* **	**376**	**25,546**	**75%**	**19,275**	**83%**	**16,044**

* 376 of the 377 projects in the population had expected non-coincident peak demand reduction.
** Expected impact multiplied by the realization rate will not equal gross evaluated savings due to rounding.
*** The row values may not add up to the totals due to rounding.

Table 3. Total Program Expected, Evaluated Gross, and Net CP Demand Reduction by Project Type

Project Type	Population Size*	Expected CP kW Impact	Realization Rate**	Gross Evaluated CP kW Impact	Net-to-Gross Ratio	Net Evaluated CP kW Impact
HVAC	39	5,537	85%	4,713	84%	3,959
Lighting	265	11,897	104%	12,339	91%	11,229
Process	36	4,738	96%	4,533	69%	3,128
Total* **	**340**	**22,172**	**97%**	**21,586**	**85%**	**18,316**

* 340 of the 377 projects in the population had expected coincident peak demand reduction.
** Expected impact multiplied by the realization rate will not equal gross evaluated savings due to rounding.
*** The row values may not add up to the totals due to rounding.

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Evaluation Parameters

Table 4 lists the parameters reviewed in this evaluation.

Table 4. Evaluated Parameters with Value, Units, and Achieved Precision and Confidence

Evaluated Parameter	Gross Realization Rates	Confidence/Precision
Energy Saving (kWh)	81%	90%/±9%
Non-Coincident Peak Demand Reduction (kW)	75%	90%/±21%
Coincident Peak Demand Reduction (kW)	97%	90%/±16%

Table 5 lists the sample periods and dates during which the team conducted evaluation activities. We selected the verification samples based on expected project contribution to program energy savings to meet the targeted relative precision of ±15% at a 90% confidence level.

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Table 5. Sample Period Start and End and Dates Evaluation Activities Were Conducted

Evaluation Phase	Component	Sample Period*	Dates Conducted	Total
1	Site Visits (TecMarket Works)	January 2014 – June 2014	September 2014	8
2	Site Visits (Cadmus)	January 2014 – June 2015	January 2016	11
3	Site Visits (Cadmus)	January 2014 – December 2015	July 2016	10

* The sample period is based on the date the incentive was paid to the customer, as recorded in DEC's database.

Impact Evaluation Findings

The evaluation team identified the following key findings through this evaluation.

- The overall energy realization rate across all projects was 81%.
- Lighting projects achieved the highest energy savings as compared to program estimates (realization rate of 100%), whereas HVAC projects achieved the lowest energy savings as compared to program estimates (realization rate of 59%). Industrial process projects had a 77% energy saving realization rate.
- Lighting projects contributed 54% of the total evaluated program energy savings. In general, the discrepancies between expected and verified savings resulted from lower verified hours of use.
- HVAC projects contributed 26% of the total evaluated program savings. In general, control strategies that were suboptimal or not fully implemented contributed to low realization rates. Additionally, the evaluated loads were less than those projected in the program application saving calculations.
- Process projects generated 20% of the evaluated program savings. Though most process projects performed as expected, one large project had a 53% energy realization rate. The evaluation team's review revealed that the installed air compressors were not as efficient as expected in the application saving calculations.
- Twelve percent of the evaluated program savings are associated with freeriders. Spillover was not included in the scope of the evaluation as it was expected to be minimal. Therefore, the program net-to-gross ratio is 88%.

Introduction and Purpose of Study

Description of Program

Through the Custom Program, DEC provides incentives for its nonresidential customers who purchase high-efficiency equipment. The program design is intended to complement the Smart $aver Prescriptive Incentive Program (Prescriptive Program), through which DEC offers incentives on preselected measures. Customers who want to purchase measures that are not eligible for the Prescriptive Program may apply for a rebate through the Custom Program. Custom Program participants must calculate their proposed measures' energy savings and include their estimate on the Custom Program application. DEC provides incentives to approved applicants based on a review of these calculations.

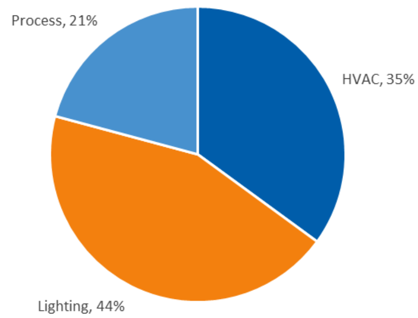
Table 6 lists the number of participants in the evaluation period, which includes program participant applications that were paid an incentive between January 2014 and December 2015. A total of 374 applications were paid during the evaluation period. Three applications included measures in both the lighting and HVAC categories. Since the evaluated energy savings and demand reduction are broken out by technology, these three applications are counted twice in the total shown here.

Table 6. Custom Program Impact Evaluation Participant Application Count

Project Type	Number of Participant Applications in Evaluation Period
HVAC	41
Lighting	300
Process	36
Total	**377**

Figure 1 shows the breakdown of expected energy savings by project type in the program tracking database for the evaluation period. As a category, lighting projects were reported to have the greatest savings, followed by HVAC projects.

Figure 1. Expected Energy Savings by Project Type



n= 170,466,992 kWh

Summary of the Evaluation

For the impact evaluation, the team conducted a tracking system review, sample design and selection, engineering review of Custom Program applications, field M&V of selected projects, data analysis, and reporting.

Evaluation Objectives

The goal of the impact evaluation was to verify energy savings and calculate energy and demand realization rates for a sample of participants in each project type: lighting, HVAC, and process. The evaluation team estimated program-wide savings by applying the average realization rates to the evaluation period population by project type.

Researchable Issues

The evaluation team researched the following issues to complete this study:

- Energy, coincident peak, and non-coincident peak demand reduction for each sampled participant
- Causes for differences between evaluated savings and expected savings
- Energy and demand realization rates for each participant
- Average energy and demand realization rates for lighting, HVAC, and process participants, along with the associated confidence intervals

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Methodology

Overview of the Evaluation Approach

Data Collection Methods, Sample Sizes, and Sampling Methodology

The evaluation team assigned participant applications to lighting, HVAC, and process categories. We then stratified all three categories by size and selected participants in each stratum either randomly (for smaller sites) or based on the magnitude of energy savings.

The evaluation team conducted M&V site visits at all sampled HVAC (n=6), lighting (n=16), and process (n=7) projects.

Study Methodology

The evaluation team prepared M&V plans for site visits following the options outlined by the International Performance Measurement and Verification Protocol (IPMVP).[1] We followed IPMVP Option A for all but two of the site M&V plans, which followed Option D. IPMVP Option A evaluates savings based on field measurement of key performance parameters, such as air compressor demand. The evaluation team estimates parameters that cannot be measured or are not selected for field measurement based on historical data, manufacturer's specifications, or engineering judgment. IPMVP Option D evaluated savings are determined through energy model simulations of the whole facility. The model must be calibrated to reflect actual energy use in the facility based on utility data. Option D is most useful when evaluating savings from interactive building systems.

We conducted site visits to verify measures, install metering equipment, and perform interviews about the pre-retrofit equipment and hours of operation with the site contacts. We used metered data or inputs collected on site to calculate evaluated energy savings and engineering analysis and statistical regression modeling for estimating demand reductions.

Number of Completes and Sample Disposition for Each Data Collection Effort

The evaluation team attempted to contact 32 program applicants. One program participant was concerned with the impact of site visits on business operations, one did not respond, and one agreed to be an alternate site. The team completed verifications of 29 projects across the three project types.

Expected and Achieved Precision

The evaluation team designed the sample to achieve 90% confidence with ±15% precision for the energy savings overall. The impact evaluation did not have a targeted precision for demand reduction.

Four of the 29 sampled projects were excluded from the energy saving realization rate and precision calculations as outliers: In one sampled project, DEC had calculated the savings using an incorrect

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1 International Performance Measurement and Verification Protocol. *Concepts and Options for Determining Energy and Water Savings. Volume 1.* January 2012. EVO 10000 – 1:2012. www.evo-world.org.

baseline. Another sampled project was removed from the realization rate calculations due to insufficient data to calculate savings. Two other projects were statistical outliers among the sampled projects with realization rates that were either too high or too low.[2] We achieved 90% confidence with ±9% precision for energy saving based on the projects included in the energy saving realization rate calculations.

Description of Baseline Assumptions, Methods, and Data Sources

The evaluation team used the pre-retrofit equipment as a baseline for the saving calculations. We collected data on baseline equipment from the program incentive application documents and verified the equipment through interviews with the site contact or vendor. We used the post-retrofit schedules or industrial/occupancy demand to develop a pre-retrofit performance assessment equivalent to the post-retrofit conditions.

Use of Technical Reference Manual Values

We used primary data collection, engineering analysis, building energy simulation modeling, and linear regression modeling to calculate evaluated savings. To calculate savings for the sampled lighting participants, we used the saving algorithm outlined in the Indiana Technical Reference Manual for *Lighting Systems (Non-Controls) (Early Replacement, Retrofit),*[3] along with the energy and demand waste heat factors calculated in an earlier study of the Smart $aver Nonresidential Prescriptive Incentive Program.[4] We used the hours of operation data collected on site to estimate the peak demand coincidence factors.

Sample Design

Based on the categories identified in the DEC program tracking database, we grouped the participant applications into similar project types (lighting, HVAC, and process) to provide better accuracy in the overall program results for each category. We separated each technology category into energy savings size-based strata. The definitions for each of the savings size-based strata are provided in Table 7.

2 Statistical outliers are those projects that have realization rates more than two standard deviations above or less than two standards deviations below the statistical mean realization rate for all projects.

3 Cadmus. *Indiana Technical Reference Manual Version 2.2.* Prepared for the Indiana Demand Side Management Coordination Committee EM&V Subcommittee. July 28, 2015.

4 TecMarket Works. *Process and Impact Evaluation of the Non-Residential Smart $aver® Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors*. April 2013.

Table 7. Stratum Definition Based on Expected Energy Savings

Group	Stratum	kWh Savings ≥
HVAC	1	3,000,000
	2	0
Lighting	1	2,000,000
	2	490,000
	3	0
Process	1	2,000,000
	2	0

We calculated the required sample size to meet our desired precision using the following equation, which incorporates the finite population correction:

$$n = \left[Z * \frac{CV}{P}\right]^2 * \sqrt{\frac{N-n}{N-1}}$$

Where:

- n = Total sample size required
- Z = z statistic (1.645 at 90% confidence)
- CV = Coefficient of variation (defined as the mean divided by the standard deviation)
- P = Desired precision
- N = Population size

We allocated samples to each stratum using Neyman's Allocation, illustrated below:

$$n_k = n * \frac{N_k * CV_k * kWh_k}{\sum N_k * CV_k * kWh_k}$$

Where:

- n_k = Total sample size required for stratum k
- CV_k = Coefficient of variation for stratum k
- kWh_k = Total expected savings for stratum k

Sample Status

The evaluation team pulled three sets of sampled applications, one for each phase. The original evaluation plan included projections for the number of program participants and expected energy savings during the evaluation period. The original evaluation sampling plan used an energy realization

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rate coefficient of variation for each technology type from a 2012 Custom Program evaluation in Ohio.[5] The team used data from the original evaluation plan and the 2012 Ohio Custom Program evaluation to determine the number of applications required to meet the targeted relative precision of ±15% at a 90% confidence level. The team pulled 19 applications for phases 1 and 2, based on this sampling plan.

Prior to selecting the remaining 10 sampled applications for phase 3, Cadmus revised the original sampling plan to incorporate the final number of program participants and expected energy savings during the evaluation period, along with the energy realization rate error ratios resulting from phase 1 and 2 verifications. We then selected the phase 3 verification sample in the lighting and HVAC strata that required additional sample points according to the updated sampling plan.

Table 8 summarizes the recommended and final phase 3 sample count based on Cadmus' update to the original sampling plan.

Table 8. Recommended and Achieved Sample Sizes Based on Phase 3 Sampling Plan Update

Group	Energy (kWh)	CV	Total Participants	Total Recommended Sample Size	Phase 1 and 2 Sampled Application Count	Phase 3 Final Sample Count	Total Evaluation Sample Count
HVAC 1	32,334,294	0.06	6	1	2	-	2
HVAC 2	27,406,066	0.50	35	5	1	3	4
Lighting 1	20,453,249	0.08	5	1	3	-	3
Lighting 2	27,447,709	0.97	31	8	2	4	6
Lighting 3	27,325,580	0.17	264	12	4	3	7
Process 1	21,080,433	0.22	5	1	2	-	2
Process 2	14,419,662	0.25	31	2	5	-	5
Total	**170,466,993**		**377**	**30**	**19**	**10**	**29**

[5] TecMarket Works. *Final Report Evaluation of the 2009 – 2011 Smart $aver Non-Residential Custom Incentive Program in Ohio*. Prepared for Duke Energy. September 2012.

Impact Evaluation Activities

This section includes a description of the review, M&V, and impact calculation activities performed for the selected sample of projects as part of this evaluation.

Documents Review

For all the sampled projects, the evaluation team performed a detailed review of program application documents, which included incentive applications, measure savings input and outputs from DSMore,[6] and supporting documentation or clarifications provided by the customer. We reviewed each application to gain an understanding of the measures included and the expected savings. We collected customer and contractor contact information, then decided on an appropriate M&V approach.

The DEC business relations manager or the key account managers associated with each sampled site contacted customers to secure their participation in the evaluation. Once they had established contact with the customer, the evaluation team followed up with the customer via phone calls and e-mails to gain additional information about the facility, installed measures, and operating schedule and procedures. We scheduled the site visits directly with the site contact.

Measurement and Verification Plan Development

The evaluation team developed an M&V plan for all 29 of the program participant applications we verified via site visits and metering. NORESCO developed M&V plans for phase 1 (as a subcontractor to TecMarket Works) and for phase 2 (as a subcontractor to Cadmus). Cadmus reviewed phase 2 plans and developed phase 3 M&V plans.

Each M&V plan covered the following topic areas:

- ***Introduction:*** a description of the project and the measures installed, including sufficient detail to understand the M&V project scope and methodology, proposed and DEC expected savings by measure, a list of M&V priorities for measures within the project, and baseline assumptions.
- ***Goals and objectives:*** a list of the overall goals and objectives of each M&V activity.
- ***Site location and contacts:*** the names, phone, email and address of site contacts.
- ***M&V option:*** a description of the IPMVP M&V Option appropriate for participant saving verification. We used Option A or Option D for each of the 29 projects verified on site.
- ***Field data points and survey plan:*** a list of specific field data points collected through the M&V plan, which included a combination of survey data, one-time measurements, and time series data collected from data loggers installed for the project or trend data collected from the site energy management system.

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6 DEC uses Demand Side Management Option Risk Evaluator (DSMore), a financial analysis tool, to estimate the costs, benefits, and risks associated with the Custom Program.

- ***Data accuracy:*** a list of meter and sensor accuracy for each field measurement point.
- ***Recording and data exchange format:*** specific values such as kWh savings, coincident and non-coincident kW savings, and therm savings and a list of raw and processed data to be supplied at the conclusion of the study.
- ***Verification and quality control:*** A list of steps taken to validate the accuracy and completeness of the raw field data.

From the M&V plans, the evaluation team created reports for each sampled project (provided in Appendix F. Site Measurement and Verification Reports – Full Customer Detail), which included the following additional topics:

- ***Data analysis:*** a list of the engineering methods and/or equations used to calculate the verified savings and a list of the data sources, which were either measured or stipulated values from secondary data sources.
- ***Conclusion:*** A summary of findings and the final realization rates, including an explanation for verified savings deviations from expected savings.

Measurement and Verification

Metering equipment included a combination of portable data acquisition equipment capable of measuring current and motor status, cellular data loggers capable of transmitting data remotely, true electric power meters, and trend logs from facility control systems. We also interviewed site personnel during meter installation, and configured the metering equipment to collect data for three weeks. Where available, we collected trend logs for one month or more.

Of the 29 sites metered, the evaluation team did not meter three HVAC projects that had permanent power meters on all controlled equipment. These were a data center, a hospital, and a large manufacturing facility. The participants' power meters recorded equipment-level demand (i.e., individual chiller, rooftop unit (RTU), and pumps). The evaluation team visited these sites (similar to others) to record equipment make and model, ensure that the trending periods were set up according to our verification schedules and requirements, and to review the sequence of operation with facility personnel.

For one lighting site, a meat processing plant, we could not install metering equipment due to operational requirements: the areas where lighting retrofits were installed were sprayed down for cleaning daily. Therefore, we inspected the lighting fixture data during our site visit and verified operation hours of use with the site contact.

At one process site, the voltage serving the equipment as listed in the application was greater than 480 volts, which is the maximum voltage we can meter. The evaluation team used the site's power meter, which collected M&V trend data points for the equipment included in the application.

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This information is summarized in Table 15 in Appendix C. Sampled Participant Calculation Summary. Appendix F. Site Measurement and Verification Reports – Full Customer Detail describes the specific instrumentation used at each site.

Measurement and Verification Calculations

The evaluation team collected post-retrofit metered and trend data for the 29 verification site visit projects. The team analyzed the data according to the M&V plan developed for each project, except where on-site findings required changes to the original metering plan; for example, we could not install logging equipment due to high-voltage or operational limitations. To conduct data analysis, we compared the original application calculations to post-retrofit monitored data that we extrapolated to annual consumption and demand using simple engineering models or linear regression techniques (as described in the M&V plans).

Appendix C. Sampled Participant Calculation Summary provides a detailed list of all the projects where we conducted on-site visits and metering. This appendix includes a summary of the M&V plan approach, measurements taken, duration of measurement, and the calculations and analysis techniques used to estimate final impact savings and demand reduction results.

Appendix F. Site Measurement and Verification Reports – Full Customer Detail contains detailed site M&V calculations for each project.

Freeridership Calculations

[Redacted]

Table 9 shows the evaluated savings-weighted freeridership scores for 377 projects, along with the original calculated scores, by project type. The projects exhibited 15% freeridership overall across all project types. Spillover questions are not included in the program application. We did not calculate spillover for this program and assumed it to be 0%. We used the following net-to-gross calculation:

$$Net\_to\_Gross = 100\% - Freeridership + Spillover = 100\% - 15\% + 0\% = 85\%$$

Table 9. Custom Program Net-to-Gross Ratio

Project type	Number of Applicants with Calculated Freeridership Score	Energy Savings Weighted Freeridership Score	Net-to-Gross Ratio
HVAC	41	16%	84%
Lighting	300	9%	91%
Process	36	31%	69%
Total	**377**	**15%**	**85%**

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Impact Evaluation Results

This section provides the evaluation results, which includes annual energy, coincident peak and non-coincident peak demand reductions, and realization rates for each participant.

Annual Savings

Table 10 summarizes annual savings and realization rates (RR) calculated by project type for the evaluation period.

Table 10. Average Annual Gross Savings Realization Rate by Project Type

Project Type	Energy Savings (kWh)			NCP Savings (kW)			CP Savings (kW)		
	Evaluated	Expected	RR	Evaluated	Expected	RR	Evaluated	Expected	RR
HVAC	35,377,874	59,740,357	59%	6,452	11,327	57%	4,713	5,537	85%
Lighting	75,950,346	75,226,538	101%	8,075	9,167	88%	12,339	11,897	104%
Process	27,237,074	35,500,097	77%	4,748	5,052	94%	4,533	4,738	96%
Total	**138,565,294**	**170,466,992**	**81%**	**19,275**	**25,546**	**75%**	**21,586**	**22,172**	**97%**

The evaluation achieved ±9% relative precision at the 90% confidence interval for the energy saving realization rate analysis. We excluded a total of four applications from the energy realization rate analysis:

- Two lighting applications had very low and very high energy realization rates (-11% and 234%) indicating that they were outliers.[7]
- For another lighting application, our evaluated baseline was starkly different from the baseline DEC used in the application saving calculations. The project was part of a major retrofit to change the space usage from a fabric weaving space to a furniture warehouse. The evaluation team excluded this application due to the exceptional circumstances that affected its energy saving and demand reduction realization rates.
- We excluded one HVAC application sampled due to insufficient data available to calculate verified savings.

The evaluation achieved ±21% relative precision at the 90% confidence interval for the non-coincident peak demand reduction realization rate analysis. We excluded four applications from the non-coincident peak realization rate analysis:

- One lighting application had a very high (918%) non-coincident peak demand reduction realization rate indicating that it was an outlier.

[7] Statistical outliers are those projects that have realization rates more than two standard deviations above or less than two standards deviations below the statistical mean realization rate for all projects.

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- We excluded one lighting application sampled from the demand reduction realization rate analysis (similar to the energy saving realization rate analysis), due to the exceptional circumstances that affected its energy saving and demand reduction realization rates.
- One HVAC application was excluded since we attributed its very low non-coincident peak demand reduction realization rate (1%) to a clerical error in DEC's recording of the expected reduction.
- We did not have sufficient data for another HVAC application sampled to calculate verified savings.

The evaluation achieved ±16% relative precision at the 90% confidence interval for the coincident peak demand reduction realization rate analysis. We excluded three applications from the coincident peak demand reduction calculations:

- One HVAC application had a very high realization rate (222%), which indicated it was an outlier.
- We excluded one lighting application sampled from the demand reduction realization rate analysis (similar to the energy saving realization rate analysis), since our evaluated baseline was starkly different from the baseline DEC used in the application saving calculations.
- We did not have sufficient data for one HVAC application sampled to calculate verified savings.

Two other lighting applications sampled had no expected coincident peak demand reduction.

Table 11 through Table 13 list the estimated precision for energy, non-coincident peak demand, and coincident peak demand realization rates, respectively, at 90% confidence. We combined the planned HVAC 1 and HVAC 2 strata into one HVAC stratum for the final realization rate calculations.

Table 11. Energy Savings Realization Rates to Achieve Sampling Precision at 90% Confidence

Stratum	Population Size	Sample Size*	Actual Sample Error Ratio	Relative Precision
HVAC	41	4	0.28	33%
Lighting 1	5	3	0.08	14%
Lighting 2	31	5	0.29	28%
Lighting 3	264	6	0.28	23%
Process 1	5	2	0.27	123%
Process 2	31	5	0.24	23%
Total	**377**	**25**	**0.27**	**9%**

* The evaluation team excluded four sampled applications from the precision analysis as described above.

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Table 12. Non-Coincident Peak Realization Rates to Achieve Sampling Precision at 90% Confidence

Stratum	Population Size	Sample Size*	Actual Sample Error Ratio	Relative Precision
HVAC	40	4	0.31	36%
Lighting 1	25	8	0.28	19%
Lighting 2	36	3	0.08	14%
Lighting 3	239	3	3.77	636%
Process 1	22	4	0.79	93%
Process 2	14	3	0.23	39%
Total	**376**	**25**	**0.60**	**21%**

* The evaluation team excluded four sampled applications from the precision analysis as described in detail above.

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Table 13. Coincident Peak Realization Rates to Achieve Sampling Precision at 90% Confidence

Stratum	Population Size	Sample Size*	Actual Sample Error Ratio	Relative Precision
HVAC	39	4	0.32	38%
Lighting 1	25	8	0.28	19%
Lighting 2	36	3	0.13	22%
Lighting 3	204	2	0.15	68%
Process 1	22	4	0.80	94%
Process 2	14	3	0.12	20%
Total	**340**	**24**	**0.46**	**16%**

* The evaluation team excluded three sampled applications from the precision analysis as described in detail above.

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Findings

Figure 2 shows the breakdown of evaluated energy savings by project type compared to expected energy savings. Lighting projects contributed the most to the verified total program savings (55%), followed by HVAC project (26%) and process projects (20%).[8]

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[8] Percentages add up to more than 100% due to rounding.

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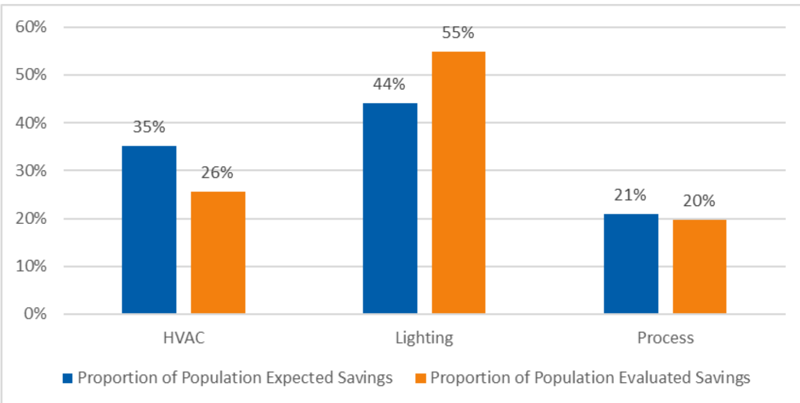
Figure 2. Contribution of Expected* and Evaluated Energy Savings by Project Type**



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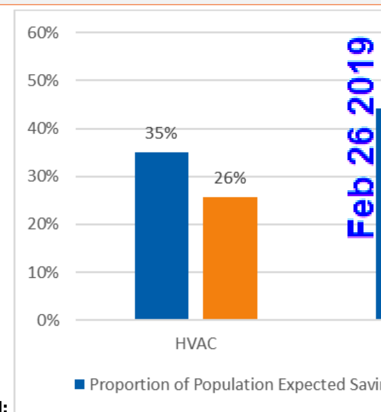

*Expected energy savings are 170,466,992 kWh.
** Evaluated energy savings are 138,565,294 kWh.

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The evaluation team's summary of findings are provided below and described in detail in Table 17 in Appendix D. Sampled Participant Detailed Results. The overall energy realization rate across all projects was 81%. The team found large variations between evaluated and expected savings in all three strata. Specific examples are provided by project type below.

HVAC

The average realization rate of HVAC projects is 59%, and these projects contributed 26% of the program evaluated savings. These projects included HVAC controls upgrades and retrofits, installation of variable frequency drives (VFDs), and installation of new high-performance HVAC systems.

Low realization rates were generally caused by control strategies that either did not perform as planned or were not fully implemented. In a few cases, the team determined that the evaluated loads were less than those originally expected in the application savings calculations. In one of the sampled applications, submitted for a high-performance HVAC system in a new data center, the expected energy savings and demand reduction would have been fully realized if all data center server racks were filled and the data center had reached design capacity. However, the project's current evaluated HVAC load (which is directly correlated with the server rack load in the data center) is only 17% of the full design load, and the site contact does not anticipate reaching full data center capacity for five to seven years. For this project, the evaluation team calculated projected energy savings and demand reduction at an assumed load growth period of seven years from the date of the evaluation. We calculated the present value savings and demand reduction using an assumed annual discount rate of 7.09%.[9] The overall projected

[9] This value is the weighted average cost of capital for North Carolina cost effectiveness tests according to DEC.

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seven-year energy savings realization rate was 69% and the summer peak demand realization rate was 59%.

Lighting

Lighting projects, on average, had the highest realization rate (101%) and they contributed half of the evaluated program savings (55%).

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Variations between evaluated and expected savings were due to differences between the expected lighting hours of use and those verified through site surveys and logging. Additionally, HVAC interactive effects were not included in the application saving calculations.

In one application, the lighting retrofits were part of a major retrofit to change the building's primary functional use from fabric weaving to a furniture warehouse. The project application savings calculations claimed savings resulting from the lighting retrofit, without taking the change in light levels into account. The evaluation team adjusted the pre-retrofit baseline lighting energy use based on the post-retrofit light level requirements and calculated the savings based on equivalent pre- and post-retrofit lighting levels. This resulted in 17% energy savings, 14% coincident peak demand reduction, and 28% non-coincident peak demand reduction realization rates. As noted previously under Annual Savings, the team did not include this project in the program realization rate calculations.

For major retrofit projects such as this, the expected savings should account for the changes in space usage and required light levels. The pre-retrofit baseline lighting system design lumen output in such cases can be adjusted to match the installed lighting design lumen output. Alternatively, the baseline lighting power density can be based on the prevalent building energy code's lighting power density requirement for the new space type, if the energy code is triggered by the retrofit.

Process

Process projects, on average, had a 77% energy realization rate and contributed 20% to the evaluated program energy savings. Only one project had an energy realization rate of less than 80%. The team's evaluation review of this air compressor retrofit project revealed that the application savings analysis contained a few minor errors that greatly impacted the energy use calculations. For example, the performance datasheet submitted as part of the application did not include site-specific inputs, and the post-retrofit installed air compressor energy performance was only slightly better than the performance of pre-retrofit air compressors. Additionally, the pre-retrofit documentation claimed having metered power, while the contractor had only metered the current in one of the three phases, then converted this to power. Also, there was no permanent airflow monitoring on the pre-retrofit or installed air compressors. It is difficult to accurately monitor airflow using a temporary meter, and it is recommended to install a permanent monitoring station. Without the airflow load profile, the team could not calculate the actual plant compressed air load. We based our evaluation calculations on trended power demand provided by the site, equipment performance data, and our best engineering judgement; this resulted in a 53% energy realization rate and 56% coincident peak demand realization rate.

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Conclusions and Recommendations

The evaluation team offers the following conclusions and recommendations resulting from our Custom Program evaluation.

- **Conclusion:** Low realization rates caused by sub-optimal or incomplete control strategies indicate that post-retrofit inspections or project commissioning may be effective strategies for realizing the full energy savings available from HVAC control measures.
  - **Recommendation:** Where possible, require post-retrofit commissioning for HVAC projects to realize the full potential of retrofit savings.
- **Conclusion:** Significant permanent changes in occupancy rate or space usage from the pre-retrofit conditions need to be accounted for in the lighting saving calculation baseline.
  - **Recommendation:** For major retrofit projects, calculate the expected savings accounting for any changes in space usage and required light levels.
- **Conclusion:** Projects with completion schedules or periods of load growth longer than one to two years will not be completed in time to be evaluated.
  - **Recommendation:** Calculate savings for projects with longer than one to two-year completion or load growth schedules based on their present value.
- **Conclusion:** HVAC interactive effects were not included in the application saving calculations for lighting projects.
  - **Recommendation:** Include HVAC interactive effects in lighting project expected saving calculations.
- **Conclusion:** DEC can improve the accuracy of its expected saving calculations for process projects by ensuring that pre-retrofit energy use calculations are based on accurate power metered data and the specific industrial process load monitoring points.
  - **Recommendation:** Where feasible, consider using pre- and post-retrofit power measurements and collecting coincident industrial process load data to arrive at accurate realized savings.
  - **Recommendation:** Require permanent airflow monitoring devices be installed on all large (greater than 400 horsepower) compressed air system retrofits to establish accurate pre- and post-retrofit load profiles.

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Appendix A. Summary Form

DUKE ENERGY

Smart $aver Custom Incentive Program

Duke Energy Carolinas
Completed EMV Fact Sheet
2016 Evaluation – Cadmus

Program Description

The Duke Energy Smart $aver Custom Incentive Program supplements the Smart $aver Prescriptive Incentive Program, which provides prescriptive rebates for preselected measures. Customers wishing to install measures not included in the Smart $aver Prescriptive Incentive Program list may apply for a rebate through the Custom Program. Participation requires a pre-approval from the program before measure installation.

Date	February 3, 2017
Region(s)	Carolinas
Evaluation Period	Applications Paid from January 2013 through December 2015
Gross Energy Savings (kWh)	138,565,294
Net Coincident kW Impact (Summer)	18,316
Measure life	Various
Net Energy Savings (kWh)	117,625,810
Process Evaluation	Yes, reported separately.
Previous Evaluation(s)	Yes 2013

Evaluation Methodology

The evaluation team conducted the impact evaluation based on measurement and verification of a sample of 29 participants in HVAC, lighting and process project types. The evaluation team estimated average energy saving and demand reduction realization rates for each project category and projected them onto the full program participant population.

Impact Evaluation Details

- The overall energy realization rate across all projects was 81%.
- Lighting projects achieved the highest energy savings as compared to program estimates (realization rate of 101%), whereas HVAC projects achieved the lowest energy savings as compared to program estimates (realization rate of 59%). Industrial process projects had a 77% energy saving realization rate. Fifteen percent of the evaluated program savings are associated with freeriders. Spillover was not included in the scope of the evaluation as it was expected to be minimal. Therefore, the program net-to-gross ratio is 85%.
- Lighting participants produced 55% of total program evaluated energy savings. HVAC and process participants produced 26% and 20% of the total program evaluated energy savings respectively. Percentages add up to more than 100% due to rounding.

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Appendix B. Required Savings Table

The DEC-required summary parameters resulting from this evaluation are provided in Table 14.

Table 14. DEC-Required Program Evaluation Summary

Measure Name	Gross kWh RR	NCP kW RR	CP kW RR	Effective Useful Life	Net-to-Gross Ratio
Custom	81%	75%	97%	Custom	85%

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Appendix C. Sampled Participant Calculation Summary

Table 15 includes a summary of the evaluation team's M&V approach, measurements taken, and calculations performed for each M&V participant sampled for this evaluation.

Table 15. Measurement and Verification and Impact Calculation Approach Summary

Site ID	Participant	Project Type	M&V Plan Summary	Measurements Taken	Monitoring Duration	Calculations
1	[Redacted]	HVAC	IPMVP Option D	Collected voltage, average current (Amps), average power (kW), and power factor for sampled air-handling unit/heat pump fans and compressors Collected supply air temperature, mixed air temperature, return air temperature, outside air temperature for sampled air-handling unit/heat pumps	Three weeks	Comparison of pre- and post-retrofit models calibrated based on equipment monitoring data
2	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in data suites, hallways, and office areas	Three weeks	Engineering equations with parameters from metered data
3	[Redacted]	Lighting	IPMVP Option A	Monitored light circuits affected by the retrofit	Three weeks	Engineering equations with parameters from metered data
4	[Redacted]	Process	IPMVP Option A	Collected voltage, average (Amps), average power (kW), and power factor for four aeration blower motors	Three weeks	Engineering equations with parameters from metered data
5	[Redacted]	Process	IPMVP Option A	Collected voltage, average (Amps), average power (kW), and power factor for three air compressors	Two weeks	Engineering equations with parameters from metered data

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Site ID	Participant	Project Type	M&V Plan Summary	Measurements Taken	Monitoring Duration	Calculations
6	[Redacted]	HVAC	IPMVP Option A	Collected trend data for chiller demand (kW), flow rate, supply and return temperatures, condenser water pump and chilled water pump demand (kW), cooling tower entering and leaving water temperatures and fan input demand (kW), and coincident outside air conditions (from the site metering system)	One year	Hourly model with typical meteorological year (TMY3) temperature data and parameters from trend data
7	[Redacted]	Lighting	IPMVP Option A	Monitored light circuits affected by the retrofit	Three weeks	Engineering equations with parameters from metered data
8	[Redacted]	Process	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for one 500-ton injection molding machine	Two weeks	Engineering equations with parameters from metered data
9	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in retail spaces	Three weeks	Engineering equations with parameters from metered data
10	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in warehouse and shop	Two weeks	Engineering equations with parameters from metered data
11	[Redacted]	HVAC	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for sampled RTUs Collected outside air temperature and relative humidity, supply air temperature, mixed air temperature, return air temperature, and supply fan current for sampled RTUs	Three weeks	Regression analysis of monitored data and environmental measurements
12	[Redacted]	HVAC	IPMVP Option A	Collected trend data for total input demand (kW) for 17 RTUs (out of 18), zone temperature for 11 RTUs, discharge and return air temperature for six RTUs, cooling status for seven RTUs, and outside air damper position for eight RTUs (all collected by the site metering system)	One month	Hourly model with TMY3 temperature data and parameters from trend data

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Site ID	Participant	Project Type	M&V Plan Summary	Measurements Taken	Monitoring Duration	Calculations
13	[Redacted]	Lighting	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for one lighting circuit	Two weeks	Engineering equations with parameters from metered data
14	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in retail area	Two weeks	Engineering equations with parameters from metered data
15	[Redacted]	Lighting	IPMVP Option A	None (refrigerated spaces were sprayed down every day)	-	Engineering equations with updated fixture counts from site visit
16	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in offices, common areas, and parking garage	Three weeks	Engineering equations with parameters from metered data
17	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in warehouse and storage areas	Three weeks	Engineering equations with parameters from metered data
18	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in retail spaces	Two weeks	Engineering equations with parameters from metered data
19	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in office spaces	Three weeks	Engineering equations with parameters from metered data
20	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in offices, warehouse, and bulk storage areas	Three weeks	Engineering equations with parameters from metered data
21	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in offices and warehouse	Two weeks	Engineering equations with parameters from metered data
22	[Redacted]	Process	IPMVP Option A	Collected true electric power logging of the new injection molding machine	Three weeks	Engineering equations with parameters from metered data
23	[Redacted]	Process	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for the VFD air compressor	Two weeks	Engineering equations with parameters from metered data

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Site ID	Participant	Project Type	M&V Plan Summary	Measurements Taken	Monitoring Duration	Calculations
24	[Redacted]	HVAC	IPMVP Option A	Collected trend data for chiller flow rate, supply and return temperature, and input demand (kW) Collected chilled water and condenser water pump demand and speed, cooling tower fan demand and speed, and coincident outside air conditions (all collected by the site metering system).	Six months to one year (depending on trending data point)	Hourly model with TMY3 temperature data and parameters from trend data
25	[Redacted]	Process	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for VFD air compressor, two air dryers, and two cooling tower pumps. Collected trend data of total input power (kW) for two 900-hp air compressors (trended on site metering equipment)	Two weeks	Engineering equations with parameters from metered data
26	[Redacted]	Lighting	IPMVP Option A	Monitored light circuits affected by the retrofit (64 loggers total)	Three weeks	Engineering equations with parameters from metered data
27	[Redacted]	Process	IPMVP Option A	Collected voltage, average current (Amps), average power (kW), and power factor for VFD air compressor Collected spot measurements of airflow and temperature for heat recovery duct	Two weeks	Engineering equations with parameters from metered data

Site ID	Participant	Project Type	M&V Plan Summary	Measurements Taken	Monitoring Duration	Calculations
28	[Redacted]	HVAC	IPMVP Options A and D	Collected billing data (monthly kWh and demand) for January 2011 to the present and confirmed trending capability in the energy management System Monitored the operation of supply fans, compressors, economizers, chilled water pumps, carbon dioxide levels, and outdoor air temperature and relative humidity for a sample of buildings	Three weeks	Comparison of pre- and post-retrofit models calibrated based on building/equipment monitoring data
29	[Redacted]	Lighting	IPMVP Option A	Monitored lighting fixture operating hours in offices, manufacturing, and warehouse areas	Three weeks	Engineering equations with parameters from metered data

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Appendix D. Sampled Participant Detailed Results

Table 16 lists the average annual realization rates by project type for the sampled participants. Table 17 lists a summary of the specific findings from each project in the sample. Highlighted cells signify calculated or otherwise determined to be outliers for energy, coincident peak or non-coincident peak demand realization rate analyses.

Table 16. Gross Savings and Realization Rate Results by Sampled Participant

Site	Participant*	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Expected	Evaluated	RR	Expected	Evaluated	RR	Expected	Evaluated	RR
1	[Redacted]	HVAC	12,700	29,757	234%	29.20	28.70	98%	28.67	24.80	87%
2	[Redacted]	Lighting	1,454,592	1,523,258	105%	165.96	173.89	105%	166.05	273.15	164%
3	[Redacted]	Lighting	31,575	21,499	68%	10.40	9.52	92%	10.40	9.52	92%
4	[Redacted]	Process	2,885,315	2,670,198	93%	329.22	656.30	199%	329.40	673.60	204%
5	[Redacted]	Process	1,239,992	994,346	80%	141.47	113.50	80%	141.55	99.00	70%
6	[Redacted]	HVAC	2,618,060	2,444,156	93%	511.51	279.01	55%	416.96	414.26	99%
7	[Redacted]	Lighting	1,625,075	2,056,890	127%	185.41	247.80	134%	185.52	243.10	131%
8	[Redacted]	Process	135,308	131,758	97%	22.12	15.00	68%	22.12	20.80	94%
9	[Redacted]	Lighting	1,734,359	1,968,028	113%	106.56	224.66	211%	486.00	611.54	126%
10	[Redacted]	Lighting	1,412,989	715,665	51%	98.65	310.40	315%	310.35	55.90	18%
11	[Redacted]	HVAC	6,299,172	3,187,362	51%	1,339.50	11.30	1%	10.80	11.30	105%
12	[Redacted]	HVAC	1,909,006	812,169	43%	122.70	92.71	76%	2.45	4.87	199%
13	[Redacted]	Lighting	2,369,488	2,633,883	111%	32.75	300.67	918%	-	-	N/A
14	[Redacted]	Lighting	337,186	375,738	111%	55.82	69.02	124%	55.82	69.02	124%
15	[Redacted]	Lighting	490,520	578,518	118%	55.97	66.00	118%	56.00	66.00	118%
16	[Redacted]	Lighting	1,476,280	1,067,046	72%	156.10	121.81	78%	240.88	270.78	112%
17	[Redacted]	Lighting	1,396,127	235,845	17%	96.05	26.92	28%	398.28	57.56	14%
18	[Redacted]	Lighting	21,696	13,750	63%	4.68	5.38	115%	4.68	3.28	70%
19	[Redacted]	Lighting	469,064	(54,834)	-12%	39.11	(6.26)	-16%	-	-	N/A
20	[Redacted]	Lighting	488,514	359,800	74%	38.38	41.07	107%	160.89	80.60	50%
21	[Redacted]	Lighting	2,812,620	3,217,635	114%	361.26	433.86	120%	361.42	395.32	109%

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Site	Participant*	Project Type	kWh Savings			NCP kW Savings			CP kW Savings		
			Expected	Evaluated	RR	Expected	Evaluated	RR	Expected	Evaluated	RR
22	[Redacted]	Process	402,674	412,822	103%	35.90	36.30	101%	47.55	36.30	76%
23	[Redacted]	Process	142,073	123,252	87%	20.80	14.10	68%	20.80	19.40	93%
24	[Redacted]	HVAC	2,914,790	1,996,787	69%	253.20	227.97	90%	233.67	137.09	59%
25	[Redacted]	Process	7,087,680	3,770,573	53%	809.13	430.43	53%	775.46	430.43	56%
26	[Redacted]	Lighting	7,901,837	7,269,128	92%	901.55	958.98	106%	902.05	916.26	102%
27	[Redacted]	Process	494,116	618,587	125%	69.69	78.30	112%	55.71	53.00	95%
28	[Redacted]	HVAC	4,602,694	2,104,233	46%	689.00	309.00	45%	414.35	921.00	222%
29	[Redacted]	Lighting	472,663	627,232	133%	68.31	71.60	105%	76.46	114.45	150%

* Note that participant names will be redacted in the public version of the report.

Highlighted cells signify applications calculated or otherwise determined to be outliers for energy, coincident peak or non-coincident peak demand realization rate analyses.

Table 17. Findings Summary by Sampled Participant

Site	Participant*	Project Type	kWh RR	CP RR	Findings Summary
1	[Redacted]	HVAC	234%	87%	The application calculations had underestimated the savings. Though the evaluated energy savings were greater than initially estimated, the reduction in energy use amounted to less than 2% of the building's annual energy consumption.
2	[Redacted]	Lighting	105%	164%	The evaluated energy savings and demand reduction were close to those originally estimated. One of the installed fixture types had a higher input wattage than expected, but the operating hours with controls were less than expected.
3	[Redacted]	Lighting	68%	92%	While the demand reduction realization rates were close to 100%, the hours of use were not accurately estimated in the application saving calculations, resulting in a reduction in energy savings compared to expected savings.
4	[Redacted]	Process	93%	204%	The evaluated energy savings were close to those expected, and the evaluated demand reduction was close to those proposed in the program participation application (but more than the savings expected by DEC).
5	[Redacted]	Process	80%	70%	The evaluated energy savings were less than those expected because the average metered demand for the compressed air system was 10% higher than expected.

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Site	Participant*	Project Type	kWh RR	CP RR	Findings Summary
6	[Redacted]	HVAC	93%	99%	The evaluated energy savings were less than originally estimated because the cooling tower fans use more energy than the pre-retrofit case (to provide more area for heat transfer).
7	[Redacted]	Lighting	127%	131%	HVAC interactive effects were not included in the projected and expected saving estimates.
8	[Redacted]	Process	97%	94%	The evaluated energy savings and peak demand reduction were close to those expected because the metered demand data closely matched data collected for the application saving calculations.
9	[Redacted]	Lighting	113%	126%	HVAC interactive effects were not included in the projected and expected saving estimates.
10	[Redacted]	Lighting	51%	18%	The evaluated energy savings were less than those expected because the metered lighting fixture operating hours were less than expected. The peak demand reduction is less than expected because the metered data revealed that the lighting fixtures only operate during a portion of the peak coincident period.
11	[Redacted]	HVAC	51%	105%	The evaluated energy savings realization rates are low due to the fact that many of the monitored units showed no signs of economizing during the logging period. There is an apparent clerical error in the reported non-coincident peak expected demand reduction in the DEC program tracking database, which is much higher than the coincident peak expected savings.
12	[Redacted]	HVAC	43%	199%	The project contacts provided trend data for month of July only and did not permit third party metering. The trend data did not indicate economizer operation, but July is not typically an economizer month. Due to lack of data during economizer season, project was removed from sample.
13	[Redacted]	Lighting	111%	N/A	The evaluated energy savings and demand reduction were higher than expected due to higher operating hours, and because the metered input wattage for one of the fixture types was 5% less than expected in the original study.
14	[Redacted]	Lighting	111%	124%	The evaluated energy savings and demand reduction were higher than originally estimated because HVAC interactive effects were not included in the original savings estimates.

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Site	Participant*	Project Type	kWh RR	CP RR	Findings Summary
15	[Redacted]	Lighting	118%	118%	The evaluated energy savings and demand reduction were higher than originally estimated because refrigeration system interactive effects were not included in the original savings estimates.
16	[Redacted]	Lighting	72%	112%	The evaluated energy savings were less than originally estimated due to a decrease in projected annual operating hours based on metered data.
17	[Redacted]	Lighting	17%	14%	The evaluated energy savings and peak demand reduction were less than originally estimated due to an inappropriate baseline that was used in the original analysis.
18	[Redacted]	Lighting	63%	70%	The evaluated energy savings and peak demand reduction were less than originally estimated due to a decrease in projected annual operating hours based on metered data.
19	[Redacted]	Lighting	-12%	N/A	The evaluation resulted in an energy penalty because there were more fixtures on emergency circuits than expected, fewer exterior parking lot pole fixtures than expected, higher operating hours for exterior fixtures than expected, and less aggressive zone control schedules than the pre-retrofit system.
20	[Redacted]	Lighting	74%	50%	The evaluated energy savings and peak demand reduction were less than originally estimated because the projected annual operating hours are 26% less than expected based on the metered data.
21	[Redacted]	Lighting	114%	109%	The evaluated energy savings and demand reduction were higher than expected due to higher operating hours than expected.
22	[Redacted]	Process	103%	76%	The evaluated savings were very close to expected savings, while coincident peak demand reduction fell slightly short of the estimate due to the molding machine's metered operating kW being higher than originally estimated.
23	[Redacted]	Process	87%	93%	The evaluated energy savings and demand reduction were less than originally estimated due to fewer annual operating hours than originally expected.
24	[Redacted]	HVAC	69%	59%	The evaluated energy savings and demand reduction were less than originally estimated because the original analysis did not account for load growth. The data center will not reach full capacity for a few years. The evaluation team accounted for the present value energy savings and demand reduction at full capacity by factoring in a discount rate of 7.09%.

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Site	Participant*	Project Type	kWh RR	CP RR	Findings Summary
25	[Redacted]	Process	53%	56%	The evaluated energy savings and peak demand reduction were less than originally estimated because the installed compressors have a lower performance than originally expected, and the original analysis contained minor errors that had a significant impact on overall savings.
26	[Redacted]	Lighting	92%	102%	The evaluated savings were very close to expected savings.
27	[Redacted]	Process	125%	95%	The evaluated energy savings were higher than originally estimated because the average metered demand was 18% less than expected. The peak demand reduction was slightly less than expected in the original study.
28	[Redacted]	HVAC	46%	222%	The low energy realization rate is mostly due to the fact that the controls energy conservation measure (ECM), which most buildings implemented, does not operate as anticipated to reduce energy use. The high coincident peak demand realization rate is mainly due to the fact that the demand reduction from the VFD ECM is much higher than projected. Typically, a VFD is not expected to reduce peak demand; however, in this case, the air handling unit supply fans appear to be significantly oversized. Even during peak cooling conditions, the fans only need to run at around 60% of full speed. As a result, the peak demand reduction is considerably higher than would normally be expected for the VFD ECM.
29	[Redacted]	Lighting	133%	150%	The evaluated energy savings and demand reduction were higher than originally estimated because the input wattages for the installed fixtures are lower than expected and the original analysis did not account for HVAC interactive effects.

* Note that participant names will be redacted in the public version of the report.

Highlighted cells signify applications calculated or otherwise determined to be outliers for energy, coincident peak or non-coincident peak demand realization rate analyses.

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Appendix E. Freeridership Questions

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Appendix F. Site Measurement and Verification Reports – Full Customer Detail

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Progress & Duke Energy Carolinas

Energy Efficient Lighting & Retail LED Programs

Evaluation Report – Final

April 6, 2018

Opinion Dynamics

Contributors

Tami Buhr
Vice President, Opinion Dynamics

Kessie Avseikova
Director, Opinion Dynamics

Katherine Randazzo
Senior Director, Opinion Dynamics

Kai Zhou
Managing Consultant, Opinion Dynamics

Dan Chen
Senior Consultant, Opinion Dynamics

Evan Tincknell
Consultant, Opinion Dynamics

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Table of Contents

Opinion Dynamics

Table of Tables

Opinion Dynamics

Opinion Dynamics

Table of Figures

1. Evaluation Summary

This report provides results of a comprehensive process and impact evaluation of two distinct programs: the Duke Energy Progress (DEP) Energy Efficient Lighting (EEL) program and the Duke Energy Carolinas (DEC) Retail LED program. The program periods under evaluation are January 1, 2016 through March 12, 2017 for the DEP EEL program and March 21, 2016 through March 12, 2017 for the DEC Retail LED program. We refer to these periods as PY2016–2017 throughout the remainder of this evaluation report.

1.1 Program Summary

1.1.1 The DEP EEL Program

DEP launched the EEL program in January 2010, with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. DEP partners with retailers and manufacturers across North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR® fixtures, with a wide range of products across these technologies. Participating retailers include a variety of channel types, including Big Box, Do-It-Yourself (DIY), Club, and Discount stores.

DEP manages the EEL program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the EEL program on behalf of DEP since 2010.

The program period under evaluation includes bulb sales invoiced from January 1, 2016 through March 12, 2017. Over this period, DEP discounted more than 3.6 million lighting products, achieving 140,215 MWh in ex ante energy savings, 23.0 MW in ex ante summer peak demand savings, and 7.1 MW in ex ante winter peak demand savings. Table 1-1 provides a summary of DEP EEL program sales and savings achievements.

Table 1-1. DEP EEL Program Sales and Savings Summary

Metric	Performance
Bulbs	3,627,458
Ex ante energy savings (MWh)	140,215
Ex ante summer peak demand savings (MW)	23.0
Ex ante winter peak demand savings (MW)	7.1

Source: Opinion Dynamics analysis of program tracking data.

1.1.2 DEC Retail LED Program

DEC launched the Retail LED program in March 2016 with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. DEC partners with retailers and manufacturers across North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, along with ENERGY STAR LED fixtures. Participating retailers include a variety of channel types, including Big Box, DIY, Club, and Discount stores.

DEC manages the Retail LED program and is responsible for overseeing program design, marketing, and operations. Ecova implements the program on DEC's behalf.

The program period under evaluation includes bulb sales from March 21, 2016 through March 12, 2017. Over this period, DEC discounted more than 1.3 million lighting products, achieving 52,602 MWh in claimed/ex ante energy savings, 8.8 MW in ex ante summer peak demand savings, and 2.6 MW in ex ante winter peak demand savings. Table 1-2 provides a summary of DEC Retail LED program sales and savings achievements.

Table 1-2. DEC Retail LED Program Sales and Savings Summary

Metric	Performance
Bulbs	1,385,056
Ex ante energy savings (MWh)	52,602
Ex ante summer peak demand savings (MW)	8.8
Ex ante winter peak demand savings (MW)	2.6

Source: Opinion Dynamics analysis of program tracking data.

1.2 Evaluation Objectives and High-Level Findings

1.2.1 Evaluation Objectives

The 2017 evaluation of both the DEP EEL and DEC Retail LED programs included process, impact, and market assessment components and addressed several major research objectives:

- Assess program performance and estimate gross and net energy (kWh) and summer and winter peak demand (kW) savings associated with program activity
- Assess program implementation processes and marketing strategies and identify opportunities for improvement
- Better understand the quickly shifting lighting market and customer lighting use

To achieve these research objectives, the evaluation team completed a range of data collection and analytic activities, including interviews with program staff, a review of deemed savings, program tracking data analysis, a residential lighting logger study, retailer shelf audits, interviews with manufacturer and retailer staff, geographic information system (GIS) analysis to estimate leakage, sales data modeling, and an impact analysis. Table 1-3 provides an overview of the evaluation activities, the scope of each, the research area that each activity supported, and an overview of the activity's purpose.

Table 1-3. Overview of Evaluation Activities

#	Evaluation Activity	Scope: DEP EEL Program	Scope: DEC Retail LED Program	Impact	Process	Market	Purpose
1	Program staff interviews	n=2			X		• Provide insight into program design and delivery
2	Deemed savings review	All data provided		X			• Review completeness, accuracy, and consistency of data and ex ante savings assumptions
3	Materials review	All materials provided			X		• Provide insight into program design and delivery
4	Program tracking data analysis	All data provided		X	X	X	• Calculate gross energy and demand savings • Understand program footprint, measure mix, retailer mix, and incentive levels
5	Residential lighting logger study	n=107		X	X	X	• Estimate hours of use (HOU), coincidence factors (CFs), and in-service rates (ISRs) for LEDs installed in customer homes • Assess lighting composition and use among residential customers with LEDs
6	Retailer shelf audits	n=15	n=15	X	X	X	• Assess shelf space distribution for general service and reflector products • Estimate baseline wattage adjustments • Provide program marketing insight
7	Retailer and manufacturer interviews	n=21	n=21	X	X	X	• Estimate net-to-gross ratio (NTGR) • Provide insight into program delivery and the current and future lighting market
8	Sales data modeling	All data provided		X			• Estimate NTGR
9	Leakage analysis	All data provided		X			• Estimate leakage rate

Source: Opinion Dynamics analysis.

1.2.2 DEP EEL Program High-Level Findings and Recommendations

The DEP EEL program realized 89% of the gross energy savings, 95% of the gross summer peak demand savings, and 113% of the gross winter peak demand savings. Table 1-4 provides a summary of the program's gross impacts by savings type and sector. As can be seen in the table, the program achieved 125,001,897 kWh in ex post energy savings, 21,962 kW in summer peak demand savings, and 8,066 kW in winter peak demand savings.

Table 1-4. DEP EEL Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	109,576,023	97,829,373	89%
	Commercial savings	30,639,454	27,172,524	89%
	Total	140,215,477	125,001,897	89%
Summer peak demand savings (kW)	Residential savings	15,796	15,503	98%
	Commercial savings	7,215	6,458	90%
	Total	23,011	21,962	95%
Winter peak demand savings (kW)	Residential savings	5,246	6,412	122%
	Commercial savings	1,880	1,654	88%
	Total	7,126	8,066	113%

Source: Opinion Dynamics analysis of program tracking data.

Opinion Dynamics used sales data modeling and interviews with program participating retailers and manufacturers to estimate program NTGR. The analysis resulted in the program-level NTGR of 0.40. Applying this NTGR to the ex post gross savings resulted in net energy savings of 50,001 MWh, net summer peak demand savings of 8.8 MW, and net winter peak demand savings of 3.2 MW.

Table 1-5. DEP EEL Program Ex Post Net Savings

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	140,215	125,002	0.40	50,001	89%
Summer peak demand savings (MW)	23.0	22.0	0.40	8.8	95%
Winter peak demand savings (MW)	7.1	8.1	0.40	3.2	113%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 744 unique products across 289 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[1] divide the adjusted number of program bulbs by the total number of residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use. The program continued efforts to reach underserved customer segments and sockets by maintaining a relatively high share of sales through the Dollar/Discount channel (which attracts lower-income shoppers) and increased its focus on specialty products (standard bulb sales decreased by 8% between PY2015 and PY2016–2017).

[1] Assuming a 5-year expected useful life (EUL) for a CFL.

The transformation of the lighting market in the DEP jurisdiction continued at an accelerated pace. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves in the DEP jurisdiction, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, the shelf space dedicated to LEDs grew from 38% to 57%.

Additionally, LED prices have decreased dramatically over time. More specifically, based on the shelf audit research we conducted in 2014 and 2016 in DEP, standard LED prices dropped from $14.65 per bulb to $4.68, which represents a 68% drop in price. Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. These decreasing prices made LEDs more affordable and accessible to the broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs ineligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated by the energy-efficient lighting penetration in the DEP jurisdiction: nearly 9 in 10 DEP customers (88%) reported having CFLs or LEDs in their homes and 42% reported having LEDs in their homes.

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are scheduled to take effect in 2020 with the second phase of the Energy Independence and Security Act (EISA) of 2007, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEP EEL program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase the program's focus on underserved customer segments. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting of specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage specialty products, and by adjusting program marketing and messaging to focus on underserved sockets and increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion.

1.2.3 DEC Retail LED Program High-Level Findings and Recommendations

The DEC Retail LED program realized 110% of the gross energy savings, 121% of the gross summer peak demand savings, and 155% of the gross winter peak demand savings. Table 1-6 provides a summary of the program's gross impacts by savings type and sector. As can be seen in the table, the program achieved 57,846,855 kWh in energy savings, 10,676 kW in summer peak demand savings, and 4,045 in winter peak demand savings.

Table 1-6. DEC Retail LED Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	41,630,988	45,761,993	110%
	Commercial savings	10,971,300	12,084,862	110%
	Total	52,602,288	57,846,855	110%
Summer peak demand savings (kW)	Residential savings	6,002	7,543	126%
	Commercial savings	2,843	3,132	110%
	Total	8,845	10,676	121%
Winter peak demand savings (kW)	Residential savings	1,993	3,359	169%
	Commercial savings	624	686	110%
	Total	2,617	4,045	155%

Source: Opinion Dynamics analysis of program tracking data.

Opinion Dynamics used sales data modeling and interviews with program participating retailers and manufacturers to estimate program NTGR. The analysis resulted in the program-level NTGR of 0.41. Applying this NTGR to the ex post gross savings resulted in net energy savings of 23,717 MWh, net summer peak demand savings of 4.4 MW, and net winter peak demand savings of 1.7 MW.

Table 1-7. DEC Retail LED Program Ex Post Net Savings

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	52,602	57,847	0.41	23,717	110%
Summer peak demand savings (MW)	8.8	10.7	0.41	4.4	121%
Winter peak demand savings (MW)	2.6	4.0	0.41	1.7	155%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 384 unique products across 300 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

The program made efforts to reach underserved customer segments and sockets by targeting Dollar/Discount retailers (which attract lower-income shoppers), and focusing on specialty products. In PY2016–2017, 44% of program participating storefronts were Dollar/Discount, and they accounted for 10% of program sales.

Shelf audits conducted over time in the neighboring DEP jurisdiction show that LED prices have decreased dramatically over time. More specifically, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68 in 2016, which represents a 68% drop in price.[2] Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. Average LED prices in the DEC jurisdiction, based on the results of the 2016 shelf audits, mimic DEP's, with the per-bulb price for standard LEDs averaging $4.87 and the per-bulb price for reflector LEDs averaging $7.01. These decreasing prices made LEDs more affordable and accessible to a broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs ineligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated in the energy-efficient lighting penetration in the DEC jurisdiction: based on the data collected as part of the Residential Lighting Logger study, more than 9 in 10 DEC customers (92%) reported having CFLs or LEDs in their homes and 33% reported having LEDs in their homes.[3]

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty product[4]s, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are scheduled to take effect in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEC Retail LED program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase focus on underserved customer segments. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and, if possible, increase targeting of specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage specialty products, and by adjusting program marketing and messaging to focus on underserved sockets and increase messaging relevance (such as specialty sockets in dining rooms).

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[2] Note that this analysis is based on the light bulbs of all wattages, including those not discounted through the DEC Retail LED program.

[3] Note that these results include LED penetration across lighting products of all wattages, and not just the wattages discounted through the program.

[4] Specialty products include lighting products designed for specialty applications, such as three-way, candelabra, globe, etc.

- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion

2. Program Descriptions

This section provides an overview of the design, implementation, and performance of the Duke Energy Progress (DEP) Energy Efficient Lighting (EEL) program and the Duke Energy Carolinas (DEC) Retail LED program. We discuss each program separately. The program periods under evaluation are January 1, 2016 through March 12, 2017 for the DEP EEL program and March 21, 2016 through March 12, 2017 for the DEC Retail LED program. We refer to these periods as PY2016–2017 throughout the remainder of this evaluation report.

2.1 The DEP EEL Program

2.1.1 Program Design

DEP launched the EEL program in January 2010, with the goal of reducing energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. The program addresses two key barriers to the purchase of efficient lighting: (1) the higher prices of CFLs and LEDs compared to incandescent and halogen bulbs and (2) customer awareness and knowledge of the benefits of efficient lighting. DEP partners with retailers and manufacturers across its service territory in North and South Carolina to provide price markdowns on customer purchases of efficient lighting products. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR® fixtures, with a wide range of products across these technologies. Participating retailers represent a variety of retail channels, including Big Box, Do-It-Yourself (DIY), Club, and Discount stores.

2.1.2 Program Implementation

DEP manages the EEL program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the EEL program on behalf of DEP since 2010. Ecova is responsible for communicating directly with participating manufacturers and retailers, obtaining and processing program sales data, training retailer staff, and promoting program products through in-store demonstration events and point-of-purchase (POP) marketing materials.

2.1.3 Program Performance

In PY2016–2017, DEP discounted more than 3.6 million lighting products through the EEL program, achieving 140,215 MWh in claimed/ex ante energy savings, 23.0 MW in ex ante summer peak demand savings, and 7.1 MW in ex ante winter peak demand savings. Table 2-1 provides a summary of PY2016–17 achieved sales and ex ante savings.

Table 2-1. DEP EEL Program Sales and Savings Summary

Metric	Performance
Bulbs	3,627,458
Ex ante energy savings (MWh)	140,215
Ex ante summer peak demand savings (MW)	23.0
Ex ante winter peak demand savings (MW)	7.1

Source: Opinion Dynamics analysis of program tracking data.

Table 2-2 provides a summary of the product mix discounted through the program during PY2016–2017. For the first time in its history, the program sold more LEDs than CFLs (67% vs. 33%). Standard bulbs accounted for more than two-thirds of all bulbs sold (71%). Close to a third (31%) of all sales and 95% of CFL sales were standard CFL products, while 40% of all sales and 60% of all LEDs sales were standard LED products.

Table 2-2. DEP EEL Program Ex Ante Savings by Product Type

Measure Type	Reported Bulbs		Ex Ante Energy Savings (kWh)		Ex Ante Summer Peak Demand Savings (kW)		Ex Ante Winter Peak Demand Savings (kW)	
	Bulbs	**% of Total Sales**	**kWh Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**
LEDs	2,435,583	67%	91,221,854	65%	15,342	67%	4,539	64%
LED Standard	*1,434,774*	*40%*	*52,590,526*	*38%*	*8,847*	*38%*	*2,617*	*37%*
LED Specialty	*301,077*	*8%*	*8,873,879*	*6%*	*1,493*	*6%*	*442*	*6%*
LED Reflector	*502,385*	*14%*	*23,290,579*	*17%*	*3,918*	*17%*	*1,159*	*16%*
LED Fixture	*197,347*	*5%*	*6,466,871*	*5%*	*1,084*	*5%*	*321*	*5%*
CFLs	1,191,875	33%	48,993,623	35%	7,669	33%	2,588	36%
CFL Standard	*1,133,010*	*31%*	*45,586,662*	*33%*	*7,136*	*31%*	*2,408*	*34%*
CFL Specialty	*1,572*	*0%*	*55,333*	*0%*	*9*	*0%*	*3*	*0%*
CFL Reflector	*7,684*	*0%*	*295,166*	*0%*	*46*	*0%*	*16*	*0%*
CFL Fixture	*49,609*	*1%*	*3,056,461*	*2%*	*478*	*2%*	*161*	*2%*
Total	3,627,458	100%	140,215,477	100%	23,011	100%	7,126	100%

Source: Opinion Dynamics analysis of program tracking data.

2.2 DEC Retail LED Program

2.2.1 Program Design

DEC launched the Retail LED program in March 2016 with the goal of reducing electric energy consumption and peak demand through increased awareness and adoption of energy-efficient lighting technologies. The program addresses two key barriers to the purchase of efficient lighting: (1) the higher prices of LEDs compared to less energy-efficient alternatives, such as incandescents and halogens, and (2) customer awareness and knowledge of the benefits of efficient lighting. DEC partners with retailers and manufacturers across its service territory in North and South Carolina to provide price markdowns on customer purchases of efficient lighting. The program promotes customer awareness and purchase of program-discounted products through a range of marketing and outreach strategies, including in-store collateral and events, bill inserts, direct mail and email marketing, mass media advertising, online advertising, and community events. The program also provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, along with ENERGY STAR fixtures, with a wide range of products across these technologies. The program product mix did not include 60-watt and 75-watt equivalents, as those products are discounted through DEC's Free LED program. Participating retailers represent several retail channels, including Big Box, DIY, Club, and Discount stores.

2.2.2 Program Implementation

DEC manages the Retail LED program and is responsible for overseeing program design, marketing, and operations. Ecova has implemented the Retail LED program on behalf of DEC since the program's inception in early 2016. Ecova is responsible for communicating directly with participating manufacturers and retailers, obtaining and processing program sales data, training retailer staff, and promoting program products through in-store demonstration events and POP marketing materials.

2.2.3 Program Performance

In PY2016–2017, DEC discounted more than 1.3 million lighting products, achieving 52,602 MWh in claimed/ex ante energy savings, 8.8 MW in ex ante summer peak demand savings, and 2.6 MW in ex ante winter peak demand savings. Table 2-3 provides a summary of PY2016–2017 sales and savings achievements.

Table 2-3. DEC Retail LED Program Sales and Savings Summary

Metric	Performance
Bulbs	1,385,056
Ex ante energy savings (MWh)	52,602
Ex ante summer peak demand savings (MW)	8.8
Ex ante winter peak demand savings (MW)	2.6

Source: Opinion Dynamics analysis of program tracking data.

Table 2-4 provides a summary of the product mix discounted through the DEC Retail LED program during the current evaluation period. Reflector bulbs accounted for 40% of bulbs sold, making up the largest share of program sales during the period. Standard LEDs comprised 24% of all sales, specialty LEDs 21%, and LED fixtures 16%.

Table 2-4. DEC Retail LED Program Ex Ante Savings by Product Type

Measure Type	Reported Bulbs		Ex Ante Energy Savings (kWh)		Ex Ante Summer Peak Demand Savings (kW)		Ex Ante Winter Peak Demand Savings (kW)	
	Bulbs	**% of Total Sales**	**kWh Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**	**kW Savings**	**% of Total Savings**
LED Standard	325,547	24%	11,932,672	23%	2,007	23%	594	23%
LED Specialty	290,875	21%	8,573,616	16%	1,442	16%	427	16%
LED Reflector	548,207	40%	24,872,820	47%	4,184	47%	1,238	47%
LED Fixture	220,427	16%	7,223,180	14%	1,210	14%	359	14%
Total	1,385,056	100%	52,602,288	100%	8,845	100%	2,617	100%

Source: Opinion Dynamics analysis of program tracking data.

3. Key Research Objectives

Opinion Dynamics' evaluation of the DEP EEL and DEC Retail LED programs included process, impact, and market assessment components. For each program, the key evaluation objectives were identical and consisted of the following:

- Assess program performance and estimate net energy (kWh) and summer and winter peak demand (kW) savings associated with program activity
- Assess program implementation processes and marketing strategies and identify opportunities for improvement
- Understand customer awareness, preferences, purchasing behaviors, and lighting market dynamics

We designed our evaluation tasks based on the following impact-related research objectives:

- Estimate program ex post gross energy and demand savings
- Estimate program ex post net energy and demand savings
- Develop updated leakage rate reflecting the share of program-discounted bulbs sold to other utilities' customers
- Develop updated residential LED in-service rates (ISRs), hours of use (HOU), summer peak coincidence factor (summer CF), and winter peak coincidence factor (winter CF)

Through our evaluation, we examined the following process-related questions:

- How effective are the program implementation and data tracking practices?
- How effective are the program marketing, outreach, and educational tactics?
- Are retailers and manufacturers satisfied with the programs?
- What are the strengths, weaknesses, and opportunities for program improvement?
- How, if at all, have retailer stocking and sales practices changed?
- What lighting technologies do customers have in their homes?
- How does energy-efficient lighting penetration vary by customer type?
- How does lighting usage vary by customer type and room type?
- What are current and future trends in the lighting market, including retailer stocking practices and customer preferences and purchasing decisions?

4. Overview of Evaluation Activities

To answer the research questions listed in the previous section, Opinion Dynamics performed a range of data collection and analytical activities. The activities were identical for both the DEP EEL and DEC Retail LED programs. Table 4-1 provides a summary of evaluation activities and the areas of inquiry each helped address. Following the table, we provide details on each activity's scope, sampling approach, and timing as applicable.

Table 4-1. Overview of Evaluation Activities

#	Evaluation Activity	Scope: DEP EEL Program	Scope: DEC Retail LED Program	Impact	Process	Market	Purpose
1	Program staff interviews	n=2			X		• Provide insight into program design and delivery
2	Deemed savings review	All data provided		X			• Review completeness, accuracy, and consistency of data and ex ante savings assumptions
3	Materials review	All materials provided			X		• Provide insight into program design and delivery
4	Program tracking data analysis	All data provided		X	X	X	• Calculate gross energy and demand savings • Understand program footprint, measure mix, retailer mix, and incentive levels
5	Residential lighting logger study	n=107		X	X	X	• Estimate HOU, CFs, and ISRs for LEDs installed in customer homes • Assess lighting composition and use among residential customers with LEDs
6	Retailer shelf audits	n=15	n=15	X	X	X	• Assess shelf space distribution for general service and reflector products • Estimate baseline wattage adjustments • Provide program marketing insight
7	Retailer and manufacturer interviews	n=21	n=21	X	X	X	• Estimate net-to-gross ratio (NTGR) • Provide insight into program delivery and the current and future lighting market
8	Sales data modeling	All data provided		X			• Estimate NTGR
9	Leakage analysis	All data provided		X			• Estimate leakage rate

Source: Opinion Dynamics analysis.

4.1 Program Staff Interviews

Opinion Dynamics completed two interviews with program staff at Duke Energy. We completed one interview in July 2016 and another in May 2017. Each interview covered both the DEP EEL and DEC Retail LED programs. For each program, the interviews explored, among other topics, program performance; changes in program design and implementation; participating retailer, product, and incentive mix; data-tracking and communication processes; and outlooks for future program planning.

4.2 Deemed Savings Review

In support of the impact evaluation, for each program, Opinion Dynamics completed a review of the energy savings assumptions used to estimate energy and peak demand savings. As part of this process, we also reviewed preliminary program sales data extracts and offered feedback to program staff regarding data quality and completeness. The objectives of the review were to identify and review the deemed savings values used for ex ante impacts and to check program sales data for any gaps, omissions, inconsistencies, or errors.

4.3 Materials Review

Opinion Dynamics conducted a review of program materials and data for each program, including marketing plans and materials, program planning documents, weekly field reports, and past evaluation reports and studies.

4.4 Program Tracking Data Analysis

Opinion Dynamics reviewed and assessed the sales data extracts for each program. Analyses included:

- Identifying any data gaps, omissions, inconsistencies, or errors, and correcting them as needed
- Summarizing program design and performance based on product mix, retailer mix, and incentive levels
- Analyzing sales trends over time, by geography and by retailer (specifically for the DEP EEL program)

4.5 Residential Lighting Logger Study

Opinion Dynamics completed a lighting logger study among DEP and DEC residential customers who had LED bulbs installed. The key goal of the study was to estimate HOU and CFs for LEDs. As part of the study, we also developed updated estimates of LED ISRs and collected valuable data on lighting penetration and saturation levels in each jurisdiction, which allowed us to assess and characterize lighting usage in customer homes in DEP and DEC jurisdictions.

4.5.1 Sample Design and Fielding

For purposes of this study, eligible customers were defined as DEP and DEC residential customers who have at least one LED installed in conditioned spaces. Because the data on the presence of LEDs are not readily available, data collection for the study consisted of two distinct activities:

- **Recruitment survey:** To identify and recruit eligible residential customers for the study

- **On-site visits:** To collect data on lighting products in use and to deploy and retrieve lighting logger equipment

We drew the sample for this study from the population of DEP and DEC residential customers provided by Duke Energy. We cleaned the customer data to remove duplicate records, customer records with no contact information, and customer records with a "do not contact" designator. We stratified the sample by jurisdiction and geographic region. We drew the sample in proportion to the share of customers in each jurisdiction and geographic region, with the goal of ensuring adequate representation of the customers from each jurisdiction and robust geographic coverage.

Identifying and recruiting customers with LEDs installed can be costly when administered over the phone, because it requires calling and screening a large number of ineligible customers. To achieve maximum efficiencies in the recruitment process, we recruited customers online as well as over the phone. We sent email invitations to participate to customers for whom we had email addresses, and called customers for whom we only had telephone numbers. To further increase the efficiency of the recruitment process, we oversampled customers with email addresses and administered a larger share of recruitment online. Online recruitment is less disruptive to customers than recruitment over the phone, much less costly, can be administered faster, and offers the valuable benefit of supplementing survey questions with visual aids (e.g., pictures of LED bulbs and socket types) for easier recognition and more-accurate self-reported data.

As part of the recruitment process, we screened customers for the presence of LEDs. During recruitment, we collected valuable data on LED and CFL penetration for all customers we spoke with, as well as customers' sociodemographic and household characteristics. This data allowed us to develop a robust post-stratification approach and to inform the process analysis.

We followed up with eligible customers to schedule a time for a site visit. As part of each site visit, we conducted a lighting inventory, sampled fixtures for logging, and placed lighting loggers. We kept the loggers in place for approximately 6 months. After 6 months, we scheduled return visits, during which we removed lighting loggers and collected updated information on key variables of interest. Customers who qualified and agreed to participate in the lighting logger study received a $50 gift card upon completion of the logger deployment site visit and another $50 gift card upon completion of the logger retrieval visit.

Table 4-2 provides a summary of the sampling and recruitment process. As can be seen in the table, from the sample of 5,866 of DEP and DEC customers, we identified 526 eligible customers, recruited 323 customers, and completed site visits with 107 of those customers. We retrieved loggers from all 107 homes where we deployed them.

Table 4-2. Summary of Sampling and Recruitment

Sampling Step	DEP	DEC	Total
Population	1,395,369	1,739,789	3,135,158
Sample frame	1,113,646	1,367,567	2,481,213
Sample drawn	1,757	4,109	5,866
Eligible customers	201	325	526
Recruited customers	131	192	323
Completed deployment site visits	46	61	107
Completed logger retrieval*	46	61	107

Source: Opinion Dynamics analysis.
* This includes homes where customers sent loggers back to us in prepaid packages with a brief self-administered survey. A total of 11 homes sent loggers back to us in prepaid packages.

We completed recruitment and deployment site visits between March and June 2016, and retrieval visits between October and December 2016. Table 4-3 provides the final survey dispositions for the study.

Table 4-3. Lighting Logger Recruitment Disposition Summary

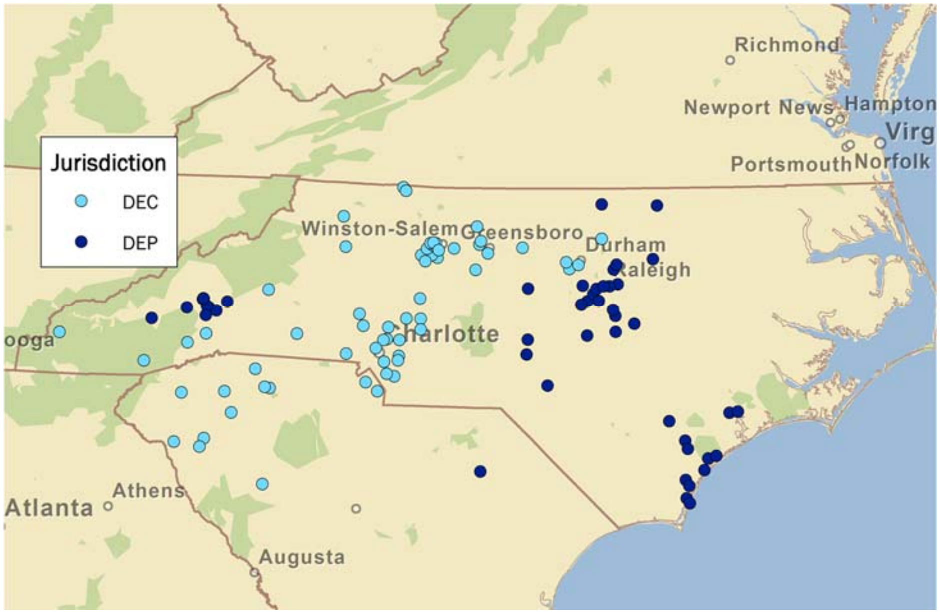
Disposition	Customers
Completed logger visit (I)	**107**
Eligible non-interviews (N)	**216**
Incomplete data	126
Recruited but site visit not completed	90
Survey ineligible household (X1)	**2,026**
Ineligible (no LEDs)	1,962
Does not live at address	55
Not a Duke Energy customer	9
Not eligible (X2)	**664**
Business number	65
Computer tone	18
Customer indicated called already	2
Disconnected phone/wrong email/phone number	579
Household with undetermined survey eligibility (U1)	**9,518**
Answering machine	863
Callback	243
Closed out of survey before completion	224
Did not open the online survey	7,034
Do not call list	31
Refusal	524
Alternative phone number	1
Language problems	57
Mid-interview terminate – do not call back	25
Not available	431
Recruited but unable to contact	85
Undetermined if eligible household (U2)	**411**
Busy tone	31
No answer	365
Privacy line/blocked number	15
Total customers in sample	*12,942*

Source: Opinion Dynamics analysis of the survey disposition data.

We calculated response rates using the Response Rate 3 (RR3) methodology specified by American Association of Public Opinion Research (AAPOR). The response rate for the lighting logger study was 6%.

Figure 4-1 illustrates the location of the 107 households that participated in the lighting logger study. As can be seen in the figure, the sample of homes adequately covered the DEP and DEC jurisdictions.

Figure 4-1. Distribution of Site Visits across DEP and DEC Jurisdictions



Source: Opinion Dynamics analysis of the site visit data.

4.5.2 Logger Deployment and Retrieval

As part of this study, we conducted an inventory of lighting products in all screw- or pin-based sockets (both medium screw-based and small screw-based sockets) located in both conditioned and unconditioned spaces (including outside).[5] We deployed loggers only on inside switches that control sockets with LEDs.

For logger deployment purposes, during the site visits, technicians classified rooms into seven following distinct room types[6]:

- Kitchen
- Living room
- Bedroom
- Bathroom
- Dining room
- Basement
- Other

For each room, technicians collected information on the total number of switches, switch controls, total number of light sockets controlled by each switch, lighting technology (CFL, LED, incandescent, halogen, empty socket), and bulb shape (twist, reflector, globe) in each socket. As part of the site visit, we also interviewed

[5] We excluded linear lighting from the inventory.

[6] Note that the list of room types for lighting inventory is more detailed and includes 16 unique room types.

homeowners and collected detailed data on their sociodemographic and household characteristics and lighting preferences.

To capture lighting usage, we used DENT loggers. We deployed up to seven loggers per home, one in each distinct room type. For homes with fewer than seven rooms with LEDs, we deployed more than one logger per room (but no more than three loggers per room) to increase the overall precision, as well as to use them as a backup loggers in case the need arose. Within each room and room type, we randomly selected the light switch to log in cases the room had multiple switches controlling LEDs. We placed lighting loggers only on switches that controlled at least one LED installed in a conditioned space. For each logger, we recorded the switch it was placed on and the count of light bulbs, by technology, it controlled. We also recorded a detailed description of the logger placement to aid in subsequent retrieval visits (e.g., light above master bathroom mirror).

To accurately capture lighting usage, we placed lighting loggers as close to the light source as possible, without compromising the aesthetics of the lighting. We recorded any instances when lighting loggers could not be placed on the desired fixture and the reasons why (e.g., accessibility, homeowner objections). In these cases, we selected alternative light fixtures for logger placement.

As part of the logger deployment process, we calibrated each logger's sensitivity setting to make sure it only captured lighting from the dedicated fixture and did not accidentally capture ambient sources of lighting, such as daylight.

Upon completion of the study, we removed the loggers using standard procedures for logger testing prior to removal, including state of light testing, and battery check prior to retrieval. We also conducted a closing interview with the homeowner about any changes in lighting usage over the course of the logging period.

4.5.3 Logger Data Preparation and Cleaning

We deployed a total of 314 loggers across 107 households. We were unable to retrieve a total of 7 loggers. To prepare the logger data for analysis, we performed a series of data-cleaning steps to ensure proper and reasonable logging. Those steps included:

- Identification and removal of corrupted/failed loggers: Initial review of the logger files identified loggers that were corrupted or failed to log the data properly. Corrupted/failed loggers consisted of those that: (1) did not contain any logs falling within the valid logging time frame (indicative of issues with logger clock calibration); (2) did not collect any data (indicative of the loggers not working properly); (3) contained logged data in stark contrast to self-reported socket usage, namely, loggers with no "on" time or very sporadically low "on" periods, while the homeowner reported the fixtures being always on or on most of the time. We identified 44 loggers that were corrupted/failed and therefore needed to be removed from further analysis.
- Logger date "trimming": This step was necessary to ensure that extraneous observations (i.e., logs) associated with logger placement, testing, and calibration were not a part of the analysis. Logger data were "trimmed" to remove all logs recorded "on" before the logger installation date, as well as on or after the logger retrieval day. To determine and validate deployment and retrieval dates, we used data recorded by the field staff as part of the deployment and retrieval process. For each logger, we trimmed the start date to be the first full day of logging and the end date to be the last full day of logging. For loggers received in the mail and therefore missing a clear indicator of the logging end period,[7] we carefully reviewed each individual logger's log patterns to determine an appropriate end date.

[7] Those loggers were removed and mailed to us by residents; thus, the retrieval process did not follow standard retrieval procedures.

Comparing the selected end date to the ship date of the package validated this assumption. We did not drop any loggers as a result of this step.

- Identification of loggers with short logging periods: Once "trimmed," we calculated logging periods for each logger. Some loggers may have failed or been removed by the residents during the early part of the logging period and therefore only contained logging data for a small fraction of the period. To increase the reliability of the HOU estimates, loggers logging for less than 1 month were excluded from the analysis. We identified one logger with a short logging period that needed to be removed from the analysis.
- Analysis of unexpected/suspicious usage patterns: To ensure proper operation of the loggers throughout the logging period, we performed an extensive analysis of logger usage patterns and flagged loggers with unusual or unexpected patterns for further review and validation. We explored a variety of patterns, including long "on" periods, long "off" periods and usage gaps, no "on" periods, and high variance in usage and usage changes over time. We did not identify any loggers with unexpected patterns and therefore did not drop any loggers from our analysis as a result of this step.
- Analysis of logger flickering: We thoroughly explored logger flickering and its impact on the HOU estimates. Logger flickering is caused by an external stimulus, such as sunlight or moisture interference. Flickering commonly manifests itself in short "flicks" or "on" and "off" periods. Flickering is generally difficult to identify and correct for because it is hard to determine whether the short-interval "on/off" periods are false positives or false negatives. We explored the impact logger flickering could have on average daily HOU by calculating, for each logger, the total number of logs that each logger recorded and normalizing the total number of logs to the days that the logger was in the field, thus arriving at an average number of logs per day. A high count of logs per day is usually indicative of loggers flickering. We then estimated the impact that potential logger flickering could have on the HOU estimates by summing for each logger every 1–10 second "on/off" period[8] and dividing them by the total number of days that the logger was deployed. The resulting number presents an upper bound of the impact that flickering has on the HOU estimates. The results of the analysis revealed that the impacts of the flickering issue on the estimation of the average daily HOU are negligible. As such, we did not make any adjustments to the logger data.

In the end, we deployed 314 loggers, of which 262 were used for the analysis (83%). Table 4-4 provides a summary of logger attrition.

Table 4-4. Logger Attrition Summary

Cut or Drop Decision	Loggers Affected		Sites Affected	
	#	%	#	%
Total deployed	314	100%	107	100%
Unusable loggers	52	17%	42	39%
Unable to retrieve	7	2%	5	5%
Corrupted/failed loggers	44	14%	36	34%
Less than 30 days of logging	1	<1%	1	1%
Total used in analysis	**262**	**83%**	**107**	**100%**

Source: Opinion Dynamics analysis of the logger data.

[8] 1–10 second "on" and "off" periods were determined as the most common "flicker" periods. This is a very conservative range because the 10-second "on/off" pattern is a very conceivable usage pattern for people to exhibit.

4.5.4 Post-Stratification

Lighting metering studies are involved and require time and effort on behalf of the customer. Certain customer types may be less likely to participate in such a study (e.g., those with higher incomes or those employed full-time). If the customers that are under- or overrepresented in our sample have different lighting usage patterns, the study results, namely HOU and CFs, will suffer from non-response error and will not be representative of the broader population.

As part of our analysis, Opinion Dynamics explored the presence of non-response bias in the site visit sample by comparing the study's site visit participants to the broader population on a range of observable characteristics associated with the lighting usage. Those include home type, homeownership status, age, income, education, household size, and employment status.

Only customers with LEDs were eligible for the lighting logger study, and the data on the sociodemographic and household characteristics of that population segment do not exist. To assess non-response bias, therefore, we made two comparisons:

- **Recruitment survey respondents to the general population of DEP and DEC customers.** As part of the recruitment survey, we collected sociodemographic and household information from both qualifying and non-qualifying customers. We compared the composition of the customers who responded to the recruitment survey to a broader population of DEP and DEC customers. We used the U.S. Census Bureau's 2010–2015 American Community Survey (ACS) data to obtain information on DEP and DEC customers. This comparison allowed us to assess the presence of the non-response bias in our recruitment effort. Aside from DEP customers being slightly underrepresented, the sample was well aligned with the population across a range of sociodemographic and household characteristics.
- **Sample of site visits to the eligible population of customers.** We compared the sociodemographic and household characteristics of the households that participated in the logger study with those of all customers eligible for the study, as determined through the recruitment survey. This comparison allowed us to assess whether customers who agreed to participate in the study were different from those who qualified but chose not to participate. We found that our site visit sample was skewed in terms of homeownership and home type, with renters and residents of multifamily properties being underrepresented. We also found that DEP customers were slightly underrepresented. As expected, HOU and other key variables of interest differed considerably across those groups.

Based on this analysis, we developed and applied post-stratification weights based on homeownership and jurisdiction to align the sample with the population. We did not weight the data by home type because home type is highly correlated with homeownership, and weighting the data by the latter automatically aligned the sample by the former. Table 4-5 summarizes the post-stratification weights that we applied.

Table 4-5. Lighting Logger Study Post-Stratification Weights

Jurisdiction	Homeownership	n	Weight
DEP	Own	41	1.0383
DEP	Rent	5	1.5645
DEC	Own	49	0.8439
DEC	Rent	12	1.2715

Source: Opinion Dynamics analysis of the site visit and logger data.

4.5.5 Hours of Use Annualization Process

Lighting logger studies that do not log usage during the entire year must employ an annualization process to adjust for changes in daylight hours that likely affect HOU. While this study did not cover the whole year, loggers were in place for most of the year, capturing data on usage during the spring, summer, and part of the fall. Such a considerable fielding period is likely to result in observed HOU estimates mimicking the annual values. In this case, using observed estimates will be appropriate, and even preferable, given the modeling uncertainty that the annualization process might introduce.

Before defaulting to the observed HOU estimates, however, we annualized the lighting usage data using an individual ordinary least squares (OLS) regression model. The model specification is provided in Equation 4-1.

Equation 4-1. Hours of Use Model Specification

$$Hd = \alpha + \beta sin(\theta d) + \varepsilon d$$

Where:

Hd = HOU on day d, starting with d=1 on January 1.

α = The intercept representing HOU when sin(θd)=0. Since average sin(θd) for the year is equal to zero by design, evaluating the model at the average declination angle leaves only the constant to estimate HOU; therefore, the intercept term is equal to average annualized HOU for each bulb.

β = Sine coefficient, or the difference between the HOU on the solstice and days with the average annual declination angle.

$Sin(\theta d)$ = Sine of the solar declination angle or day d converted to follow the change in the HOU and adjusted to fit the −1 to +1 interval with an average of zero for the year (for ease of analysis). The solar declination angle represents the latitude at which the sun is directly overhead at midday. We used the following formula to calculate the sine of the solar declination angle for each day of the year:

$$\sin(-\pi * 2 * (284+d)/365)$$

εd = Residual error

We fit sinusoid regression models separately for weekends and weekdays for each individual logger and then combined the results in proportion to the percent of weekends versus weekdays in a year. We analyzed each regression model for goodness of fit to determine if the individual bulb was sufficiently daylight-sensitive to justify regression-based annualization and to determine if the sinusoid model could provide a reliable estimate (i.e., the sinusoid model accurately represented trends in lighting use over time). Specifically, we looked at:

- Significance of the sine coefficient t-statistic. Loggers with a t-statistic lower than 1.282 or higher than −1.282 were flagged as “poor fit” (meaning that the solar declination angle is not significantly different from 0 at a 90% confidence level).
- Magnitude of the sine coefficient. Models that resulted in extremely high sine coefficients (absolute magnitude of seven or more) were flagged as “poor fit.”[9]

[9] In many of those cases, use changed dramatically during different periods of the study, and it was not possible to determine typical use. For example, lights may have stayed continuously on for a portion of the study, and then used intermittently.

- The value of the intercept. Models with the negative intercept were flagged as "poor fit."

If any of the parameters described above were true, we replaced the modeled HOU with non-annualized observed daily average HOU. As part of this exercise, we replaced 76% of modeled results with observed HOU estimates.

4.5.6 Coincidence Factor Estimation

CFs represent the fraction of time during the peak period that the light is on. We used the following definitions of peak periods in the CF calculations:

- Summer peak period: non-holiday weekday, during the months of June–August, between the hours of 3pm and 5pm
- Winter peak period: non-holiday weekday, during the months of December–February, between the hours of 7am and 9am

Because loggers were in the field for the entire duration of the summer peak period, annualization of the lighting usage was not necessary. Therefore, we relied on the observed usage data to estimate summer peak CFs. We calculated the summer peak CF by summing, for each logger, the time the light was on during the summer peak period and dividing the result by 2 (3pm–5pm).

Conversely, we did not log lighting usage during the winter peak period. To determine winter peak CFs, we annualized lighting usage. We performed similar goodness of fit calculations as with the HOU annualization described in the section above. We calculated the winter peak CF by summing, for each logger, the time the light was on during the winter peak period and dividing the result by 2 (7am–9am).

4.5.7 Hours of Use and Coincidence Factor Aggregation Process

Consistent with the three-stage cluster or multi-stage sampling approach to deploying loggers, wherein we first select households, then rooms, then switches to place loggers on, we aggregated the individual logger results first to the room level within each household, then to the room level across households, and finally across room levels to the overall household-level estimate. To arrive at the room-level HOU and CF estimates within a household, we aggregated the results from the individual loggers, weighting down loggers that were installed in the same room type in a single household so that room-level estimates' contribution to the overall estimate is consistent across households. This weighting process ensured that a household where multiple loggers were installed within the same room type did not contribute to the room-level estimate more heavily than a household where only one logger was installed in a given room type. We then developed across-household room-level estimates by weighting individual estimates by the number of light bulbs logged as part of the process. Finally, we weighted room-level estimates by the share of LEDs in each room type to arrive at the overall HOU and CF estimates.

4.5.8 In-Service Rate Calculation

We calculated ISRs for LEDs by summing all of the LEDs in storage and dividing the result by the sum of LEDs installed inside and outside of customers' homes, as well as in storage. We developed ISRs for each household and then weighted the results to the overall ISR for each jurisdiction by the share of LEDs in each household. This ensured that homes with more LEDs contributed more heavily to the program ISR. We also applied homeownership weights as described in the section above to ensure representativeness of the results.

Table 4-7 summarizes achieved relative precision across all metrics.

Table 4-6. Precision and Margins of Error at 90% Confidence

Metric of Interest	Relative Precision (at 90% Confidence)
DEP ISR	4%
DEC ISR	5%

Source: Opinion Dynamics analysis of the site visit data.

4.5.9 Targeted Confidence and Precision

The evaluation targeted 10% precision at the 90% confidence level (90/10) for the HOU estimates across the DEP and DEC jurisdictions combined. Opinion Dynamics achieved the desired precision for HOU estimates. Precision around the CF estimates is slightly worse than 90/10. With ISR estimates, we were able to meet 90/10 at the jurisdiction level. Table 4-7 summarizes achieved relative precision across all metrics.

Table 4-7. Precision and Margins of Error at 90% Confidence

Metric of Interest	Relative Precision (at 90% Confidence)
HOU	9%
Summer CF	12%
Winter CF	12%

Source: Opinion Dynamics analysis of the logger data.

4.6 Retailer Shelf Audits

Opinion Dynamics completed retail shelf audits across a range of retail channels in DEP and DEC jurisdictions in September 2016. We completed shelf audits at both participating and non-participating retailers. We selected a purposeful sample of retailers and storefronts to provide good geographic and retailer channel coverage, while capturing a meaningful percentage of program bulb sales. Table 4-8 summarizes the shelf audit sample by retail channel and jurisdiction. As can be seen in the table, we completed 15 retailer shelf audits per jurisdiction. Of the 15 DEP retailers, 12 were participating in the DEP EEL program and 3 were not. Of the 15 DEC retailers, 10 were participating in the program and 5 were not. The 12 participating retailers that we visited in the DEP jurisdiction accounted for 21% of program sales, and the 10 participating retailers that we visited in the DEC jurisdiction accounted for 25% of program sales.

Table 4-8. Shelf Audit Data Collection Overview

Retail Channel	DEP			DEC		
	Participating Retailers	% of Program Sales	Non-Participating Retailers	Participating Retailers	% of Program Sales	Non-Participating Retailers
Big Box	1	1%	1	2	<1%	1
DIY	3	5%	2	4	4%	2
Club	4	13%	0	4	21%	2
Discount*	1	<1%	0	0	<1%	0
Hardware	3	2%	0	0	<1%	0
Total	12	21%	3	10	25%	5

Source: Opinion Dynamics analysis of the shelf audit data.
* Discount channel includes Dollar Tree, Goodwill, and Habitat ReStore stores.

As part of each shelf audit, the evaluation team recorded the number and price ranges of different lighting products in key wattage categories. We recorded data separately for general service products and reflector products. The evaluation team also recorded the presence of program-sponsored POP marketing and promotional materials. We used results from the study to adjust baseline wattage assumptions and to provide insight into the shelf space devoted to different lighting products.

As described above, the selection of retailers for shelf audits made use of a purposeful sampling approach. As a non-probability sampling method, the concept of sampling error does not apply, so there is no estimate of precision for the resulting estimates.[10]

4.7 Retailer and Manufacturer Interviews

Opinion Dynamics completed a total of 33 interviews with store-level retailer staff and manufacturer contacts. The sample frame for retailer interviews included all participating retailer locations. We drew a purposeful sample with consideration of geographic and retail channel coverage, and attempted to maximize representation of total program sales.

The sample frame for manufacturers and corporate-level retailers was supplied to us by the program manager and included a total of 15 contacts from 14 companies. We reached out to nearly all manufacturer contacts, with a purposeful focus on the retailers and manufacturers representing the most program sales. All the manufacturers we contacted sold products discounted by both programs during the evaluation period.

Table 4-9 provides a summary of the retailer and manufacturer interviews by jurisdiction and stakeholder type. The table also provides the percent of sales accounted for by each group of interviewed respondents.

[10] There may be other sources of uncertainty, such as measurement error, that are associated with these interviews and all the NTGR methods. It is not possible to quantify these errors like we can sampling error. We discuss these other research limitations throughout this report.

Table 4-9. Retailer and Manufacturer Interview Data Collection Overview

Interview Type	DEP			DEC		
	Planned Interviews	Completed Interviews	% of Bulb Sales	Planned Interviews	Completed Interviews	% of Bulb Sales
Store-level retailer staff	10	10	20%	10	12	28%
Manufacturer contacts*	7	11	84%	7	9	84%
Total	17	21	83%	17	21	90%

Source: Opinion Dynamics analysis of retailer and manufacturer interview data.
* We spoke to 11 manufacturer contacts, 9 of whom provided feedback for both programs and 2 of whom participated in only the DEP EEL program.

As described above, retailer and manufacturer interviews made use of a purposeful sampling approach. As a non-probability sampling method, the concept of sampling error does not apply, so there is no estimate of precision for the resulting estimates, including NTGR.[11]

4.8 Sales Data Modeling

The goal of the sales data modeling was to develop a NTGR estimate. As part of this research activity, we estimated, for each program, lighting price elasticities using regression modeling of PY2016–2017 program sales and pricing data. We calculated a NTGR estimate from the price elasticities. A detailed description of the sales data modeling methodology can be found in Section 6.1 of this report.

Sales data modeling uses sales data from the entire period under evaluation rather than a sample of the program sales records. Because no sampling was used, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

4.9 Leakage Analysis

Leakage occurs when non-Duke Energy customers purchase program-discounted products and install them in homes or businesses located outside of a utility’s service territory. The program leakage rate reflects the percentage of program bulbs purchased by non-Duke Energy electric customers. Duke Energy cannot claim savings from those products, and the savings associated with them need to be subtracted from the overall program impacts.

DEP and DEC share a border. With both jurisdictions running upstream lighting programs, program bulbs are “leaking” from one jurisdiction into the other. As part of the leakage analysis, it is therefore important to estimate not only leakage “out” (percent of program bulbs purchased by non-utility customers) but also leakage “in” (percent of other program’s bulbs purchased by utility customers). The final leakage rate, as a result, is the net of the two leakage estimates (see Equation 4-2 below).

Equation 4-2. Leakage Rate Formula

$$Leakage\ Rate = Leakage\ Out - Leakage\ In$$

[11] There may be other sources of uncertainty, such as measurement error, that are associated with these interviews and all the NTGR methods. It is not possible to quantify these errors like we can sampling error. We discuss these other research limitations throughout this report.

The key factor affecting leakage for an upstream residential lighting program is the location of the participating stores in relation to the DEP and DEC jurisdiction borders. Opinion Dynamics relied on geographic information system (GIS) analysis to estimate both leakage "out" and "in" rates for each jurisdiction. We leveraged three data sources to perform the analysis:

- Participating store location and bulb sales data
- U.S. Census 2015 ACS data at the census block group level
- Customer data

To calculate leakage rates, we performed the following steps:

- Mapped respective store locations participating in the DEP EEL and DEC Retail LED programs.
- Defined a store's territory as the area lying within a certain radius from participating stores. We customized radius designators depending on whether the stores were located in urban or rural areas. We relied on the U.S. Census definitions of urban area, urbanized cluster, and rural area,[12] and assigned a 5-mile radius to the stores located in urban areas, a 7-mile radius to the stores located in urbanized clusters, and a 10-mile radius to the stores located in rural areas. The customized radius assignments assume that customers will need to travel further in rural compared to urban areas to have access to the types of retailers that participate in the program.
- Calculated the number of households living within each participating store's territory by summing the total number of households across all census block groups lying within the store-assigned radius (5, 7, or 10 miles). In cases where a portion of a census block group fell within the designated radius, we apportioned the population of shoppers based on the percentage of land mass falling within the designated radius of the store.
- Calculated the total number of the DEP and DEC customers, respectively, living within each participating store's territory by mapping DEP and DEC customer data to the census block groups lying within each store's designated radius and summing the customers across the census block groups. Similar to calculating the total number of households within a store's territory, in cases where a part of a census block group fell within a designated radius, we apportioned the population of DEP and DEC customers based on the percentage of land mass falling within that radius.
- Calculated leakage "out" for each participating store by dividing the total number of DEP and DEC customers, respectively, by the total population falling within each store's territory and subtracting it from 1 (see Equation 4-3 below). We calculated a program-level leakage "out" by weighting the individual store rates by the program sales volume, so stores that sold more bulbs through the program had more weight.

Equation 4-3. Leakage Out Formula

$$Leakage\ Out\ (DEP) = 1 - \left(\frac{DEP\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEP\ Participating\ Stores}\right)$$

[12] The U.S. Census defines urban area as an area with the population of 50,000 or more, an urbanized cluster as an area with population between 2,500 and 50,000, and a rural area as areas that are not urban areas or urbanized clusters. It should be noted that a store's territory and the shopping patterns are likely to be influenced by a number of factors, including the type of store, the road network, and the population density of the area. It was not possible to consider all of these factors for this analysis.

$$Leakage\ Out\ (DEC) = 1 - \left(\frac{DEC\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEC\ Participating\ Stores}\right)$$

- Calculated leakage "in" for each participating store by diving the total number of the opposite jurisdiction's customers living within a store's territory by the total population within each store's territory. Similar to the leakage "out" calculation, we developed initial program-level leakage "in" by weighting the individual store rates by the program sales volume, so stores that sold more bulbs through the program had more weight.

Equation 4-4. Initial Leakage In Formula

$$Initial\ Leakage\ In\ (DEP) = \left(\frac{DEC\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEP\ Participating\ Stores}\right)$$

$$Initial\ Leakage\ In\ (DEC) = \left(\frac{DEP\ Customer\ Total}{Population\ Total\ within\ Designated\ Radius\ of\ DEC\ Participating\ Stores}\right)$$

We applied the resulting rates to the energy savings to estimate the total savings "leaking into" the DEP jurisdiction from the DEC Retail LED program and vice versa. We adjusted the savings to reflect the ISRs associated with the jurisdiction in which bulbs would being installed. We then divided the resulting leakage "in" savings by the program's overall ex post gross savings to arrive at the normalized final leakage "in" rate for each program.

Equation 4-5. Final Leakage In Formula

$$Leakage\ In\ (DEP) = \left(\frac{Leakage\ In\ Savings\ from\ DEC}{DEP\ Ex\ Post\ Gross\ Savings}\right)$$

$$Leakage\ In\ (DEC) = \left(\frac{Leakage\ In\ Savings\ from\ DEP}{DEC\ Ex\ Post\ Gross\ Savings}\right)$$

Leakage data analysis relied on sales data from the entire period under evaluation rather than a sample of the program sales records. Because no sampling was used, the concept of sampling error does not apply, so there is no estimate of precision for the resulting leakage rate estimates.

5. Gross Impact Evaluation

This section describes the methodology the evaluation team used to conduct the gross impact analysis and the results of the analysis. Due to the similarities in the savings assumptions and analytical approaches across the DEP EEL and DEC Retail LED programs, we present the methodology and the results of the gross impact evaluation together for the two programs.

The evaluation team completed the following activities as part of the gross impact analysis:

- Reviewed program tracking data and ex ante savings values for accuracy, completeness, and consistency
- Reviewed and compiled appropriate ex post assumptions based on recent Carolinas-specific research
- Conducted engineering analysis to develop estimates of ex post gross energy and demand savings

5.1 Methodology

Neither North Carolina nor South Carolina has a Technical Reference Manual (TRM) that provides a recommended savings estimation approach and savings assumptions. Therefore, all savings assumptions are based on the most recent available Carolinas-specific research.

Duke Energy changed its approach to estimating ex ante savings during the current evaluation period, relying on per-unit savings by product category and applying a single set of values across all products within each category. Per-unit values are based on results of the previous evaluation (DEP EEL PY2015), and categories are defined by bulb technology, shape, and subtype (e.g., general purpose CFLs, outdoor reflector LEDs, 3-way LEDs). We applied the per-unit savings specified by the program based on product categories recorded in the program tracking data.

We estimated gross savings using the recommended approach in the Uniform Methods Project (UMP) protocols. Per the UMP protocols, savings calculations account for baseline wattages, actual bulb wattages, ISR, lighting operation (HOU and CFs), and interactive effects. These equations and all recommended savings parameters are detailed below. We reviewed program sales data and corrected any inconsistencies in product categorization or bulb specifications prior to calculating gross savings.

5.1.1 Review of Program Tracking Data for Completeness and Consistency

Opinion Dynamics analyzed the program sales data for any gaps and inconsistencies. As part of the analysis, we performed the following steps:

- Checked the core data fields for missing values
- Checked the data for temporal gaps (due to missing invoices, transactions, etc.) by reviewing variation in monthly invoiced sales
- Verified consistency of product categorization for each product, cross-checked these categories with detailed measure descriptions, and corrected any inconsistent product categories based on available information from the ENERGY STAR or retailer websites

- Cross-checked wattages, lumen outputs, incandescent equivalent wattages, and detailed measure description data fields for consistency and accuracy and corrected inconsistent values
- Checked pack size and rebate information for outliers or unreasonable values

Opinion Dynamics identified and corrected slight inconsistencies in bulb categorizations, bulb wattage, and lumen assignments. None of those inconsistencies was widespread; each adjustment affected a fraction of a percent of total sales, and the effect on program savings was negligible.

5.1.2 Recommended Savings Assumptions

In this section, we provide an overview of the savings assumptions applied to estimate ex post gross savings for each program. We chose the savings assumptions with consideration of the following factors:

- Assumptions are based on Carolinas-specific research
- Assumptions are based on the most recent available research and analysis
- LED savings assumptions are specific to LEDs as much as possible

We relied on a standard equation to estimate program savings and estimated savings attributable to the residential vs. commercial installations separately. The equation incorporates baseline wattages, actual bulb wattages, ISR, lighting operation (HOU and CFs), and interactive effects. Equation 5-1 provides the formula that we used to estimate energy savings, while Equation 5-2 provides the formula for demand savings. These formulas are standard and are routinely used to estimate savings for lighting programs.

Equation 5-1. Annual Energy Savings

$$Res\ kWh_{saved} = NUMUNIT * ResShare\left[\left(\frac{\Delta W}{1{,}000}\right) * HOU_{Res} * ISR_{Res} * INT_{Res}\right]$$

$$Com\ kWh_{saved} = NUMUNIT * ComShare\left[\left(\frac{\Delta W}{1{,}000}\right) * HOU_{Com} * ISR_{Com} * INT_{Com}\right]$$

Equation 5-2. Annual Demand Savings

$$Res\ kW_{saved} = NUMUNIT * ResShare\left[\left(\frac{\Delta W}{1{,}000}\right) * CF_{Res} * ISR_{Res} * INT_{Res}\right]$$

$$Com\ kW_{saved} = NUMUNIT * ComShare\left[\left(\frac{\Delta W}{1{,}000}\right) * CF_{Com} * ISR_{Com} * INT_{Com}\right]$$

Where:

kWh_{saved} = First-year electric energy savings

kW_{saved} = Summer peak electric demand savings

$NUMUNIT$ = Number of bulbs

$ResShare$ = Percentage of light bulbs installed in residential applications (accounts for leakage)

$ComShare$ = Percentage of light bulbs installed in commercial applications (accounts for leakage)

ΔW = Delta watts = Baseline wattage minus efficient lighting product wattage

HOU = Annual operating hours

ISR = In-service rate

INT = Cooling and heating interactive effects

CF = Summer/winter peak coincidence factor

Res = Residential values

Com = Commercial values

Table 5-1 presents the sources of savings assumptions used to calculate program ex post gross energy and demand savings.

Table 5-1. Ex Post Savings Assumption Sources

Assumption	Source of Residential Assumptions	Source of Commercial Assumptions
Sales to residential/ commercial customers	2011 and 2012 Intercept Surveys	
Leakage rate	GIS analysis	
Baseline wattage	Incandescent equivalent adjusted for Energy Independence and Security Act (EISA) based on 2016 Retailer Shelf Audit and U.S. Department of Energy's (DOE) Energy Conservation Standards for Incandescent Reflector Lamps	
Replacement wattage	Actual product wattage	
HOU	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2012 DEP Residential Metering Study (CFLs)	2016 DEP Commercial Lighting Logger Study
First-year ISR and future installation rate trajectory	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2013 DEP General Population Survey (CFLs) 2014 DEP Storage Log Study (future installations)	2016 DEP Commercial Lighting Logger Study 2014 DEP Storage Log Study (future installations)
Interactive effects	2012 DOE2 Simulation Models	No interactive effects applied
CF (summer and winter)	2017 DEP-DEC Residential Lighting Logger Study (LEDs) 2012 DEP Residential Metering Study (CFLs)	2016 DEP Commercial Lighting Logger Study

Source: Opinion Dynamics analysis and prior evaluation reports.

Table 5-2 provides the savings assumptions used to calculate ex post gross savings. Following the table, we provide greater detail on each assumption.

Appendix M contains a detailed overview of the ex ante savings assumptions and their sources.

Table 5-2. Ex Post Savings Assumption Values

Assumption	DEP EEL Program		DEC Retail LED Program	
	Residential	**Commercial**	**Residential**	**Commercial**
Sales to residential/ commercial customers*	0.817	0.099	0.880	0.107
Leakage rate	0.084	0.084	0.013	0.013
Baseline wattage	Minimum efficiency baseline adjusted for applicable federal standards			
Replacement wattage	Actual product wattage			
HOU	2.922 (CFLs) 2.881 (LEDs)	6.930 (CFLs) 5.783 (LEDs)	2.881	5.783
First-year ISR	0.795 (CFLs) 0.943 (LEDs) 1.0 (fixtures)	0.879 (CFLs) 0.979 (LEDs) 1.0 (fixtures)	0.865 (LEDs) 1.0 (fixtures)	0.979 (LEDs) 1.0 (fixtures)
Interactive effects	0.94 (Energy) 1.27 (Summer peak) 0.50 (Winter peak)	1.0	0.94 (Energy) 1.27 (Summer peak) 0.50 (Winter peak)	1.0
Summer CF	0.1138 (CFLs) 0.1283 (LEDs)	0.4966 (CFLs) 0.5471 (LEDs)	0.1283	0.5471
Winter CF	0.0960 (CFLs) 0.1451 (LEDs)	0.1737 (CFLs) 0.1199 (LEDs)	0.1451	0.1199

Source: Opinion Dynamics analysis and prior evaluation reports.
* Together with the leakage rate, these values add up to 1.

Sales to Residential/Commercial Customers and Leakage Rate

Because the DEP EEL and DEC Retail LED programs rely on retail channels to reach customers, both residential and commercial customers end up purchasing and installing program-discounted lighting products. Due to longer operating hours, savings from the discounted lighting products installed in commercial settings are greater than residential savings. Furthermore, not all program bulbs are installed in homes where Duke Energy provides electric service (leakage). The nature of the upstream program design makes it difficult to limit the purchase of program-discounted products to Duke Energy customers only.

As part of the previous DEP EEL program evaluations (namely, 2011 and 2012 in-store intercept survey efforts), Navigant Consulting estimated the percentage of program sales to commercial versus residential customers (Table 5-3). We relied on these estimates to apportion program savings across residential and commercial customers for the current evaluation. We leveraged the results of the GIS analysis to estimate program leakage and adjusted program savings based on the results.

Table 5-3. Residential versus Commercial Installations

Metric	Percent of Sales
Share of sales to residential customers	89%
Share of sales to commercial customers	11%
Total	100%

Source: Navigant Consulting. EM&V Report for the 2013 Energy Efficient Lighting Program.

For leakage rates, we relied on the GIS analysis. As part of the analysis, we estimated both leakage in and leakage out, as well as leakage in for each program. Table 5-4 provides the results of the leakage rate analysis. As can be seen in the table, the overall leakage rate is 8.4% for the DEP EEL program and 1.3% for the DEC Retail LED program.

Table 5-4. Program Leakage Rates

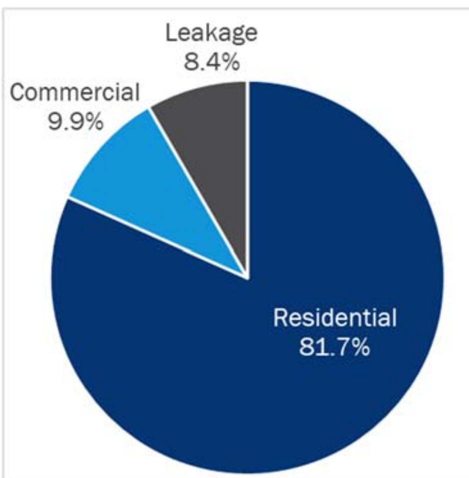
Program	Leakage Out Rate	Leakage In Rate	Total Leakage Rate
DEP EEL	8.7%	0.3%	8.4%
DEC Retail LED	3.4%	2.1%	1.3%

Source: Opinion Dynamics GIS analysis.

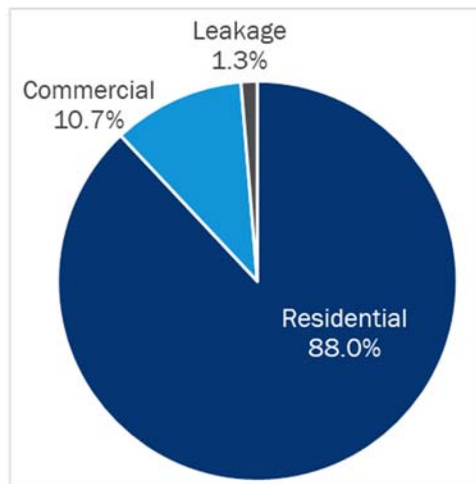
Figure 5-1 provides the distribution of program sales for each program across sectors and outside of each program's respective jurisdiction.

Figure 5-1. Sales to Residential/Commercial Customers and Leakage Rate Assumptions

DEP EEL Program



DEC Retail LED Program



Source: Opinion Dynamics GIS analysis.

Baseline Wattages

We used the minimum efficiency baseline approach to determine baseline wattages for program-discounted products for both programs (in both residential and commercial settings). Minimum efficiency standards in the market vary by product type based on the federal standards. Below we detail the methods we used to calculate baseline wattages for each product type.

General Service Products

Incandescent products have historically been the lowest efficiency product on the market. The 2007 EISA gradually phased out general service incandescent products, replacing them with halogens and thus making them the new baseline. The EISA regulations affected 100-watt incandescent products in January 2012, 75-watt incandescent products in January 2013, and 60-watt and 40-watt incandescent products in January 2014. However, products did not immediately disappear from the market, as manufacturers and retailers were allowed to sell through their existing inventory of incandescents. Because some incandescent products may still have been available for purchase in 2016, assuming a halogen baseline may not reflect the actual market and be too punitive to program savings.

To assess incandescent product availability and determine if any upward adjustments to the baseline wattage are warranted, Opinion Dynamics relied on the shelf audit research.

Of the 15 stores in DEP jurisdiction, none carried 100-watt or 75-watt incandescents. One retailer (a participating hardware store) carried one 60-watt incandescent product. The incandescent product was one of twenty 60-watt equivalent products available to the customers at that store. Two stores (both participating hardware stores) carried 40-watt incandescent products. In both stores, incandescent products represented a small portion of 40-watt equivalent products (2 out of 14 products in one store, and 3 out of 22 products at the other). The three stores that carried incandescent products accounted for a small percent of program sales (10%).

Of the 15 stores that we visited in the DEC jurisdiction, none carried incandescent products, and all but Club stores carried halogen products.

Given that we did not find any incandescent products in the DEC jurisdiction and the very limited availability of these products in the DEP service territory, we used halogen baseline wattages to estimate savings for general service CFLs and LEDs discounted through both the DEP EEL and DEC Retail LED program (see Table 5-5).

Table 5-5. Recommended Baseline Wattages for General Service Products

Equivalent Incandescent Wattage	EISA Baseline Wattage
100-watt equivalents	72
75-watt equivalents	53
60-watt equivalents	43
40-watt equivalents	29

Source: Opinion Dynamics analysis.

Reflector Products

To determine baseline wattages for flood lights and reflector bulbs and fixtures, we relied on the approach established by the Navigant Consulting team during its PY2013 evaluation of the DEP EEL program. Baselines were assigned based on a combination of maximum allowable wattage and the available information for replacement bulbs regarding wattage and lumen output. We accounted for higher efficiency standards introduced by the DOE Energy Conservation Standards for some incandescent reflector lamps that went into effect in July 2012. We deemed this approach reasonable given the complexities associated with assigning baseline wattages to reflector products, which include a non-linear lumen-to-watt ratio, a variety of bulb shapes and sizes of varying efficacies, and the discrepancy between maximum allowable wattages and product availability on store shelves.

Table 5-6. Baseline Wattage Assumptions for Reflector and Flood Light Products

Bulb Type	Lumen Range		Baseline Watts	Exemption Status
	Lower End	Upper End		
R, PAR, ER, BR, BPAR, or similar bulb shapes with medium screw bases with diameter > 2.5" (*see exceptions below)	600	739	50	
	740	849	50	
	850	999	55	
	1,000	1,300	65	
*ER30, BR30, BR40, ER40	400	449	40	Exempt
	450	499	45	Exempt
	500	1,419	65	Exempt
*R20	400	449	40	Exempt
	450	719	45	Exempt
*All reflector lamps below the lumen ranges specified above	200	299	30	
	300	399	40	

Source: Opinion Dynamics analysis and prior evaluation reports.

Specialty Products

Neither EISA nor DOE Energy Conservation standards for incandescent reflector lamps affect other specialty products, such as three-way bulbs, candelabra bulbs, and globe bulbs. As such, we used incandescent equivalent wattage as the baseline for these specialty products.

Replacement Wattage

For the replacement wattage, we used the actual bulb wattage associated with each discounted lighting product. We compared the listed wattage to lumen outputs and measure descriptions where possible to ensure that the most accurate wattage was applied.

Hours of Use and Coincidence Factors

A light metering study is the industry standard to estimate HOU and CFs. Depending on the technology and customer type, we relied on several metering studies for HOU and CF for the two programs.

On the residential side, HOU and CF assumptions for CFLs (for the DEP EEL program only) were drawn from the 2012 DEP Residential Metering study. Table 5-7 provides a summary of the HOU and CF values for CFLs.

Table 5-7. Residential HOU and CF Assumptions for CFLs

Statistic	CFL Value
HOU	2.922
Summer CF	0.1138
Winter CF	0.0960

Source: Prior evaluation reports.

Residential HOU and CF assumptions for LEDs for both programs are based on the results from the 2016 DEP-DEC Residential Lighting Logger study. As part of the study, we metered LED usage across a representative sample of 107 homes across DEP and DEC jurisdictions, including 46 homes in the DEP jurisdiction and 61 homes in the DEC jurisdiction. The study yielded updated LED- and Carolinas-specific residential HOU and CF estimates. Table 5-8 provides LED HOU and CF estimates from the study.

Table 5-8. Residential HOU and CF Assumptions for LEDs

Statistic	LED Value
HOU	2.881
Summer CF	0.1283
Winter CF	0.1451

Source: Opinion Dynamics lighting logger analysis.

Appendix N provides additional results from the study.

On the commercial side, we applied commercial HOU and CF estimates from the 2015–2016 DEP Commercial Lighting Logger study completed by Opinion Dynamics as part of the PY2015 DEP EEL program evaluation. As part of the study, Opinion Dynamics logged CFL and LED lighting in 79 commercial facilities across the DEP service territory over an 8-month period.[13] Table 5-9 provides recommended HOU and CF assumptions for commercial installation.

Table 5-9. Commercial HOU and CF Assumptions

Statistic	CFL	LED
HOU	6.930	5.783
Summer CF	0.4966	0.5471
Winter CF	0.1737	0.1199

Source: Opinion Dynamics lighting logger analysis.

First-Year In-Service Rate and Future Savings

First-year ISR varies by technology, customer type (residential vs. commercial), and jurisdiction. For residential CFL installations (for the DEP EEL program only), we relied on the results from the general population survey completed by Navigant Consulting as part of the DEP EEL PY2013 evaluation. For residential LED installations, we relied on results from the 2016 Residential Lighting Logger study completed as part of this evaluation. As

[13] Opinion Dynamics placed loggers in 88 facilities, but excluded logger data from 9 facilities during the data-cleaning process.

part of the study, we collected information on the number of LEDs installed and in storage. We estimated the first-year ISR by dividing the total number of LEDs installed by the total number of LEDs installed and in storage. We estimated independent ISRs for DEP and DEC. For commercial savings, we relied on the results of the 2015–2016 DEP Commercial Lighting Logger Study that Opinion Dynamics completed as part of the PY2015 DEP EEL program evaluation. As part of that study, we completed a full inventory of all medium screw-based sockets within each business facility, including bulbs that were in storage. The ISR for a given bulb type is defined as the number of installed bulbs divided by the total number of bulbs found within the facility. For lighting fixtures, we used a first-year ISR of 100% for both residential and commercial sectors and across both programs. It is highly unlikely that customers who purchase lighting fixtures do not install them right away. Table 5-10 summarizes the first-year ISRs that we used in the impact analysis.

Table 5-10. First-Year In-Service Rates

Year	DEP			DEC		
	LEDs	**CFLs**	**Fixtures**	**LEDs**	**CFLs**	**Fixtures**
Residential	94.3%	79.5%	100.0%	86.5%	N/A	100.0%
Commercial	97.9%	87.9%	100.0%	97.9%	N/A	100.0%

Source: Opinion Dynamics lighting logger analysis and prior evaluation reports.

Although the first-year ISR is less than 100% for both CFLs and LEDs, research studies across the country have found that customers eventually install nearly all bulbs received through a program. The two main approaches to claiming savings from these later installations are: (1) staggering the savings over time and claiming some in later program years and (2) claiming the savings from the expected installation in the program year the product was sold but discounting the saving by a societal or utility discount rate. While the "staggered" approach allows program administrators to more accurately capture the timing of the realized savings, the "discounted savings" approach allows for the simplicity of claiming all costs and benefits during the program year and eliminates the need to keep track of and claim savings from future installations.

Opinion Dynamics used the discounted savings approach to claim savings from future installations.

To allocate installations over time, we relied on the installation trajectory from the lighting storage log study conducted by Navigant Consulting as part of the PY2013 DEP EEL program evaluation. The study estimates that participants install 97% of bulbs within 4 years of purchase. Table 5-11 presents the approach to developing installation rates over the 4 years following purchase, based on the study.

Table 5-11. Installation Rate Trajectory Formulas

Year	Installation Rate Trajectory	Incremental Installation Trajectory
Year 1	First-Year ISR	First-Year ISR
Year 2	((1 – First-Year ISR) * 41%) + First-Year ISR	(1 – First-Year ISR) * 41%
Year 3	((1 – First-Year ISR) * 69%) + First-Year ISR	(1 – First-Year ISR) * 28%
Year 4	97%	97% – ((1 – First-Year ISR) * 69%) + First-Year ISR

Source: Uniform Methods Project (UMP) Lighting Evaluation Protocols.

To claim savings from future installations of PY2015 sales, we discounted all future savings by the utility-specified discount rate using the net present value (NPV) formula (Equation 5-3). Program staff provided discount rates for each utility.

Equation 5-3. Net Present Value Formula

$$NPV = \frac{R_t}{(1+i)^t}$$

Where:

R = savings

t = number of years in the future savings take place

i = discount rate

Table 5-12 provides NPV-adjusted ISRs by program, sector, and bulb type.

Table 5-12. Final NPV-Adjusted In-Service Rates

	DEP			DEC		
Year	**LEDs**	**CFLs**	**Fixtures**	**LEDs**	**CFLs**	**Fixtures**
Residential	95.8%	95.2%	100.0%	95.9%	N/A	100.0%
Commercial	97.9%	96.1%	100.0%	97.9%	N/A	100.0%

Source: Opinion Dynamics analysis.

Interactive Effects

CFLs and LEDs emit less heat than incandescents, resulting in increased heating loads as more energy is needed to supplement heat emitted by incandescent light bulbs. Efficient bulbs also decrease cooling loads as less energy is needed to compensate for heat given off by incandescents. Application of interactive effects accounts for the changes in heating and cooling loads in the estimation of savings.

Consistent with the most recent evaluation, we used residential HVAC system interaction factors of 0.94 for energy savings, 1.27 for summer peak demand savings, and 0.50 for winter peak demand savings. These interactive effects estimates are based on the simulation analysis performed as part of the 2012 DEP EEL program evaluation by Navigant. Our review of the estimates determined that these factors were reasonable, relatively recent, and based on Carolinas-specific research.

Due to differences in technologies, interactive effects caused by CFLs and LEDs are likely different. The difference in these effects is unclear, especially as it pertains to the DEP and DEC jurisdictions. We are unaware of any existing modeling or simulation efforts to estimate LED-specific interactive effects. In our professional judgment, the difference between CFL and LED interactive effects is likely to have only a marginal impact on energy and peak demand savings. Given the small anticipated change in energy and peak demand savings estimates due to LED-specific interactive effects and the relatively high cost of conducting the modeling and simulation needed to estimate those interactive effects, Opinion Dynamics used previously established interactive effect estimates for CFLs from the study cited above.

For both DEP EEL and DEC Retail LED programs, we set commercial interactive effects to 1.0. In the absence of a reliable interactive effects estimate and a projected small impact of the lighting products on heat loss or gain given the nature of commercial-scale HVAC systems in place in commercial settings; not applying interactive effects is both reasonable and appropriate.

5.2 Gross Impact Results

This section presents the results of the gross impact analysis for the DEP EEL and DEC Retail LED programs.

5.2.1 Review of Program Tracking Data and Ex Ante Savings

As a first step in the gross impact analysis, the evaluation team analyzed the program sales data for any gaps, inconsistencies, and inaccuracies. We found that data fields were generally clean and fully populated, with very minor exceptions, and we did not identify any observable gaps between invoice dates and found the data to be complete and reasonable. Opinion Dynamics identified and corrected slight inconsistencies in bulb categorizations, bulb wattage, and lumen assignments. None of those inconsistencies was considerable nor resulted in a significant difference in savings.

As mentioned in the earlier section of this report, Duke Energy changed its approach to estimating ex ante savings during the current evaluation period. Duke Energy relied on per-bulb savings by product category, using categories defined by bulb technology, shape, and application (e.g., general purpose CFLs, outdoor reflector LEDs, 3-way LEDs), and applying a single set of values across all products within a category based on evaluation-recommended savings from the PY2015 DEP EEL program evaluation. We compared these ex ante per-bulb savings values to those provided by PY2015 DEP EEL program evaluation and found that all values matched perfectly. Table 5-13 provides the ex ante per-bulb savings values associated with each product category that program staff used to generate ex ante savings for both the DEP EEL and DEC Retail LED programs.

Table 5-13. Applied Ex Ante Per-Bulb Savings

	Residential Per-Bulb Savings			Commercial Per-Bulb Savings		
Product Category	Energy (kWh)	Summer Peak (kW)	Winter Peak (kW)	Energy (kWh)	Summer Peak (kW)	Winter Peak (kW)
Reflector track lighting LED	28.88	4.16	1.38	62.94	16.31	3.58
Reflector recessed LED	37.95	5.47	1.82	82.70	21.43	4.70
Reflector outdoor LED	50.88	7.33	2.44	110.87	28.73	6.30
Globe LED	22.32	3.22	1.07	48.64	12.61	2.77
General purpose LED	32.50	4.69	1.56	70.83	18.35	4.03
Fixture LED	29.26	4.22	1.40	61.61	15.97	3.50
Candelabra LED	25.86	3.73	1.24	56.35	14.60	3.20
3-way LED	71.77	10.35	3.44	156.40	40.53	8.89
Reflector recessed CFL	32.89	4.74	1.57	83.83	16.47	5.77
Globe CFL	29.25	4.22	1.40	74.54	14.65	5.13
General purpose CFL	34.45	4.97	1.65	87.81	17.25	6.04
Fixture CFL	52.88	7.62	2.53	133.43	26.22	9.18
Candelabra CFL	30.33	4.37	1.45	77.31	15.19	5.32

Source: Opinion Dynamics analysis of program tracking data.

5.2.2 DEP EEL Program Ex Post Gross Savings

Review of product category fields in the program tracking data extract revealed inconsistent bulb categorization for six unique products (identified by unique model number), which resulted in miscategorization of a small number of total bulb sales (0.1%). As such, total ex ante energy savings would have been very slightly higher (<0.1%) if the program had used the corrected product categories. One unique product was also recorded with inconsistent pack sizes. Correcting the discrepant pack size increased total bulb sales by 0.2% and would have increased ex ante savings by the same percentage.

Following program tracking data review, we calculated ex post gross energy and peak demand savings achieved by the DEP EEL program during PY2016–2017.

The program achieved 125,002 MWh in ex post gross energy savings, 22.0 MW in ex post gross summer peak demand savings, and 8.1 MW in ex post gross winter peak demand savings. The respective gross realization rates are 89% for energy savings, 95% for summer peak demand savings, and 113% for winter peak demand savings.Table 5-14 presents the results of the analysis.

Table 5-14. DEP EEL Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	109,576,023	97,829,373	89%
	Commercial savings	30,639,454	27,172,524	89%
	Total	140,215,477	125,001,897	89%
Summer peak demand savings (kW)	Residential savings	15,796	15,503	98%
	Commercial savings	7,215	6,458	90%
	Total	23,011	21,962	95%
Winter peak demand savings (kW)	Residential savings	5,246	6,412	122%
	Commercial savings	1,880	1,654	88%
	Total	7,126	8,066	113%

Source: Opinion Dynamics analysis of program tracking data.

5.2.3 DEC Retail LED Program Ex Post Gross Savings

Review of product category fields revealed inconsistent bulb categorization for 13 unique products (identified by unique model number), which resulted in miscategorization of a small number of total bulb sales (1.6%). As such, total ex ante energy savings would have been slightly higher (0.5%) if the program had used the corrected product categories.

Following program tracking data review, we calculated ex post gross energy and peak demand savings achieved by the DEC Retail LED program during PY2016–2017.

The program achieved 57,847 MWh in ex post gross energy savings, 10.7 MW in ex post gross summer peak demand savings, and 4.0 MW in ex post gross in winter peak demand savings. The respective gross realization rates are 110% for energy savings, 121% for summer peak demand savings, and 155% for winter peak demand savings. Table 5-15 presents the results of the analysis.

Table 5-15. DEC Retail LED Program Gross Impact Results by Sector

Savings Type	Savings Category	Ex Ante Savings	Ex Post Gross Savings	Gross Realization Rate
Energy savings (kWh)	Residential savings	41,630,988	45,761,993	110%
	Commercial savings	10,971,300	12,084,862	110%
	Total	52,602,288	57,846,855	110%
Summer peak demand savings (kW)	Residential savings	6,002	7,543	126%
	Commercial savings	2,843	3,132	110%
	Total	8,845	10,676	121%
Winter peak demand savings (kW)	Residential savings	1,993	3,359	169%
	Commercial savings	624	686	110%
	Total	2,617	4,045	155%

Source: Opinion Dynamics analysis of program tracking data.

5.3 References

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6. Net-to-Gross Analysis

This section describes our approach for estimating the NTGR for each program and presents the resulting NTGRs and program net impacts.

6.1 Methodology

The NTGR represents the portion of the gross energy savings associated with a program-supported measure or behavior change that would not have been realized in the absence of the program. In other words, the NTGR represents the share of gross savings that are attributable to the program. The NTGR consists of free-ridership (FR) and spillover (SO) and is calculated as $(1 - FR + SO)$. FR is the proportion of the program-achieved verified gross savings that would have been realized absent the program. SO is additional energy-saving actions that are influenced by program interventions but did not receive program support. Sales data modeling only produces an estimate of FR.

The assessment of NTGR for upstream residential lighting programs is especially challenging for the following reasons:

- Because customers purchase discounted bulbs in a retail setting where they do not need to provide contact information, there is no list of participants with whom we can conduct a follow-up self-report NTGR survey (i.e., customers who purchased discounted bulbs through the program). Because light bulbs are a low-cost commodity product, most customers do not put extensive thought into or have reliable recall of their purchase decision. Customers may not even be aware that they purchased discounted bulbs. Therefore, we cannot conduct a general population survey in which we ask customers about their past light bulb purchases and the influence of program discounts on those purchases.
- Although we have detailed data regarding sales for the bulbs associated with the program, we lack any information about sales of other bulbs sold at the same retailers (including less-efficient and non-discounted products). Thus, while we can successfully model the relationship between bulb price and sales for the products associated with the program, we cannot take into consideration how other factors (e.g., discounts of non-program bulbs) may have affected our results.
- Program interventions may affect manufacturer distribution and retailer stocking practices, resulting in shelf space changes. Those changes are not visible to participants and therefore call for research with a range of market actors and, ultimately, triangulation of NTGR estimates from multiple sources.

To understand customers' counterfactual behaviors and to develop the most accurate possible estimates of the programs' NTGRs, Opinion Dynamics relied on two distinct methods:

- Sales data modeling
- Retailer and manufacturer interviews

Our assessment of NTGRs for the two programs was identical in approach. Below we discussed the methodology associated with each NTGR approach.

6.1.1 Sales Data Modeling

The sales data modeling approach to estimating NTGRs is based on the simple economic principle that a change in price causes a change in product sales. This assumption is the foundation of upstream program theory, so measuring the effect of program discounts on bulb sales serves as a good indicator of a program's net impact. The sales data modeling method models this relationship between product price and sales volume using the program sales data. The model produces price elasticity curves, allowing for predictions of sales at various prices, namely, program-discounted and non-discounted price levels.

For the modeling effort to succeed, there must be sufficient price variation for identical products during the evaluation period. The program implementer supported this analysis by facilitating price variation via changes in program discounts throughout the year across the two programs. As the first step in our analysis, we reviewed the data to confirm sufficient variation in product pricing. Our analysis confirmed sufficient price variation to support data modeling. In fact, price variation achieved in PY2016–2017 for the DEP EEL program exceeded that observed in the previous program years, namely, PY2014 and PY2015.

The program tracking data for both programs contained transaction-level sales summaries. Depending on the retailer and manufacturer, transaction periods ranged from 1 week to 1 month, though the majority were weekly. To ensure time series consistency and to maximize the potential for capturing the effect of in-store events on bulb sales, we normalized transaction periods to a weekly level. In instances where transactions were available only at the monthly level, the sales were split evenly across weeks of the month.

To reach our final price elasticity estimates, we fit a series of theoretically driven models predicting sales volume from product price. These models all fell into two categories: (1) models that included bulb characteristics (e.g., lumens) and interactions between bulb characteristics and (2) models that included unique product identifiers. For each model, we examined several diagnostics to assess the model's performance in terms of efficiency, omitted variables, and heteroscedasticity of residuals.[14] We also considered model fit indices, favoring models with larger R-squared values[15] and lower Akaike's Information Criterion (AIC) values[16] relative to other models based on comparable bulb quantities or sales transactions.

The simplest model, which used only unique product identifiers (inherently representative of all bulb characteristics), emerged as the best performing for both the DEP EEL and DEC Retail LED programs. Although the methodology and model design were the same for both programs, we present separate results for each.

Equation 6-1 contains the final sales data model specification. As is common in this type of analysis, we used the log of both price and sales quantity, which greatly improves the distributions of those variables, and allows for the interpretation of the price coefficient as the percent increase in sales given a one percent decrease in price, simplifying the process of analyzing price elasticity and NTGR.

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14 Heteroscedasticity is a statistical term that describes errors in prediction that vary in size across different values of a predictor. One of the assumptions of the OLS regression is that the errors are homoscedastic (that the variance around the regression line is the same for all values of a predictor variable), so when they are heteroscedastic, an assumption of the method is violated.

15 R-squared value is a summary statistic for many regression techniques. It shows the proportion of the total variance in the outcome variable that is correctly predicted by the model's predictor variables.

16 AIC is a summary statistic that is based on how well the outcome variable is predicted given the number of predictor variables in the regression model. The AIC value has no inherent meaning except in comparison to the values on the same statistic produced by alternative models under consideration. Modelers seek to minimize the AIC value, along with other ways of judging the models.

Equation 6-1. Final Sales Data Model Specification

$$ln(Q_m) = \alpha + \beta_1 ln(P_m) + \sum_{\mu}(\beta_\mu model\ dummy_m)$$

Where:

m = model

ln = natural log

Q = quantity of bulbs sold

P = price per bulb[17]

model dummy = a vector of dummy variables equaling 1 for each unique model number, and 0 for all others

β_1 = coefficient representing average price elasticity

β_μ = a vector of coefficients representing each unique model number (*m*)

α = constant

Using the modeled results, the evaluation team estimated sales at non-discounted prices using Equation 6-2. We used MSRP data supplied as part of the program sales data extract for estimates of non-discounted prices.

Equation 6-2. Estimating Sales at Non-Discounted Prices

$$\widehat{Sales}_{wo} = Sales_w * \left(\frac{Price_{wo}}{Price_w}\right)^{PC}$$

Where:

$\widehat{Sales}_{wo}$ = Estimated sales without discount (MSRP)

$Sales_w$ = Sales with discount (actual sales)

$Price_{wo}$ = Price without discount (MSRP)

$Price_w$ = Price with discount (actual price)

PC = Price coefficient

We excluded bulbs sold through the Dollar/Discount retailer channel from the sales data modeling based on feedback from retailer and manufacturer staff due to lack of price variation. We developed NTGRs by comparing the predicted sales at non-discounted prices to the actual sales at program-discounted prices using Equation 6-3 below.

Equation 6-3. Sales Data Modeling NTGR Estimation Formula

$$NTGR = \frac{\widehat{Sales}_{wo} - Sales_w}{Sales_w} = \frac{NetSales}{DiscountedSales}$$

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[17] We received two discounted prices in the data set, one that reflects program discounts and one that reflects other retailer or manufacturer discounts. We included the other retailer or manufacturer discounts in all projections.

Where:

$NTGR$ = NTGR (excluding any SO)

$\widehat{Sales}_{wo}$ = Estimated sales without discount (MSRP)

$Sales_w$ = Sales with discount

6.1.2 Retailer and Manufacturer Interviews

Opinion Dynamics completed a total of 33 interviews across a range of participating manufacturers and retailers in DEP and DEC jurisdictions to support the NTGR assessment. Of the 33 interviews, 21 informed the NTGR assessment for the DEP EEL program and 21 for the DEC Retail LED program. The interviews yielded feedback from retailers and manufacturers that accounted for 83% of DEP EEL program sales and 90% of DEC Retail LED program sales. We asked each interviewee to estimate the percentage by which the sales of efficient bulbs would be different in the absence of the program for each bulb category (i.e., standard and specialty; CFLs and LEDs). Respondents who said that sales of energy-efficient products would have decreased received a follow-up question asking to estimate the percent that would have shifted to other energy-efficient products (e.g., a percentage of LEDs that would have been CFLs or percent of ENERGY STAR LEDs that would have been non-ENERGY STAR LEDs), to account for the efficient product substitution effect. The percentage of energy-efficient bulb sales expected to move to non-energy-efficient products in the program's absence represents the NTGR for the respondent.

To the degree possible, we asked the NTGR questions for each major program-discounted product type, namely, standard and specialty LEDs, standard and specialty CFLs (only for DEP EEL program), and fixtures. As part of the interview guide, we embedded a range of validation questions to check responses for consistency. We asked respondents to provide their rationale for the reported percent change in sales in the absence of the program. Other questions included exploratory questions asking retailers to rank the importance of the program rebates as compared to the other factors, such as EISA, the need to stay ahead of the competition in terms of technological advancements, and manufacturing practices.

As part of the NTGR analysis, we estimated a NTGR for each respondent we interviewed, which we aggregated to the retail chain level and sales-weighted to the program level. As part of the analysis and aggregation process, a single manufacturer could contribute to the NTGRs across several retail channels, as long as that manufacturer was supplying its product to those retail channels.

6.2 NTGR Results

This section contains NTGR results for each program.

6.2.1 DEP EEL Program NTGR Results

Below we first present the NTGR results from sales data modeling and retailer and manufacturer interviews separately, then provide an overview of the triangulation approach, and finally present the final program-level NTGR for the DEP EEL program.

Sales Data Modeling

Using the results from the sales data model, Opinion Dynamics estimated total sales at program-discounted and non-discounted prices separately for CFLs and LEDs. For LEDs, price variation within product categories was sufficient to model outputs separately for each product category (standard LEDs, specialty LEDs, reflector LEDs, and LED fixtures). Because 95% of program-discounted CFLs were standard bulbs, this breakout was not possible or practical for CFLs. We averaged product-level NTGRs to an overall sales data modeling-based NTGR, weighting the contribution of each estimate in proportion to product sales in the program. Because sales records across the entire evaluation period were used and there was no sampling needed, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

According to the results of the sales data modeling, customers would have purchased slightly fewer LEDs and considerably fewer CFLs in the absence of program discounts. We found that 90% of all LED program sales would have occurred regardless of the program discounts, and slightly more than half of program CFL sales (54%) would have occurred in the absence of the program discounts. In other words, the NTGR is 0.10 for LEDs and 0.46 for CFLs. When weighted by program sales, this reflects a program-wide NTGR of 0.20. Within LEDs, fixtures and standard bulbs showed the lowest price elasticity and therefore NTGRs (0.03 and 0.06, respectively), while reflector and specialty bulbs were more price-elastic, resulting in higher NTGRs (0.14 and 0.20, respectively). Table 6-1 summarizes NTGR results from sales data modeling. Note that the 0.20 NTGR established through the sales data modeling methods excludes the Dollar/Discount retailer channel.

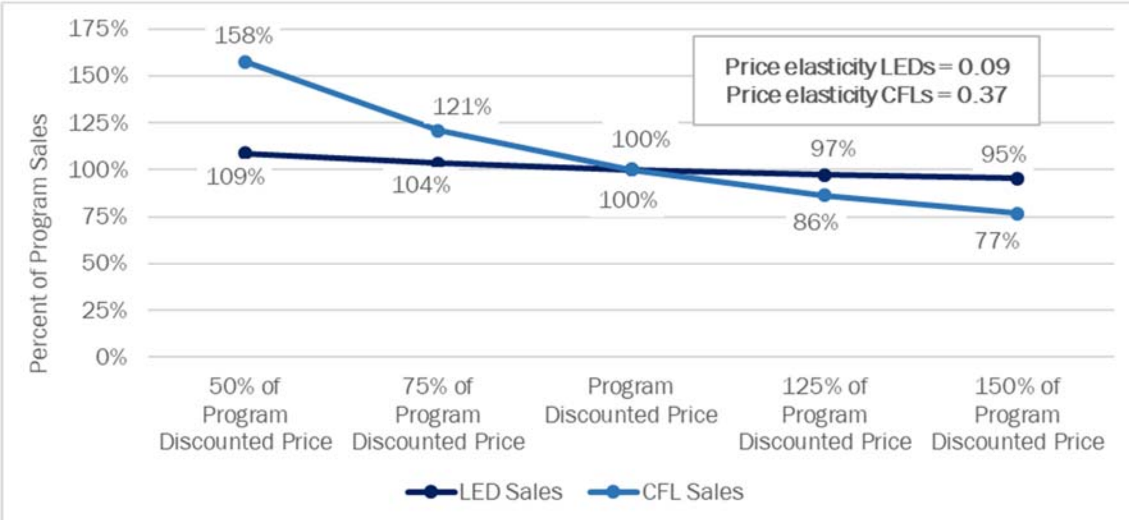
Table 6-1. DEP EEL Program NTGRs from Sales Data Modeling

Bulb Type	NTGR	% of Total Sales
All LEDs	0.10	67%
LED standard	*0.06*	*40%*
LED specialty	*0.20*	*8%*
LED reflector	*0.14*	*14%*
LED fixture	*0.03*	*5%*
All CFLs	0.46	33%
Total	0.20	100%

Source: Opinion Dynamics sales data modeling analysis.

We used the modeling results to estimate price elasticities for both CFLs and LEDs. The elasticity curves show minimal to moderate sensitivity to changes in price. CFLs exhibited greater sensitivity to price changes than LEDs. As can be seen in Figure 6-1, LED price elasticity is only 0.09 and CFL elasticity is 0.37. A price elasticity of 0.09 for LEDs means that for every 100% increase in price, there is a 9% decrease in sales. Similarly, a price elasticity of 0.37 for CFLs means that for every 100% increase in price there is a 37% decrease in sales.

Figure 6-1. Modeled Price Elasticity Based on DEP EEL Program Sales Data



Source: Opinion Dynamics sales data modeling analysis.

The higher NTGR for CFLs than LEDs likely reflects consumer preferences shifting away from CFLs as superior-quality LEDs continue to drop in price and grow in popularity. It requires a greater discount for customers to purchase CFLs because of their preference for LEDs.

Retailer and Manufacturer Interviews

Using the results from the retailer and manufacturer interviews, we estimated NTGRs by retailer channel. Dollar and Discount stores received the highest NTGR of 1.00, while NTGRs for other retail channels range from 0.32 for DIY and grocery stores to 0.38 for Big Box stores. The NTGR of 1.00 for the Dollar/Discount channel reflects feedback from corporate retailer and manufacturer contacts that availability of energy-efficient lighting products at these stores is solely dependent on the DEP EEL program. In the program's absence, energy-efficient lighting products would not be stocked at these locations. Customers who shop at these stores, in turn, are likely to be highly price sensitive and, in the absence of the energy-efficient products offered through the program, would have defaulted to the lowest-cost alternative present on the market, which is currently a halogen bulb. Table 6-2 provides NTGRs for each retail channel included in the DEP EEL program.

Table 6-2. DEP EEL Program NTGRs from Retailer and Manufacturer Interviews

Retailer Channel	NTGR	% of Program Sales
DIY	0.32	30%
Club	0.33	19%
Dollar/Discount	1.00	18%
Big Box	0.38	17%
Hardware	0.37	15%
Grocery	0.32	<1%
Other	0.34	<1%
Total	0.46	100%

Source: Retailer and manufacturer interviews.

Final NTGR Estimation

Opinion Dynamics combined the NTGRs derived through the two methods described above using the following triangulation approach to arrive at a final program-wide NTGR, summarized in Table 6-3:

- Given the complete dependence of lighting product availability on program operations within the Discount/Dollar retailer channel and the likely price sensitivity of the customers shopping at those stores, we assigned a NTGR of 1.00 to all sales made through this retail channel.
- We based the NTGRs for all other retail channels on an average of the bulb-weighted average derived from each of the two approaches. By averaging the NTGR of 0.20 from the sales data modeling analysis and 0.34 from retailer and manufacturer interviews,[18] we arrive at a NTGR of 0.27 for bulbs sold through all retail channels except Dollar and Discount stores.
- The bulb-weighted average of the Dollar/Discount NTGR estimate of 1.00 and the NTGR estimate for all other retail channels of 0.27 produces the final program-wide NTGR of 0.40.

Table 6-3. Final DEP EEL Program-Wide NTGR Triangulation

Retail Channel	NTGR Source	NTGR	% of Program Sales
Dollar/Discount	Retailer/manufacturer interviews	1.00	18%
All other channels	Combined	0.27	82%
	Sales data modeling*	*0.20*	
	Retailer/manufacturer interviews*	*0.34*	
Overall		0.40	100%

Source: Opinion Dynamics analysis.
* Excludes the Dollar/Discount channel.

6.2.2 DEC Retail LED Program NTGR Results

Below we first present the NTGR results from sales data modeling and retailer and manufacturer interviews separately, then provide an overview of the triangulation approach, and finally present the final program-level NTGR for the DEC Retail LED program.

Sales Data Modeling

Using the results from the sales data model, Opinion Dynamics estimated total sales at program-discounted and non-discounted prices separately for each LED product category (standard LEDs, specialty LEDs, reflector LEDs, and LED fixtures). To arrive at the program-wide NTGR, we weighted the bulb category-specific NTGR estimates by program sales. Because sales records across the entire evaluation period were used and there was no sampling needed, the concept of sampling error does not apply, so there is no estimate of precision for the resulting NTGR estimate.

According to the results of the sales data modeling, customers would have purchased fewer LEDs in the absence of program discounts. We found that 73% of all LED program sales would have occurred regardless of the program discounts, i.e., a NTGR of 0.27. The NTGR is the highest for specialty LEDs (0.39) and lowest for standard LEDs and LED fixtures (0.21 and 0.16, respectively). Table 6-4 summarizes NTGR results from

[18] This NTGR excludes the Dollar/Discount retailer channel.

sales data modeling. Note that the 0.27 NTGR established through the sales data modeling methods excludes the Dollar/Discount retailer channel.

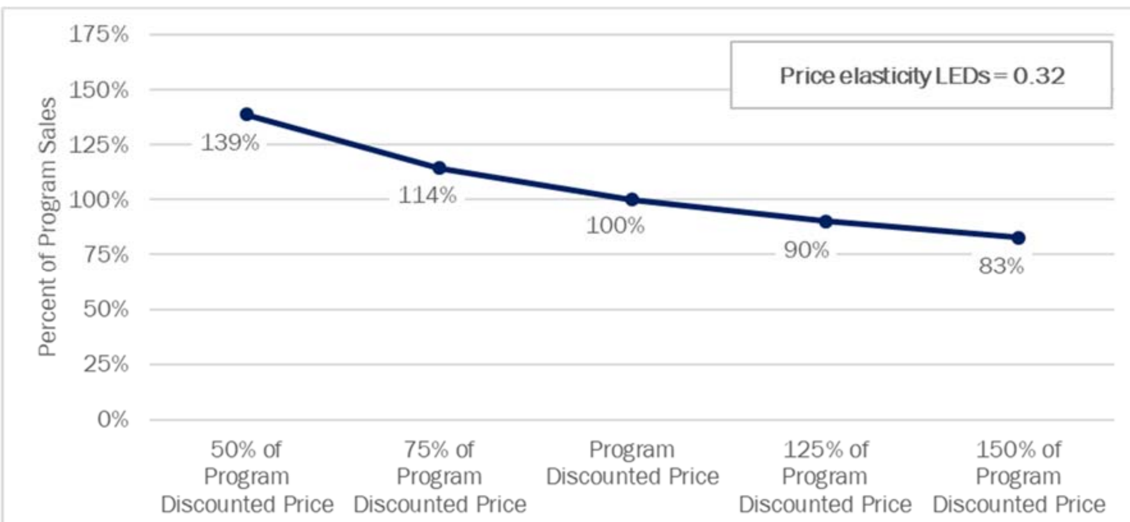
Table 6-4. DEC Retail LED Program NTGRs from Sales Data Modeling

Bulb Type	NTGR	% of Total Sales
LED standard	0.25	22%
LED specialty	0.39	21%
LED reflector	0.24	40%
LED fixture	0.23	16%
Total	0.27	100%

Source: Opinion Dynamics sales data modeling analysis.

We used the modeling results to estimate price elasticity for program bulbs. The elasticity curve shows moderate sensitivity to changes in price. As shown in Figure 6-2, LED price elasticity is 0.32, meaning that for every 100% increase in price, there is a 32% decrease in sales.

Figure 6-2. Modeled Price Elasticity Based on DEC Retail LED Program Sales Data



Source: Opinion Dynamics sales data modeling analysis.

Retailer and Manufacturer Interviews

Using the results from the retailer and manufacturer interviews, we estimated NTGRs by retail channel. The Dollar/Discount channel received a NTGR of 1.00, reflecting the feedback from corporate retailer and manufacturer contacts who said that availability of energy-efficient lighting products at these participating stores is solely dependent on the DEC Retail LED program. In the program's absence, energy-efficient lighting products would not be stocked at these locations. Customers who shop at these stores, in turn, are likely to be highly price sensitive and, in the absence of the energy-efficient products offered through the program, would have defaulted to the lowest-cost alternative present on the market, which is a halogen bulb. NTGRs for other retailer channels range from the low of 0.33 for Club stores to 0.51 for DIY stores. Table 6-2 provides NTGRs for each retail channel included in the DEC Retail LED program. As can be seen in the table, the overall NTGR for the program is 0.47.

Table 6-5. DEC Retail LED Program NTGRs from Retailer and Manufacturer Interviews

Retailer Channel	NTGR	% of Program Sales
Club	0.33	47%
DIY	0.51	36%
Dollar/Discount	1.00	10%
Big Box	0.46	7%
Total	0.47	100%

Source: Retailer and manufacturer interviews.

Final NTGR Estimation

Opinion Dynamics combined the NTGRs derived through the two methods described above using the following triangulation approach to arrive at a final program-wide NTGR, summarized in Table 6-6:

- Given the complete dependence of lighting product availability on program operations within the Discount/Dollar retail channel and the likely price sensitivity of the customers shopping at those stores, we assigned a NTGR of 1.00 to all sales made through this retail channel.
- We based the NTGRs for all other retail channels on an average of the bulb-weighted average derived from each of the two approaches. By averaging the NTGR of 0.27 from the sales data modeling analysis and 0.42 from retailer and manufacturer interviews,[19] we arrive at a NTGR of 0.34 for bulbs sold through all retail channels except Dollar and Discount stores.
- The bulb-weighted average of the Dollar/Discount NTGR estimate of 1.00 and the NTGR estimate for all other retail channels of 0.34 produces the final program-wide NTGR of 0.41.

Table 6-6. Final DEC Retail LED Program-Wide NTGR Triangulation

<table>
<tr><th>Retail Channel</th><th>NTGR Source</th><th>NTGR</th><th>% of Program Sales</th></tr>
<tr><td>Dollar/Discount</td><td>Retailer/manufacturer interviews</td><td>1.00</td><td>10%</td></tr>
<tr><td rowspan="3">All other channels</td><td>Combined</td><td>0.34</td><td rowspan="3">90%</td></tr>
<tr><td>Sales data modeling*</td><td>0.27</td></tr>
<tr><td>Retailer/manufacturer interviews*</td><td>0.42</td></tr>
<tr><td colspan="2">Overall</td><td>0.41</td><td>100%</td></tr>
</table>

Source: Opinion Dynamics analysis.
* Excludes the Dollar/Discount channel.

[19] This NTGR excludes the Dollar/Discount retailer channel.

6.3 Net Impact Results

The sections below provide net impact results for each program.

6.3.1 DEP EEL Program

We applied the program-level NTGR to ex post gross energy and peak demand savings to arrive at ex post net savings (Table 6-8). Program net energy savings for the DEP EEL program in PY2016–2017 were 50,001 MWh, net summer peak demand savings were 8.8 MW, and net winter peak demand savings were 3.2 MW.

Table 6-7. DEP EEL Program Ex Post Net Savings Summary

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	140,215	125,002	0.40	50,001	89%
Summer peak demand savings (MW)	23.0	22.0	0.40	8.8	95%
Winter peak demand savings (MW)	7.1	8.1	0.40	3.2	113%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

6.3.2 DEC Retail LED Program

We applied the program-level NTGR to ex post gross energy and peak demand savings to arrive at ex post net savings (Table 6-8). Program net energy savings in PY2016–2017 were 23,717 MWh, net summer peak demand savings were 4.4 MW, and net winter peak demand savings were 1.7 MW.

Table 6-8. DEC Retail LED Program Ex Post Net Savings Summary

Savings Type	Ex Ante Savings	Ex Post Gross Savings	NTGR	Ex Post Net Savings	Net Realization Rate*
Energy savings (MWh)	52,602	57,847	0.41	23,717	110%
Summer peak demand savings (MW)	8.8	10.7	0.41	4.4	121%
Winter peak demand savings (MW)	2.6	4.0	0.41	1.7	155%

Source: Opinion Dynamics analysis of program tracking data.
* Denominator is ex ante net savings.

7. Process Evaluation and Market Assessment

Opinion Dynamics relied on the following data collection and analytic activities to support evaluation of program processes and characterization of the lighting market in the DEP and DEC service territories.

- Program staff interviews
- Materials review
- Program tracking data analysis
- Retailer and manufacturer interviews
- Retailer shelf audits
- Residential lighting logger study

Section 4 provided a detailed overview of each data collection method, as well as targeted and achieved confidence and precision levels.

As part of the process evaluation specifically, Opinion Dynamics examined the following key program performance indicators:

- Retailer satisfaction with the programs
- Presence of program marketing in participating stores
- Retailer satisfaction with program marketing and training
- Knowledge of the programs and their benefits among sales staff at participating retailers

7.1 Researchable Questions

Process evaluation activities aimed at answering the following researchable questions for each program:

- How effective are the program implementation and data-tracking practices?
- How effective are the program marketing, outreach, and educational tactics?
- Are retailers and manufacturers satisfied with the programs?
- What are the strengths, weaknesses, and opportunities for program improvement?
- How have retailer stocking and sales practices changed?
- What lighting technologies do customers have in their homes?
- How does energy-efficient lighting penetration vary by customer type?
- How does lighting usage vary by customer type and room type?
- What are current and future trends in the lighting market, including retailer stocking practices and customer preferences and purchasing decisions?

7.2 Key Findings

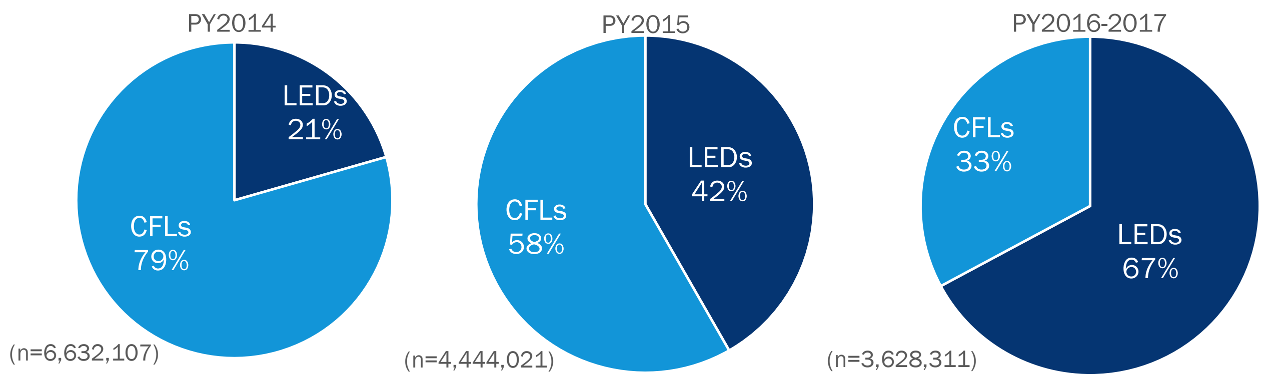
We present process findings results separately for the DEP EEL and DEC Retail LED programs. Sections below contain detailed key process and market findings.

7.2.1 DEP EEL Program

Program Participating Product Mix

The DEP EEL program sold 3,628,311 bulbs and fixtures in PY2016–2017, which included 2,436,436 LED bulbs and fixtures (67% of all sales) and 1,191,875 CFL bulbs and fixtures (33% of all sales). Overall program sales decreased by 18% compared to PY2015, when the program discounted 4,444,021 light bulbs and fixtures. Over time, the program has shifted its focus from CFLs to LEDs. In PY2016–2017, LED sales accounted for more than three times the portion of program sales that they did in PY2014 (67% compared to 21%), as shown in Figure 7-1.

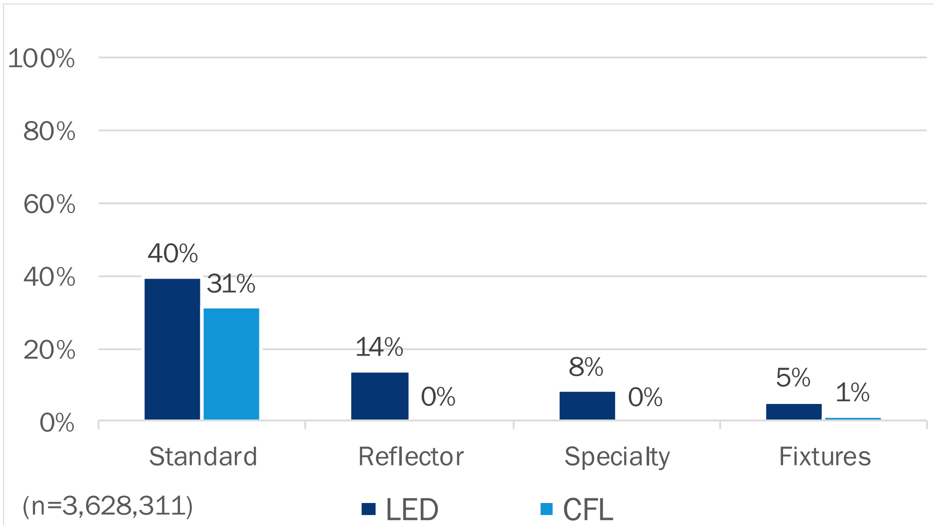
Figure 7-1. DEP EEL Program Changes in Bulb Technology Shares



Source: Opinion Dynamics analysis of program tracking data.

Standard products accounted for more than two-thirds of total bulb sales in PY2016–2017 (71%), followed by reflectors (14%) and specialty products (8%). Fixtures accounted for just 6% of all PY2016–2017 sales. CFLs were largely limited to the standard product category: 95% of PY2015–2016 CFL sales share were standard CFLs. LED products dominated specialty and reflector sales (Figure 7-2).

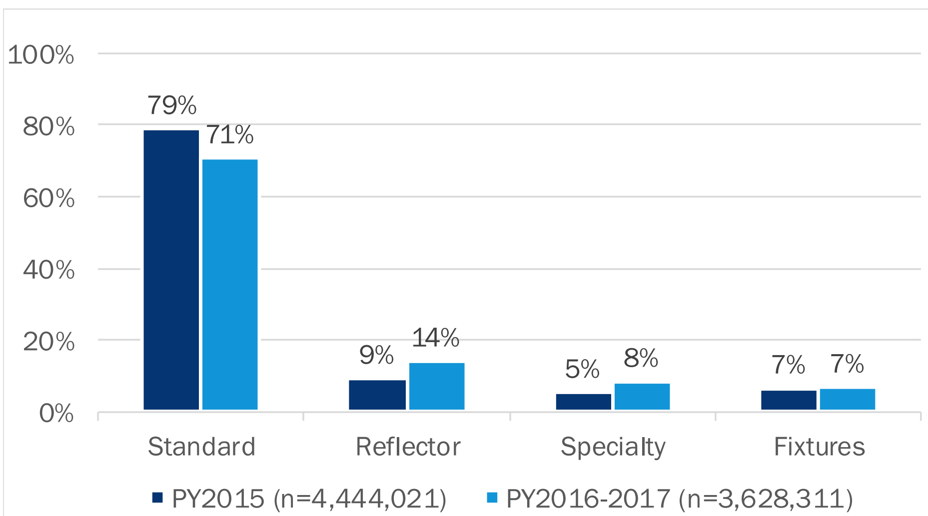
Figure 7-2. DEP EEL Program Technology Shares by Product Type



Source: Opinion Dynamics analysis of program tracking data.

Compared to PY2015, the share of specialty products increased slightly. As can be seen in Figure 7-3, program sales increased from 9% to 14% for reflector products and from 5% to 8% for specialty products and subsequently decreased from 79% to 71% for standard products.

Figure 7-3. DEP EEL Program Changes in Product Type Shares



Source: Opinion Dynamics analysis of program tracking data.

Over the course of PY2016–2017, the DEP EEL program discounted 744 unique products across a range of bulb types and wattages, which represents a 21% increase from PY2016, when the program managed 614 unique products. Such a large number of products can present implementation challenges in terms of managing the discounts and accurately tracking the sales data and calculating savings. Program staff effectively managed this large number of products, which is evidenced in clean and accurate program sales records (discussed in greater detail in Section 5.2 of this report) and high levels of retailer and manufacturer satisfaction described later in this section.

The DEP EEL program discounted a range of pack sizes over the course of PY2016–2017. Figure 7-4 provides a breakdown of program sales by pack size. As can be seen in the figure, standard CFLs were sold in larger packs, whereas LEDs of all types were sold predominantly in single packs. For standard CFLs, four-packs were most common, accounting for 62% of all packages sold. Conversely, 69% of LED packages were single packs. The reflector and specialty CFL product categories were dominated by two-packs, which comprised 59% of all packs sold in PY2016–2017. The number of large multipacks (six-pack and larger) decreased compared to PY2016, primarily due to a decrease in sales by club retailers, which tend to sell bulbs in large packages.

Figure 7-4. DEP EEL Program Sales by Package Type

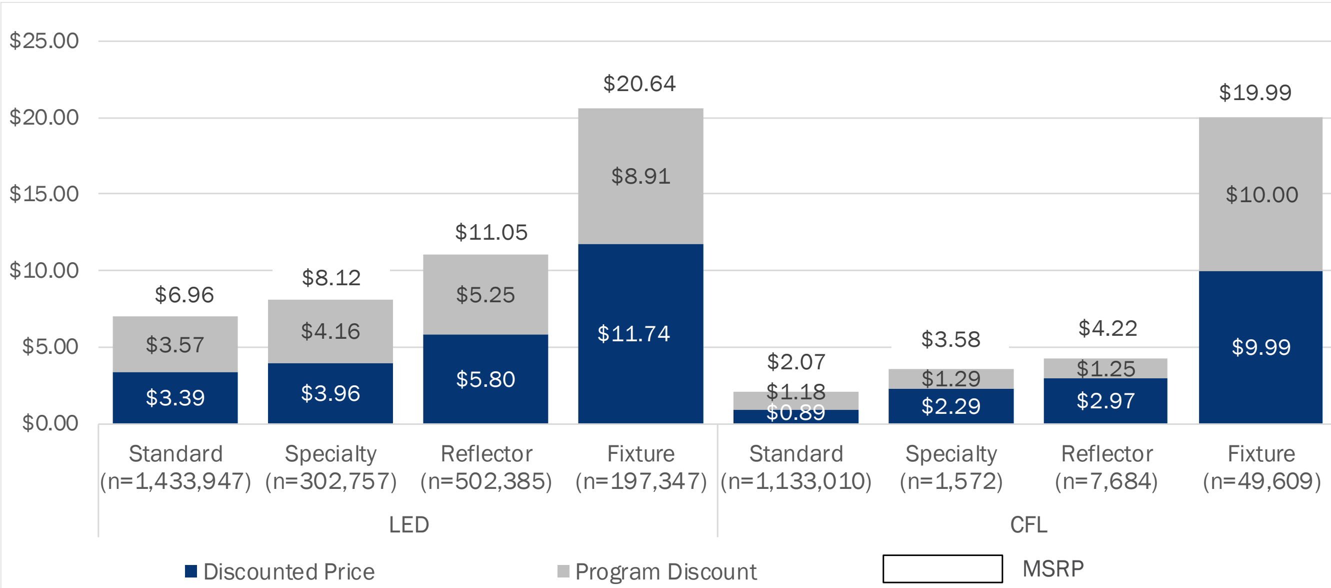
Distribution of Program Sales Across Pack Sizes by Technology

							Total
Standard CFLs (n=285,926)	14%	5%	2%	62%	8%	8%	100%
Standard LEDs (n=823,718)	69%	9%	2%	21%	0%	0%	100%
Reflector and Specialty CFLs (n=2,820)	0%	59%	12%	0%	29%	0%	100%
Reflector and Specialty LEDs (n=516,165)	69%	13%	12%	5%	1%	0%	100%

Source: Opinion Dynamics analysis of program tracking data.

Average program discounts ranged from $1.18 for standard CFLs to $10.00 for CFL fixtures. Depending on the product category, the average discount as a percentage of MSRP ranged from 30% for reflector CFLs to 57% for standard CFL products. The average program discount across all product categories was $3.48, which represents on average 50% of MSRP. Figure 7-5 provides a detailed overview of the program discounts by product type in PY2016–2017. As can be seen in the figure, discounts on LED products were higher than on CFL products as a result of the technology being generally more expensive. Average LED discounts ranged from $3.57 for standard LEDs to $8.91 for LED fixtures.

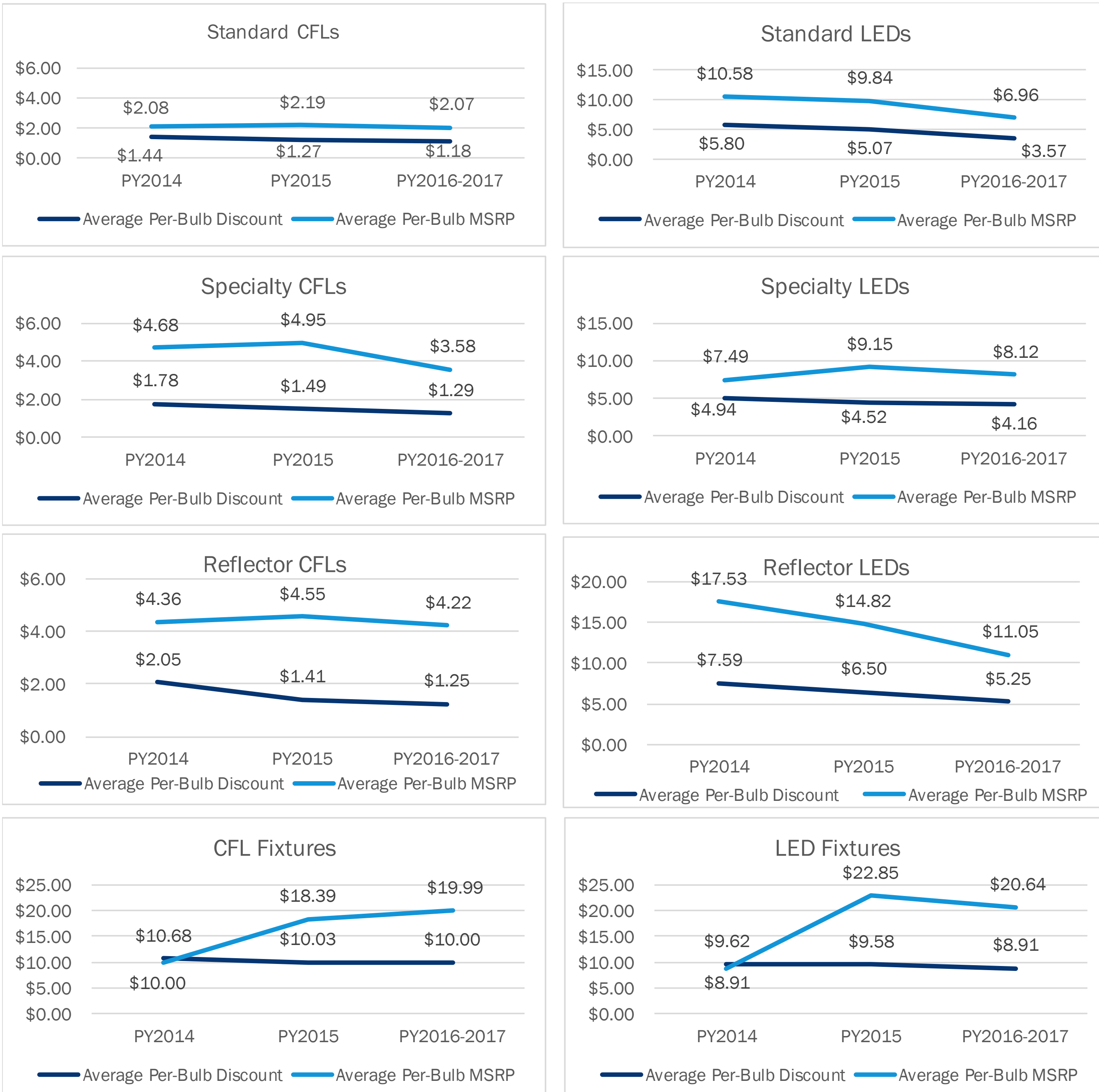
Figure 7-5. DEP EEL Program Pricing



Source: Opinion Dynamics analysis of program tracking data.

Compared to PY2014, MSRP for program-discounted products decreased across nearly all product categories. CFL fixtures is the only exception. Program discounts kept pace, indicating that program discounts were aligned with the changing retail pricing of the lighting products. Figure 7-6 shows changes in program-discounted prices and MSRP by product category over time. Program LED products decreased in price quite considerably over time, especially standard LEDs, where the MSRP dropped by 34% from $10.58 to $6.96, as well as reflector LEDs, where the MSRP dropped by 37% from $17.53 to $11.05.

Figure 7-6. DEP EEL Program Changes in Discounts and MSRP Over Time



Source: Opinion Dynamics analysis of program tracking data.

Program Retailer Mix

Similar to previous program years, the retailer mix in PY2016–2017 included a range of retailer channels. The program engaged 17 unique retailers across 289 storefronts in PY2016–2017. This represents a 7% increase from 269 storefronts in PY2015. Through the participating retailer mix, the program maintained good coverage of the DEP service territory, thus ensuring equitable customer access to program-discounted lighting products.

Table 7-1 shows a breakdown of participating storefronts and program sales across retailer channels, as well as changes in this breakdown over time. Club stores and DIY stores cumulatively captured nearly half of program sales (49%). Program sales decreased from 31% in PY2015 to 19% in PY2016–2017 for the Club retailer channel and doubled for the Hardware channel (from 7% to 15%). The program continued to discount a considerable share of sales (18%) through the Dollar/Discount channel. This focus on the Dollar/Discount channel and a shift to the Hardware channel illustrates the program's continued effort to target underserved customer segments, such as low-income customers.

Table 7-1. DEP EEL Program Changes in Participating Retailer Mix

	PY2015		PY2016–2017	
Retailer Channel	% of Storefronts (n=269)	% of Sales (n=4,444,021)	% of Storefronts (n=289)	% of Sales (n=3,628,311)
DIY	14%	26%	13%	30%
Club	4%	31%	4%	19%
Dollar/Discount	36%	18%	35%	18%
Big Box	21%	17%	14%	17%
Hardware	17%	7%	20%	15%
Grocery/Authentic	6%	<1%	11%	<1%
Other	1%	1%	1%	<1%
Total	100%	100%	100%	100%

Source: Opinion Dynamics analysis of program tracking data.

Program Marketing and Outreach

Over the course of PY2016–2017, the DEP EEL program relied on a range of marketing and outreach tactics:

- **In-store events and special promotions.** In conjunction with DEP marketing, Ecova performed a total of 246 in-store events and demonstrations in PY2016–2017 across 54 unique storefronts, with an average of 21 events per month. Ecova held the events at storefronts that were top-sellers for the program. The 54 unique storefronts where events were held accounted for a total of 48% of program sales in PY2016–2017. During these events, Ecova field staff promoted program products and discounts and educated customers about the benefits of energy-efficient lighting products.
- **Store visits and POP marketing material placement.** Over the course of the year, Ecova completed a total of 3,393 store visits, during which field staff checked for the presence and proper placement of program POP materials, updated materials as necessary, and checked for sufficient levels of inventory of program-discounted lighting products. The frequency of store visits varied by retailer based on sales volumes. This enabled team members to concentrate their visits on stores that had higher sales volumes and also tended to discount more products.

- **Community events.** Over the course of the program year, Ecova completed a total of 17 community events in which the program field representatives visited community centers to provide educational materials.
- **Direct mail, mass media, and other marketing.** Other sources of program marketing in PY2016–2017 included targeted bill inserts, direct mailers, email blasts, web promos, radio spots, and billboards.
- **POP marketing material presence.** Evaluators verified the presence of POP marketing materials as part of their visits to 12 participating retailers. POP marketing materials were present at all participating locations.

Program Implementation Processes and Program Satisfaction

Program implementation processes were smooth and consistent, resulting in high levels of retailer and manufacturer satisfaction. Program staff whom we interviewed as part of the evaluation did not identify any implementation issues or bottlenecks. The average satisfaction rating of participating manufacturers and retailers was 9.4 on a scale of 0 to 10, where 0 is “extremely dissatisfied” and 10 is “extremely satisfied.” The average satisfaction rating for the product mix included in the program was 8.9, and average satisfaction with the discount size was 9.4 on the same scale. In fact, corporate-level retailers and manufacturers praised the DEP EEL program for being above average compared to similar programs across the country in terms of both incentive amounts and product mix.

“They are a top utility program across the country.”

Corporate-level manufacturers were also highly satisfied with the program data-tracking and invoicing processes. The average satisfaction rating was 9.0. Several manufacturer contacts did point to challenges associated with formatting data for submission, but still expressed satisfaction with the support they received around these issues.

“The support we get from Ecova makes it much easier. They're great at communicating...as far as implementers, the best in the country.”

“We struggle with some upload issues, but we tend to get those resolved very quickly.”

"It might take an extra hour to format data to be able to upload, but it means that it’s accurate and easy to read and understand."

Most store-level retailer contacts expressed high levels of satisfaction with marketing materials and training provided by Ecova, but some suggested that sturdier or larger signage could be helpful, and they provided an average satisfaction ratings of 7.8 Those familiar with program representatives or demonstrations expressed praise for their effectiveness and professionalism.

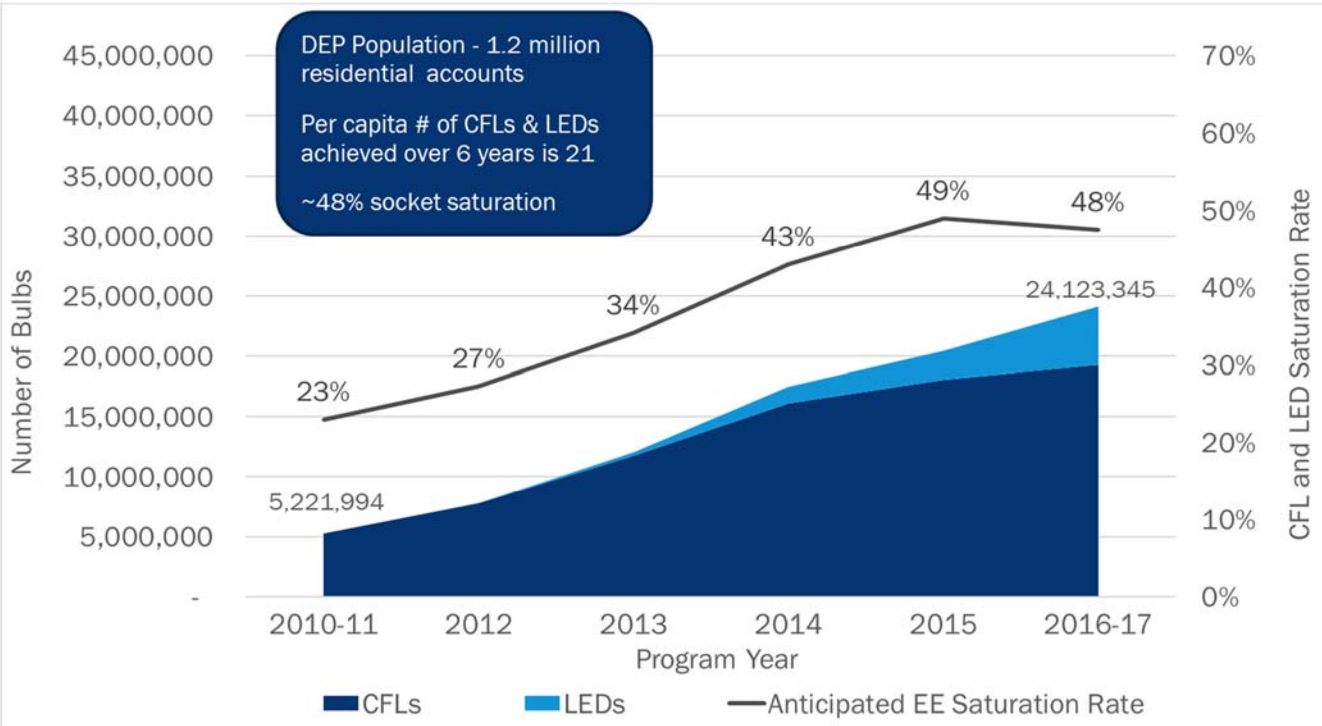
Program Impact in the DEP Service Territory and Market Trends

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[20] divide the adjusted number of program bulbs by the total number of

[20] Assuming a 5-year expected useful life (EUL) for a CFL.

residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use.

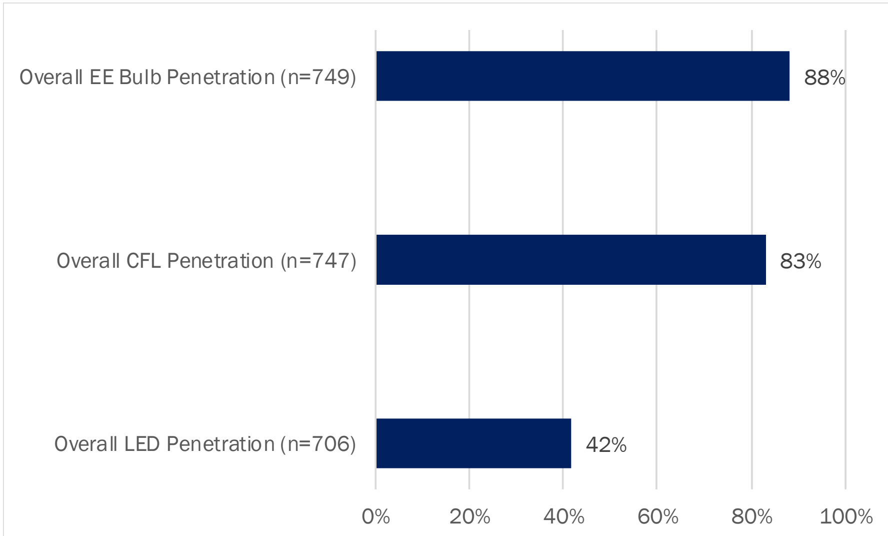
Figure 7-7. DEP EEL Program Impact on Efficient Bulb Saturation



Source: Opinion Dynamics analysis of program tracking data.
Note that 24,123,345 bulbs is not adjusted for CFL burnout, while the estimated saturation rate of 48% is adjusted for CFL burnout from the early program years.

Most customers in DEP jurisdiction have energy efficient products in their homes. As can be seen in Figure 7-8, nearly 9 in 10 customers reported having either CFLs or LEDs in their homes (88%), 83% reported having CFLs, and 42% reported having LEDs.

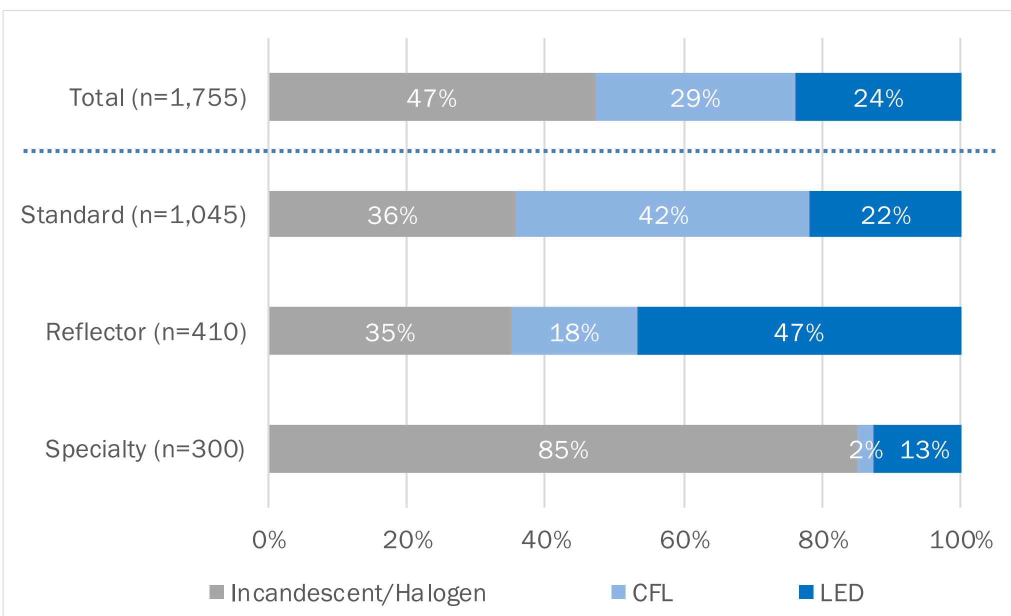
Figure 7-8. DEP EEL Program Energy-Efficient Product Penetration



Source: Opinion Dynamics analysis of site visit data.

As part of the lighting logger study, we collected detailed information on the lighting inventory in homes with LEDs. We found that even in homes with LEDs, a considerable number of sockets, especially specialty ones, contain less efficient bulbs. Figure 7-9 details the results. As can be seen in the figure, 24% of all sockets in homes with LEDs contain LEDs and 29% contain CFLs. LEDs are much more prominent among reflector products, accounting for 47% of all sockets, than in standard and specialty sockets, of which 22% and 13%, respectively, contain LEDs. Overall, 47% of all sockets and 83% of specialty sockets still have less-efficient light bulbs.

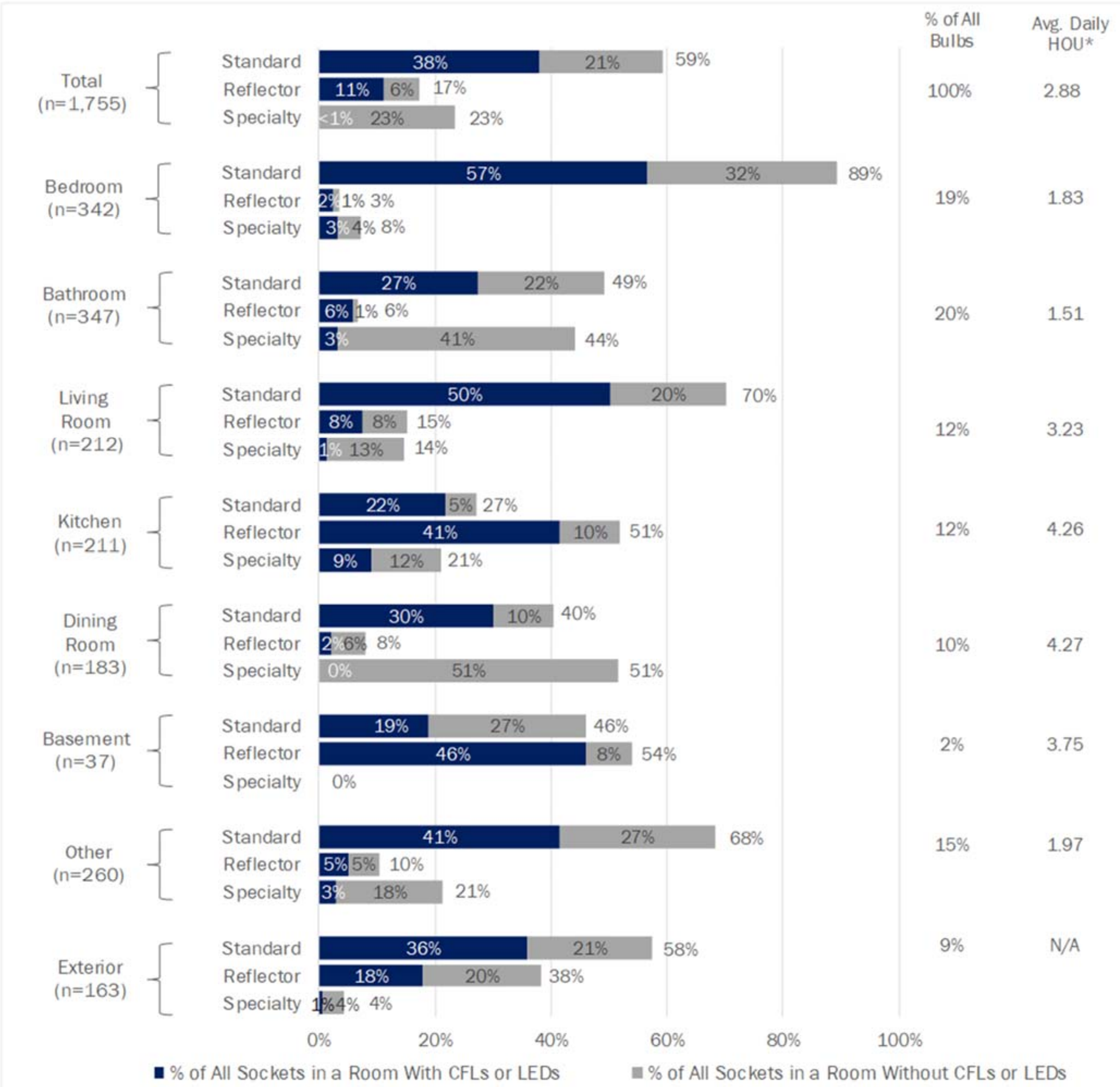
Figure 7-9. DEP EEL Program Bulb Mix in Homes with LEDs



Source: Opinion Dynamics analysis of site visit data.

An analysis of product mix by room in homes with LEDs shows pockets of opportunity. Figure 7-10 provides a breakdown of lighting products by technology and type in homes with LEDs. The figure also provides a percent distribution of all bulbs by room type, as well as average daily hours of use by room type. As can be seen in the figure, across room types, energy efficient bulbs are used more frequently in standard sockets than in specialty sockets. Energy-efficient product shares vary by room type, with kitchens having the highest share of energy-efficient products (72%) and dining rooms having the lowest (32%). More than half of light sockets in dining rooms (51%) are specialty sockets, and none of them have energy-efficient bulbs in them, which explains the low energy-efficient bulb share in this room type. Yet at the same time, dining rooms feature high average HOU (4.27 hours a day on average). Focusing program messaging on specialty products in dining rooms may help increase the marketing relevance and help the program reach these underserved sockets.

Figure 7-10. DEP EEL Program Product Mix by Room Type



Source: Opinion Dynamics analysis of site visit data.

* Average daily HOU values are for the DEP and DEC jurisdictions combined.
Note that percentages may not add up due to rounding.

A detailed analysis of the reported CFL and LED penetration among DEP customers, as well as an analysis of lighting composition in homes with LEDs, shows that there remain underserved customer segments. Table 7-2 provides a comparative analysis of the reported CFL and LED penetration rates among DEP customers, as well as the percent of sockets with LEDs among a subset of DEP customers with LEDs. As can be seen in the table, customers residing in multifamily and mobile homes, customers who rent their homes, older customers (ages

65+), customers with lower education levels, and customers with lower income levels (<$50,000) are less likely to have CFLs or LEDs in their homes. Furthermore, customers in these segments who have LEDs generally tend to have fewer LEDs. The program's continued focus on these underserved segments will ensure further transformation of the lighting market.

Table 7-2. DEP EEL Program CFL and LED Penetration by Customer Segment

Customer Segment	Energy-Efficient Light Bulb Penetration	CFL Penetration	LED Penetration	% of Sockets with LEDs*
Home Type				
Single-family	89%	84%	46%	24%
Multifamily	86%	82%	25%	26%
Mobile home	84%	75%	25%	7%
Homeownership				
Own	89%	84%	46%	24%
Rent	87%	82%	28%	26%
Age				
<35	90%	83%	31%	25%
35–64	91%	86%	45%	26%
65+	79%	73%	40%	15%
Education				
Less than college degree	85%	79%	35%	22%
College degree +	92%	87%	48%	25%
Income				
<$50,000	84%	77%	32%	27%
$50,000+	93%	88%	49%	22%

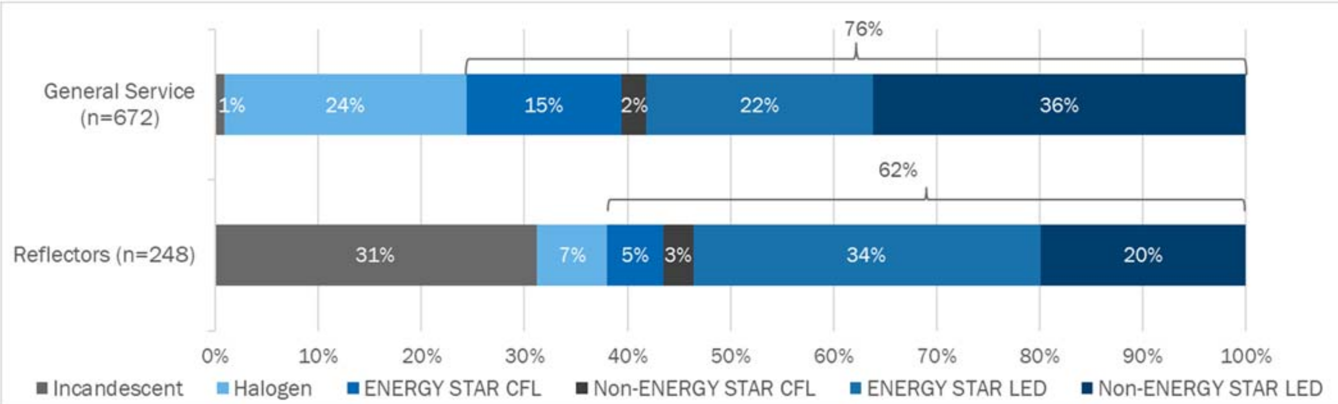
Source: Opinion Dynamics analysis of site visit data.

* Among customers who have LEDs.

shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Figure 7-11 provides a breakdown of the shelf space across lighting technologies. As can be seen in the figure, more than three-quarters of the general service products on the retailer shelves (76%) are CFLs and LEDs, and 58% are LEDs. Incandescent products are virtually not available and halogen products represent just under a quarter (24%) of all products. General service ENERGY STAR LEDs are more prominent than non-ENERGY STAR LEDs (36% vs. 22% of all general service products).

In the reflector product category, incandescent products are much more prominent than in the general service category, CFLs are a lot less prominent, and ENERGY STAR LEDs are more common than non-ENERGY STAR LEDs. Incandescent products account for almost a third of all products (31%), while CFLs and LEDs account for 62%, and LEDs account for 54%. ENERGY STAR LEDs account for a larger share of all reflector products than non-ENERGY STAR LEDs (34% vs. 20%). The reflector category may present a program opportunity due to a higher share of incandescent and halogen products.

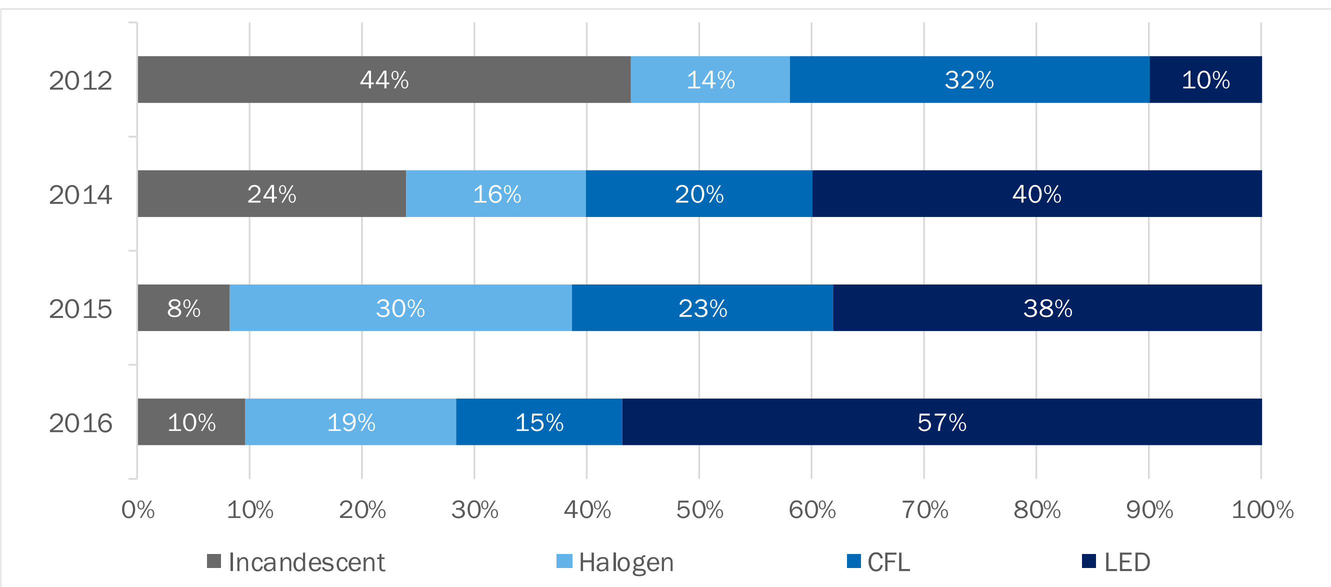
Figure 7-11. DEP EEL Program Shelf Composition of General Service and Reflector Products



Source: Opinion Dynamics analysis of shelf audit data.

The lighting products that retailers stock has changed rapidly, and the rate of change especially accelerated in the last year. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, the shelf space dedicated to LEDs grew from 38% to 57% (Figure 7-12).

Figure 7-12. DEP EEL Program Changes in the Lighting Shelf Space Composition Over Time



Source: Opinion Dynamics analysis of shelf audit data and prior evaluation reports.

The mix of bulb technologies varies by retailer channel, with Club stores carrying only CFLs and LEDs, in both the general service and reflector categories.[21] DIY and Big Box stores are the retailers with the highest percentage of halogen general service products (25% and 30%, respectively), while DIY and Hardware stores

[21] Note that the Dollar/Discount store that we visited as part of the shelf audit was a participating store and was carrying only program LEDs.

are the retailers with the highest percentage of reflector incandescent and halogen products (41%). Focusing program efforts on further shifting the shelf space away from incandescent and halogen products at these retailer channels, while further reducing program presence at the Club stores, could help increase program impact on the market.

Table 7-3. DEP EEL Program Lighting Shelf Space Composition by Retailer Channel

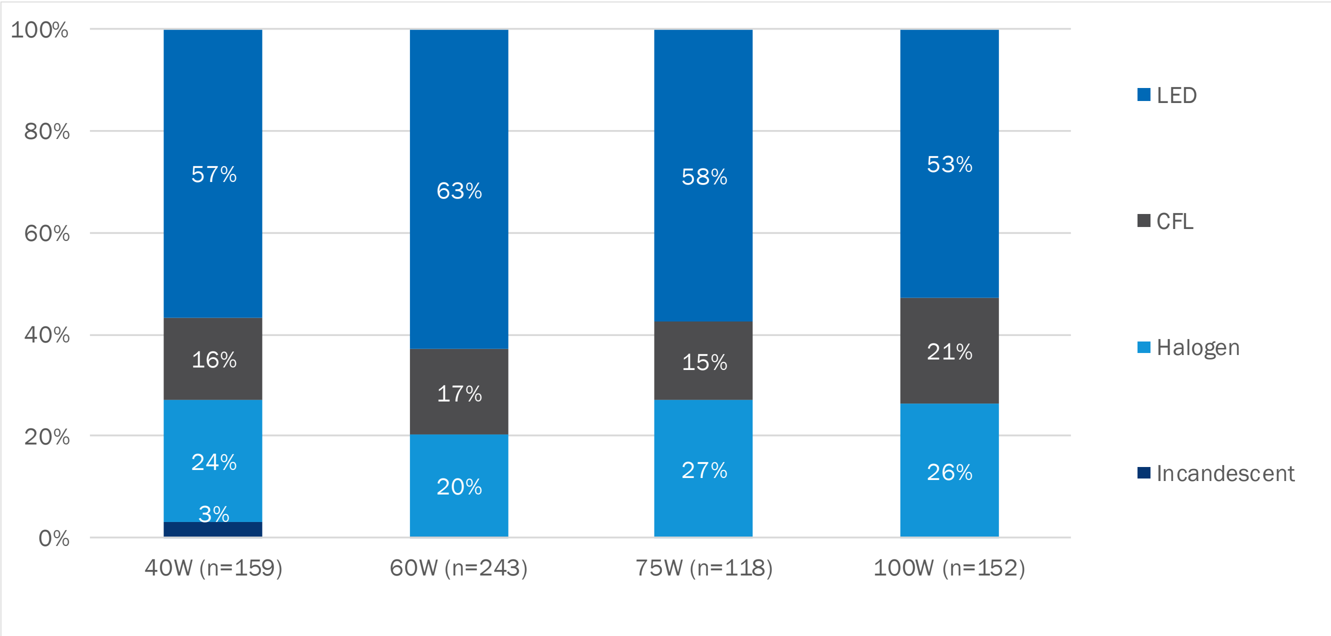
Retailer Channel	Big Box (2 stores)	Club (4 stores)	DIY (5 stores)	Dollar/ Discount (1 store)*	Hardware (3 stores)	Total (15 stores)
General Service Products						
Number of Products (n=)	*194*	*14*	*281*	*2*	*181*	*672*
Incandescent	0%	0%	0%	0%	3%	1%
Halogen	25%	0%	30%	0%	14%	24%
CFLs (Non-ENERGY STAR)	0%	0%	0%	0%	9%	2%
CFLs (ENERGY STAR)	0%	14%	16%	0%	29%	15%
LEDs (Non-ENERGY STAR)	59%	43%	31%	0%	20%	36%
LEDs (ENERGY STAR)	15%	43%	23%	100%	24%	22%
Total	100%	100%	100%	100%	100%	100%
Reflector Products						
Number of Products (n=)	*51*	*9*	*150*	*0*	*66*	*276*
Incandescent	33%	0%	29%	N/A	39%	31%
Halogen	0%	0%	12%	N/A	2%	7%
CFLs (Non-ENERGY STAR)	2%	0%	0%	N/A	11%	3%
CFLs (ENERGY STAR)	0%	22%	3%	N/A	12%	5%
LEDs (Non-ENERGY STAR)	22%	22%	23%	N/A	11%	20%
LEDs (ENERGY STAR)	43%	56%	33%	N/A	26%	34%
Total	100%	100%	100%	N/A	100%	100%

Source: Opinion Dynamics analysis of shelf audit data.

* Participating store.

An analysis of shelf space by most common bulb wattages shows that the share of energy-efficient products is relatively evenly distributed across standard bulb wattages. As can be seen in Figure 7-13, between 20% and 27% of products within a given wattage category are incandescent or halogen. LEDs, however, are slightly more prominent in the most popular 60-watt equivalent wattage.

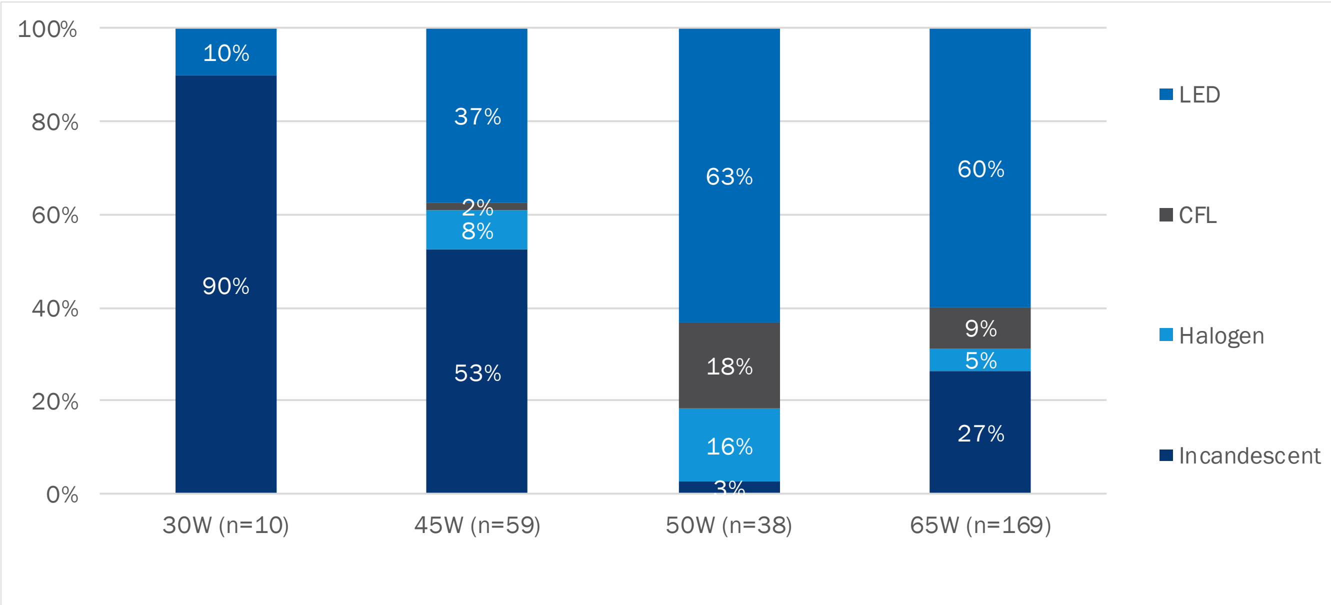
Figure 7-13. DEP EEL Program General Service Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

When it comes to reflectors, however, the technology mix varies considerably depending on the wattage. Lower-wattage reflectors (30-watt and 45-watt equivalents) are dominated by incandescents (90% and 53% of all products, respectively), while 50-watt and 65-watt equivalents are dominated by LEDs (63% and 60%, respectively). Across all stores, lower-wattage reflector products account for a quarter of all reflector products (25%), which represents a considerable share of products. Increasing the volume of lower-wattage reflector products discounted through the program may help further increase program impact on the lighting market transformation.

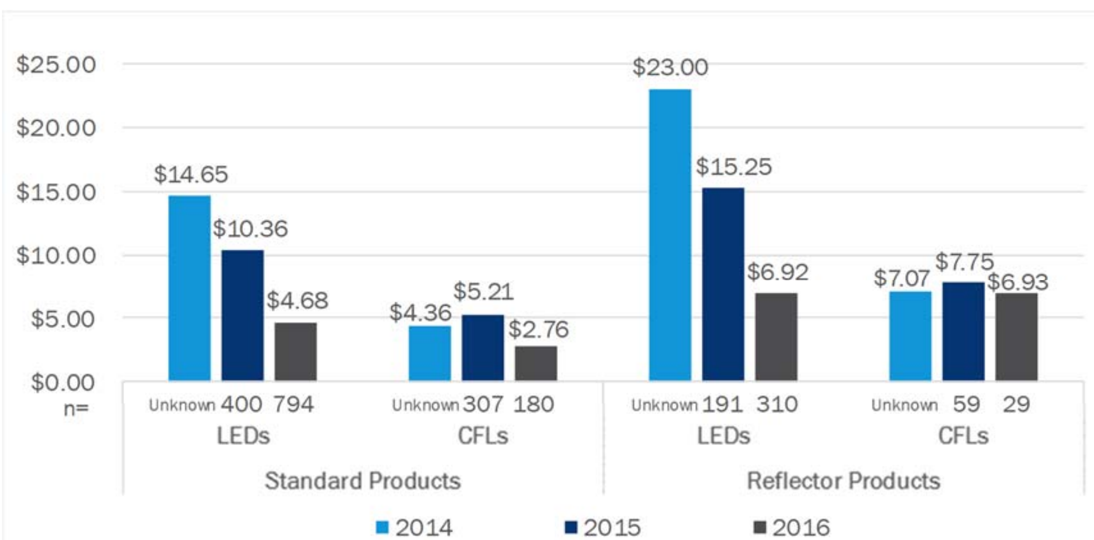
Figure 7-14. DEP EEL Program Reflector Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

In addition to becoming increasingly available on the store shelves, LEDs prices dropped considerably, making them more affordable. As part of the shelf audits, Opinion Dynamics collected data on product pricing for general service and reflector LEDs and CFLs. As can be seen in Figure 7-15, general service LED prices dropped from an average of $10.36 per bulb to $4.68 over the course of a year, and reflector LED prices dropped from an average of $15.25 per bulb to $6.92 over the course of a year. General service CFL prices also decreased, from an average of $5.21 per bulb to $2.76. Reflector CFL prices remained relatively stable over time.

Figure 7-15. DEP EEL Program Changes in Non-Discounted Light Bulb Prices Over Time



Source: Opinion Dynamics analysis of shelf audit data.

Despite the drops in price, CFLs and LEDs continue to be the most expensive product on the market, and halogens continue to be the least expensive lighting technology. As can be seen in Table 7-4, the average price is $1.98 for a general service halogen, $2.76 for a general service CFL, and $4.68 for a general service LED. The average price for a reflector incandescent is $4.69, for a reflector halogen is $6.24, and for a reflector CFL is $6.93. The average price for a reflector LED is $6.92. For the price-sensitive customer segments, such as lower-income residential customers, program incentives can help bring LEDs on par with halogen and incandescent pricing, thus making the technology an affordable alternative.

Table 7-4. DEP EEL Program General Service and Reflector Pricing

	Average Price (15 stores)	Min Price (15 stores)	Max Price (15 stores)
General Service Products (n=672)			
Incandescent	$0.92	$0.60	$1.25
Halogen	$1.98	$1.60	$2.36
CFLs	$2.76	$2.18	$3.33
LEDs	$4.68	$3.89	$5.48
Reflector Products (n=672)			
Incandescent	$4.69	$4.06	$5.31
Halogen	$6.24	$6.05	$6.44
CFLs	$6.93	$5.84	$8.02
LEDs	$6.92	$5.74	$8.10

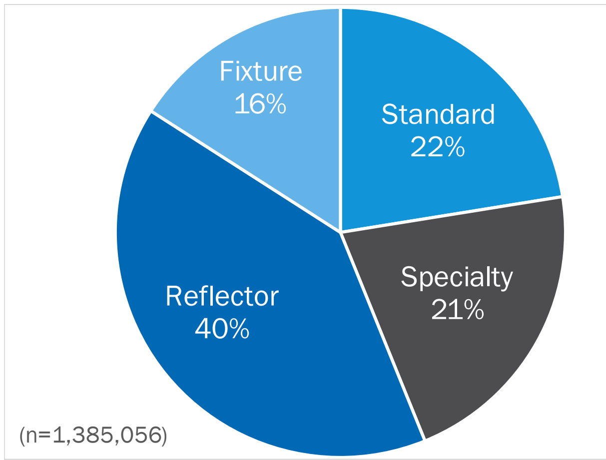
Source: Opinion Dynamics analysis of shelf audit data.

7.2.2 DEC Retail LED Program

Program Participating Product Mix

The DEC Retail LED program sold 1,385,056 LED bulbs and fixtures in PY2016–2017. As can be seen in Figure 7-16, reflector LEDs accounted for the largest share of the program sales (40%). Standard LEDs accounted for 22% of all sales, specialty LEDs for 21%, and LED fixtures for 16%.

Figure 7-16. DEC Retail LED Program Technology Shares by Product Type



Source: Opinion Dynamics analysis of program tracking data.

Over the course of PY2016–2017, the DEC Retail LED program discounted 384 unique products across a range of bulb types and wattages. Program staff effectively managed this number of products, which is evidenced in clean and accurate program sales records (discussed in greater detail in Section 5.2 of this report) and high levels of retailer and manufacturer satisfaction described later in this section.

The DEC Retail LED program discounted a range of pack sizes over the course of PY2016–2017. Figure 7-17 provides a breakdown of program sales by pack size. As can be seen in the figure, more than half of standard and specialty and reflector LEDs (59% and 57%, respectively) were sold in single packs, and 80% of LED fixtures were sold in single packs. A very small percent of reflector and specialty products (2%) were sold in six-packs, and none of the standard LEDs were sold in packages larger than four-bulb packs.

Figure 7-17. DEC Retail LED Program Sales by Package Type

Distribution of Program Sales Across Pack Sizes by Technology

						Total
Standard LEDs (n=159,896)	59%	8%	13%	20%	0%	100%
Reflector and specialty LEDs (n=453,825)	57%	15%	15%	11%	2%	100%
LED fixtures (n=186,563)	82%	18%	0%	0%	0%	100%

Source: Opinion Dynamics analysis of program tracking data.

Average program discounts ranged from $3.38 for specialty LEDs to $8.11 for fixtures. Depending on the product category, the average discount as a percentage of MSRP ranged from 45% for reflector LEDs to 55% for standard LEDs. The average program discount across all product categories was $4.49, which represents on average 46% of MSRP. Figure 7-18 provides an overview of the program discounts by product type in PY2016–2017. As can be seen in the figure, discounts for standard and specialty LEDs were generally on par, at $3.40 and $3.38, respectively. Discounts on LED fixtures were the highest, at $8.11.

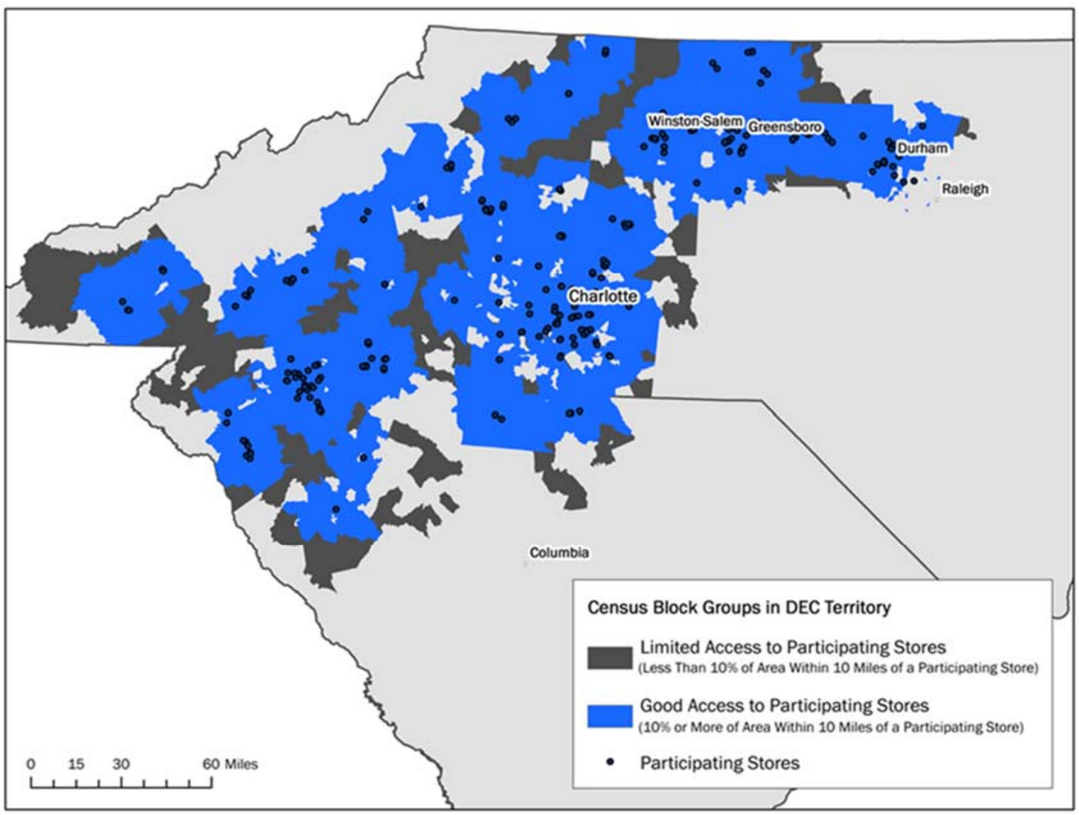
Figure 7-18. DEC Retail LED Program Pricing

Source: Opinion Dynamics analysis of program tracking data.

Program Retailer Mix

The retailer mix in PY2016–2017 included a range of retailer channels. The program engaged eight unique retailers across 300 storefronts in PY2016–2017. Through the participating retailer mix, the program maintained good coverage of the DEC jurisdiction, thus ensuring equitable customer access to program-discounted lighting products. Figure 7-19 displays the coverage of the DEC jurisdiction with participating retailers. Blue and dark gray areas on the map combined show the DEC jurisdiction boundaries. The areas of the map colored in blue show census block groups with good access to program participating storefronts, while areas in dark grey show census block group with limited access to program participating storefronts. As can be seen, most of the census block groups in the DEC jurisdiction have good access to program participating stores.

Figure 7-19. DEC Retail LED Program Participating Retailer Coverage of DEC Jurisdiction



Source: Opinion Dynamics GIS analysis.

Table 7-5 shows a breakdown of participating retailers, storefronts, and program sales across retailer channels. Club stores cumulatively captured close to half of program sales (47%), and DIY stores captured an additional 36% of sales. The program discounted 10% of products through the Dollar/Discount channel. A continued focus on the Dollar/Discount channel is important to reach underserved customer segments and also helps to maintain NTGRs.

Table 7-5. DEC Retail LED Program Participating Retailer Mix

Retail Channel	# of Retailers	% of Storefronts (n=300)	% of Sales (n=1,385,056)
Club	2	7%	47%
DIY	2	26%	36%
Dollar/Discount	3	44%	10%
Big Box	1	23%	7%
Total	8	100%	100%

Source: Opinion Dynamics analysis of program tracking data.

Program Marketing and Outreach

Over the course of PY2016–2017, the DEC Retail LED program relied on a range of marketing and outreach tactics:

- **In-store events and special promotions.** In conjunction with DEC marketing, Ecova performed a total of 236 in-store events and demonstrations in PY2016–2017 across 47 unique storefronts, with an average of 20 events per month. Ecova held the events at storefronts that were top-sellers for the program. The 47 unique storefronts where events were held accounted for a total of 62% of program sales in PY2016–2017. During these events, Ecova field staff promoted program products and discounts and educated customers about the benefits of energy-efficient lighting products.
- **Store visits and POP marketing material placement.** Over the course of the year, Ecova completed a total of 3,156 store visits, during which field staff checked for the presence and proper placement of program POP materials, updated materials as necessary, and checked for sufficient levels of inventory of program-discounted lighting products. The frequency of store visits varied by retailer based on sales volumes. This enabled team members to concentrate their visits on stores that had higher sales volumes and also tended to discount more products.
- **Community events.** Over the course of the program year, Ecova completed a total of 19 community events in which the program field representatives visited community centers to provide educational materials.
- **Direct mail, mass media, and other marketing.** Other sources of program marketing in PY2016–2017 included targeted bill inserts, direct mailers, email blasts, web promos, radio spots, and billboards.
- **POP marketing material presence.** Evaluators verified the presence of POP marketing materials as part of their visits to 10 participating retailers. POP marketing materials were present at 9 out of 10 participating locations.

Program Implementation Processes and Program Satisfaction

Program implementation processes were smooth and consistent, resulting in high levels of retailer and manufacturer satisfaction. Program staff whom we interviewed as part of the evaluation did not identify any implementation issues or bottlenecks. Corporate manufacturer contacts gave an average overall satisfaction rating of 9.3, and store employees gave an average rating of 8.9 on a scale of 0 to 10, where 0 is “extremely dissatisfied” and 10 is “extremely satisfied.”

“They’re in the top 1% of all the 50 or 60 utility programs we participate in.”

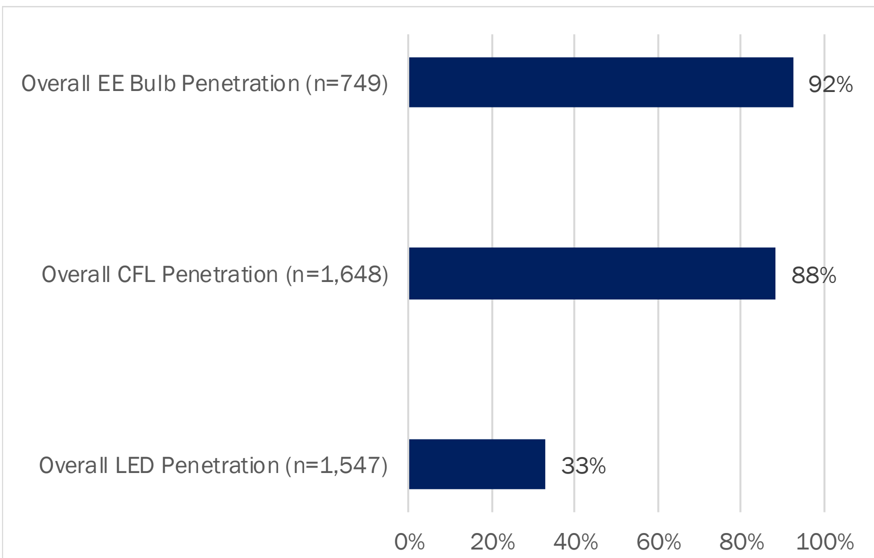
– *(Director of Sales at participating manufacturer)*

Corporate manufacturer contacts gave an average rating of 9.0 for the tracking and invoicing process, and had only positive feedback regarding interactions with Ecova. Satisfaction with the program's product mix received slightly lower ratings from both manufacturers and retailer staff (8.8 on average); some were confused by the exclusion of 60W and 75W standard bulbs. Store employees gave lower ratings to program marketing materials (7.4 on average), and suggested that sturdier signage might be helpful to avoid having it knocked down.

Program Impact in the DEC Service Territory and Market Trends

By discounting more than 1.3 million products since its inception, the program contributed to energy-efficient bulb penetration. In 2016, based on the results from the Residential Lighting Logger study, more than 9 in 10 (92%) customers had either LEDs or CFLs in their homes, 88% had CFLs, and 33% had LEDs (Figure 7-20).

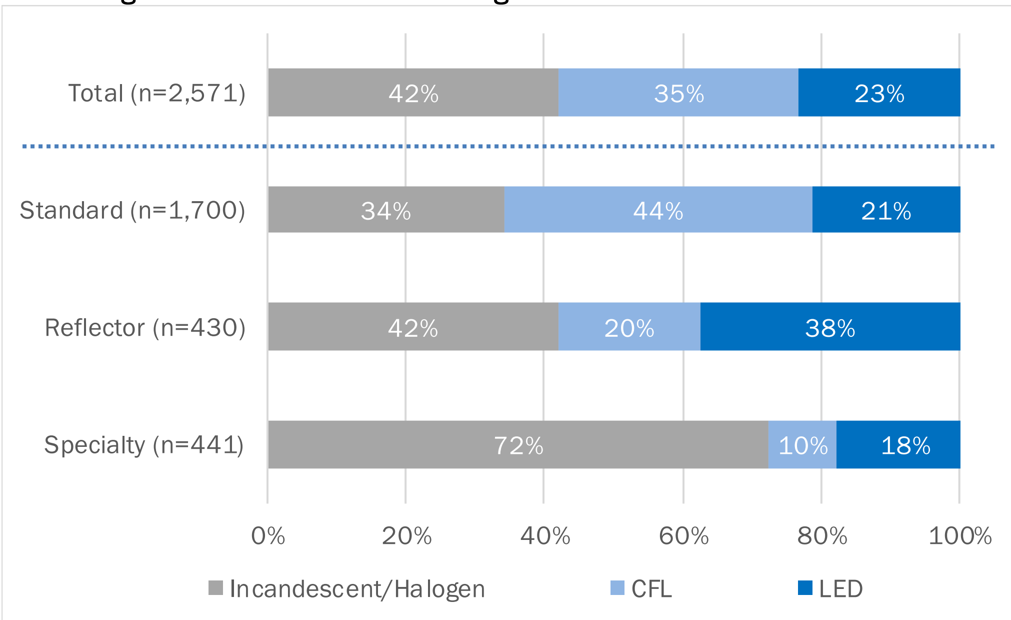
Figure 7-20. DEC Retail LED Program Energy-Efficient Product Penetration



Source: Opinion Dynamics analysis of site visit data.

As part of the lighting logger study, we collected detailed information on the lighting inventory in homes with LEDs. We found that even in home with LEDs, a considerable number of sockets, especially specialty ones, contain less-efficient technologies. Figure 7-21 details the results. As can be seen in the figure, 23% of all sockets in homes with LEDs contain LEDs and 35% contain CFLs. LEDs are much more prominent among reflector products, accounting for 38% of all sockets, than in standard and specialty sockets, where 21% and 18% of sockets, respectively, contain LEDs. Overall, 43% of all sockets and 72% of specialty sockets still have less-efficient light bulbs.

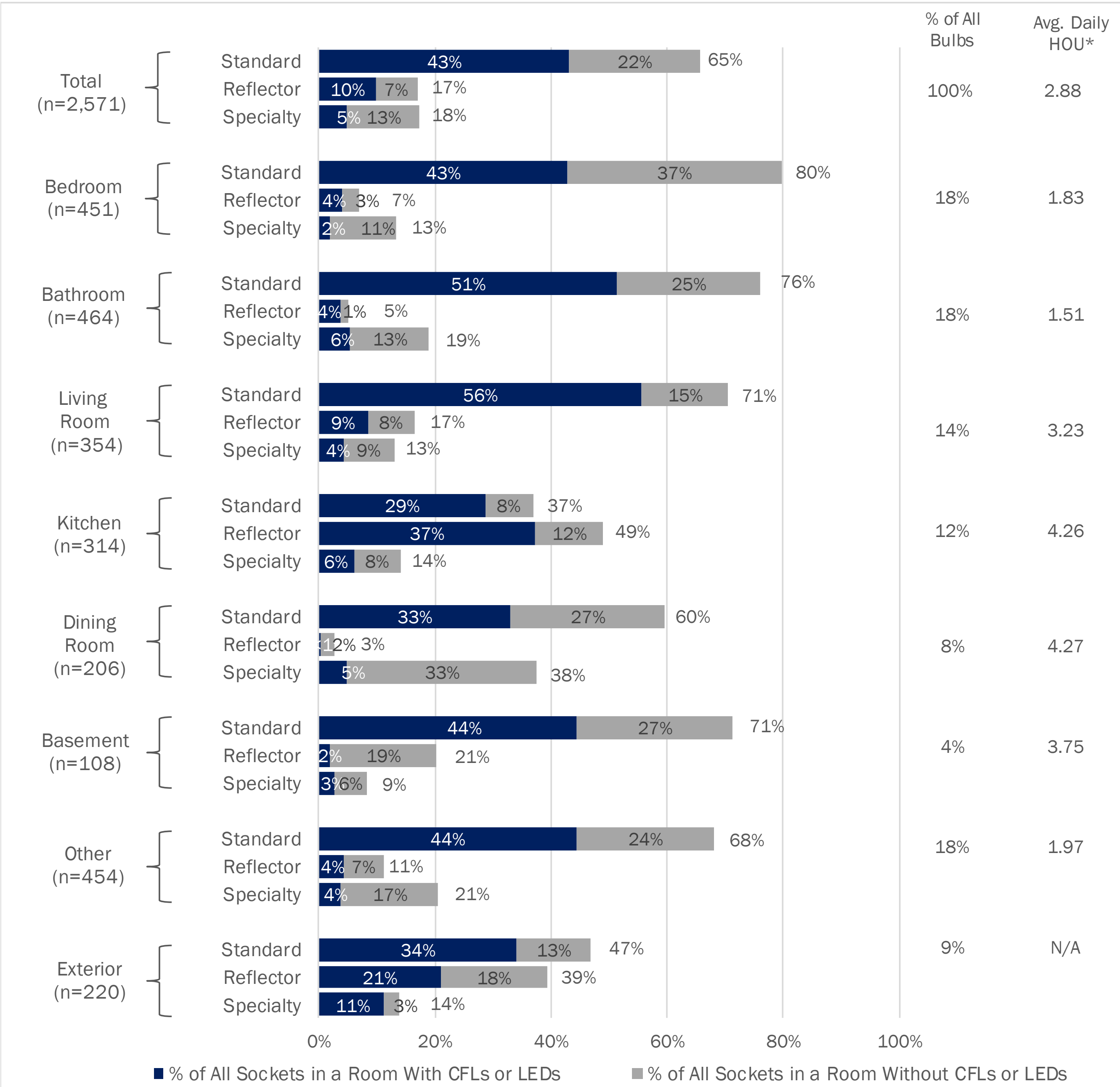
Figure 7-21. DEC Retail LED Program Bulb Mix in Homes with LEDs



Source: Opinion Dynamics analysis of site visit data.

An analysis of product mix by room in homes with LEDs shows pockets of opportunity. Figure 7-22 provides a breakdown of lighting products by technology and type in homes with LEDs. The figure also provides a percent distribution of all bulbs by room type, as well as average daily HOU by room type. As can be seen in the figure, across nearly all room types, energy efficient bulbs are used more frequently in standard sockets than in specialty sockets. Energy-efficient product shares vary by room type, with kitchens having the highest share of energy-efficient products (72%) and dining rooms having the lowest (38%). A considerable percent of light sockets in dining rooms (40%) are specialty sockets, and few of them have energy-efficient bulbs in them, which explains the low energy-efficient bulb share in this room type. Yet at the same time, dining rooms feature high average HOU (4.27 hours a day on average). Focusing program messaging on specialty products in dining rooms may help increase the marketing relevance and help the program reach these underserved sockets.

Figure 7-22. DEC Retail LED Program Product Mix by Room Type



Source: Opinion Dynamics analysis of site visit data.

* The average daily HOU values are for the DEP and DEC jurisdictions combined.
Note that percentages may not add up due to rounding.

A detailed analysis of the reported CFL and LED penetration among DEC customers, as well as an analysis of lighting composition in homes with LEDs, shows that there remain underserved customer segments. Table 7-6 provides a comparative analysis of the reported CFL and LED penetration rates among DEC customers, as well as the percent of sockets with LEDs among a subset of DEC customers with LEDs. As can be seen in the table, customers residing in multifamily and mobile homes, older customers (ages 65+), customers with lower education levels, and customers with lower income levels (<$50,000) are less likely to have CFLs or LEDs in their homes. Furthermore, customers in these segments who have LEDs generally tend to have fewer LEDs. The program's continued focus on these underserved segments will ensure further transformation of the lighting market.

Table 7-6. DEC Retail LED Program CFL and LED Penetration by Customer Segment

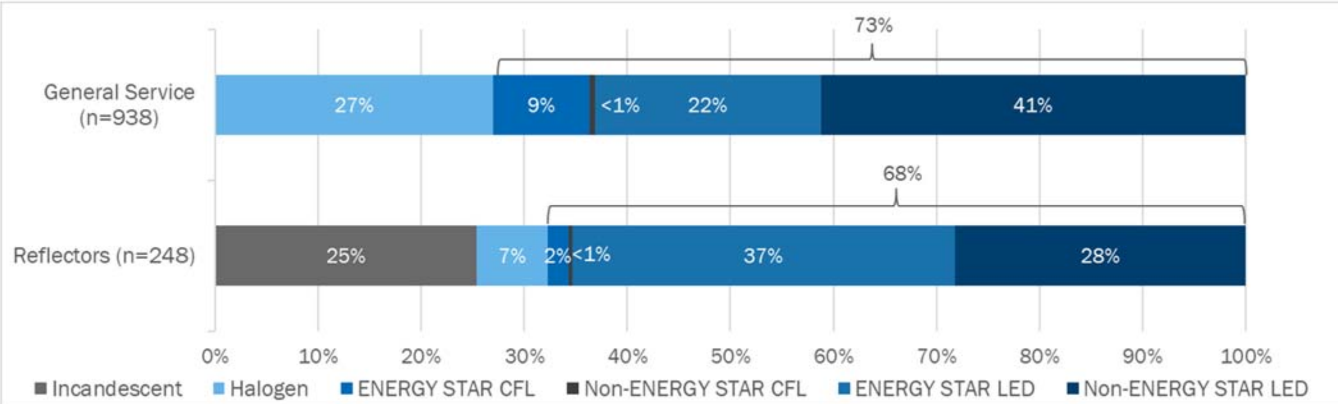
Customer Segment	Energy-Efficient Light Bulb Penetration	CFL Penetration	LED Penetration	% of Sockets with LEDs
Home Type				
Single-family	94%	90%	37%	23%
Multifamily	89%	85%	24%	32%
Mobile home	89%	85%	22%	35%
Homeownership				
Own	93%	89%	38%	23%
Rent	92%	88%	24%	32%
Age				
<35	93%	90%	27%	36%
35-64	94%	90%	36%	39%
65+	88%	81%	32%	21%
Education				
Less than college degree	91%	86%%	29%	25%
College degree +	95%	92%	39%	23%
Income				
<$50,000	90%	86%	25%	21%
$50,000+	96%	92%	96%	24%

Source: Opinion Dynamics analysis of site visit data.

Energy-efficient lighting products are not only prominent in DEC customers' homes but also on the store shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Figure 7-23 provides a breakdown of the shelf space across lighting technologies. As can be seen in the figure, close to three-quarters of the general service products on the retailer shelves (73%) are CFLs and LEDs, and 63% are LEDs. Incandescent products are not available and halogen products represent just over a quarter (27%) of all general service products. General service ENERGY STAR LEDs are more prominent than non-ENERGY STAR LEDs (41% vs. 22% of all general service products).

In the reflector product category, incandescent products are much more prominent than in the general service category, CFLs are a lot less prominent, and ENERGY STAR LEDs are more common than non-ENERGY STAR LEDs. Incandescent products account for a quarter of all products (25%), while CFLs and LEDs account for 68%, and LEDs account for 65%. ENERGY STAR LEDs account for a larger share of all reflector products than non-ENERGY STAR LEDs (37% vs. 28%). The reflector category may present a program opportunity due to a higher share of incandescent and halogen products.

Figure 7-23. DEC Retail LED Program Shelf Composition of General Service and Reflector Products



Source: Opinion Dynamics analysis of shelf audit data.

The mix of bulb technologies varies by retailer channel, with Club stores carrying only CFLs and LEDs in the general service category and only LEDs in the reflector category. Both DIY and Big Box stores carried halogen general service products (26% and 29%, respectively) and halogen and incandescent reflector products (36% and 32%, respectively). Focusing program efforts on further shifting the shelf space away from incandescent and halogen products at these retailer channels, while further reducing program presence at the Club stores, can help increase program impact on the market. As presented in Section 6.2 of this report, based on the retailer and manufacturer interviews, the NTGR is the lowest for the Club retailer channel (0.33) compared to the Big Box, DIY, and Dollar/Discount channels (0.46, 0.51, and 1.00, respectively). Further decreasing focus on the Club retailer channel could help increase the program's net impacts.

Table 7-7. DEC Retail LED Program Lighting Shelf Space Composition by Retailer Channel

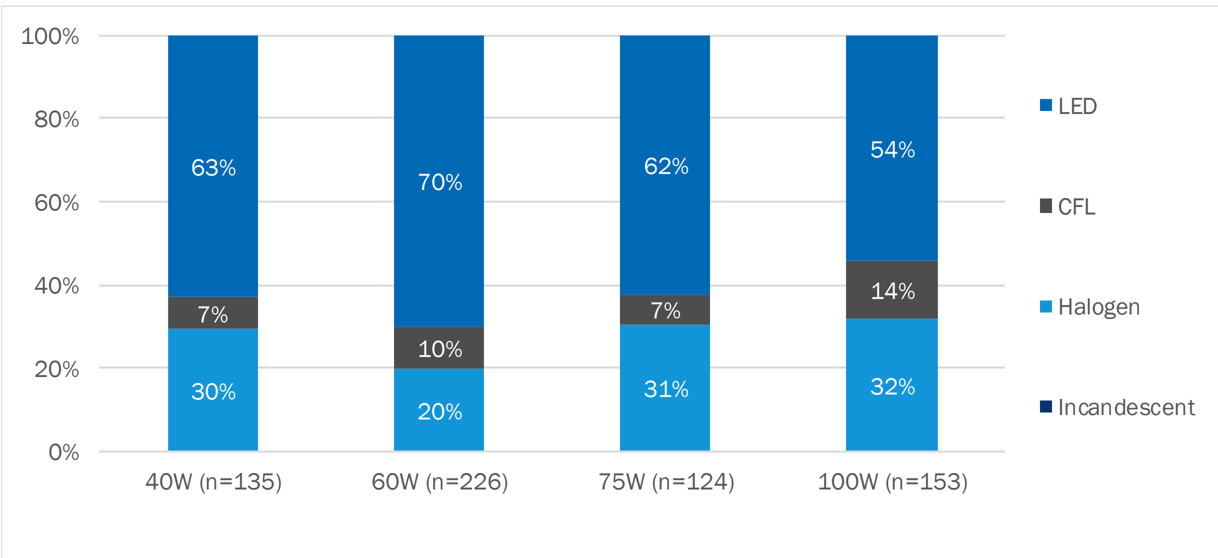
Retailer Channel	Big Box (3 stores)	Club (6 stores)	DIY (6 stores)	Total (15 stores)
Number of Products (n=)	*296*	*18*	*324*	*638*
Incandescent	–	–	–	–
Halogen	26%	0%	29%	27%
CFLs (Non-ENERGY STAR)	0%	0%	1%	0%
CFLs (ENERGY STAR)	0%	0%	19%	9%
LEDs (Non-ENERGY STAR)	56%	39%	27%	41%
LEDs (ENERGY STAR)	18%	61%	24%	22%
Total	100%	100%	100%	100%
Number of Products (n=)	*74*	*10*	*164*	*248*
Incandescent	36%	0%	22%	25%

Retailer Channel	Big Box (3 stores)	Club (6 stores)	DIY (6 stores)	Total (15 stores)
Halogen	0%	0%	10%	7%
CFLs (Non-ENERGY STAR)	0%	0%	1%	0%
CFLs (ENERGY STAR)	0%	0%	3%	2%
LEDs (Non-ENERGY STAR)	31%	0%	29%	28%
LEDs (ENERGY STAR)	32%	100%	35%	37%
Total	100%	100%	100%	100%

Source: Opinion Dynamics analysis of shelf audit data.

An analysis of shelf space by most common bulb wattage shows that the share of energy-efficient products is relatively evenly distributed across standard bulb wattages. As can be seen in Figure 7-24, between 20% and 32% of products within a given wattage category are halogen. LEDs, however, are slightly more prominent in the most popular 60-watt equivalent category, accounting for 70% of all products.

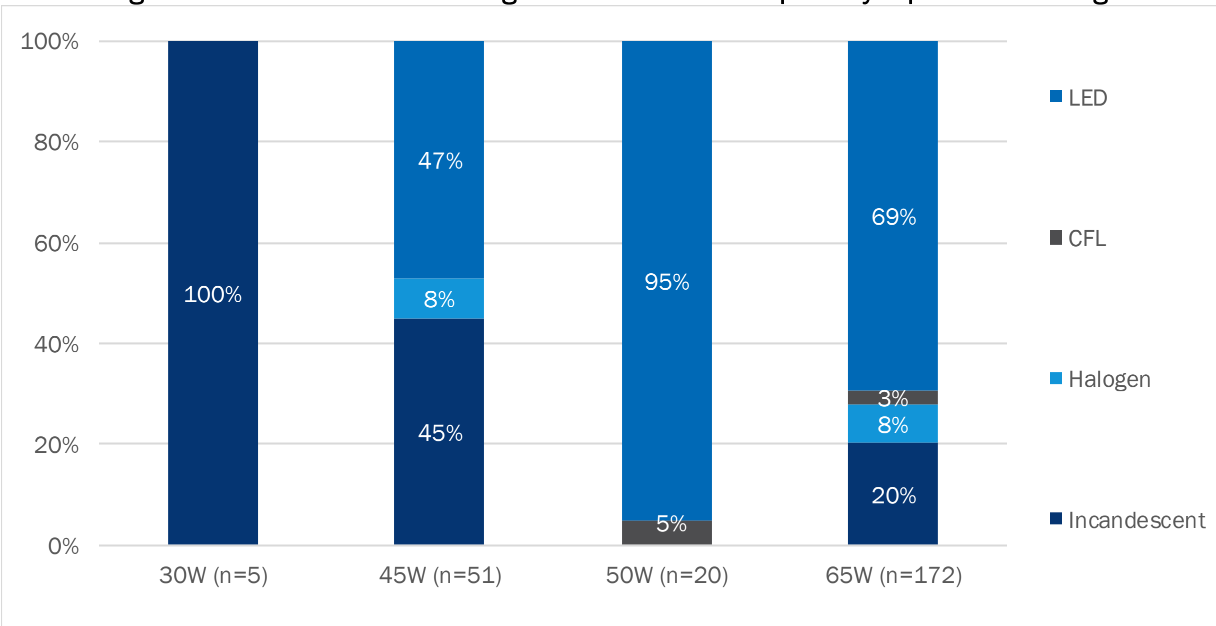
Figure 7-24. DEC Retail LED Program General Service Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

When it comes to reflectors, however, the technology mix varies considerably depending on the wattage. Lower-wattage reflectors (30-watt equivalent) are dominated by incandescents (100% of all products), while 50-watt and 65-watt equivalents are dominated by LEDs (95% and 69%, respectively). Across all stores, lower-wattage reflector products (30-watt and 45-watt) account for just under a quarter of all reflector products (23%). Increasing the volume of lower-wattage reflector products discounted through the program may help further increase program impact on the lighting market transformation.

Figure 7-25. DEC Retail LED Program Reflector Shelf Space by Equivalent Wattage



Source: Opinion Dynamics analysis of shelf audit data.

Despite their prominence on the store shelves, CFLs and LEDs continue to be the most expensive product on the market, and halogens continue to be the least expensive one. As can be seen in Table 7-8, the average price is $1.99 for a general service halogen, $2.87 for a general service CFL, and $4.87 for a general service LED. Average price for a reflector incandescent is $4.26, a reflector halogen is $5.33, a reflector CFL is $6.26, and reflector LED is $7.01. For the price-sensitive customer segments, such as lower-income residential customers, program incentives can help bring LEDs on par with the halogen and incandescent pricing, thus making the technology an affordable alternative.

Table 7-8. DEC Retail LED Program General Service and Reflector Pricing

	Average Price (15 stores)	Min Price (15 stores)	Max Price (15 stores)
General Service Products (n=638)			
Halogen	$1.99	$1.54	$2.44
CFLs	$2.87	$2.54	$3.21
LEDs	$4.87	$3.92	$5.81
Reflector Products (n=248)			
Incandescent	$4.26	$3.84	$4.68
Halogen	$5.33	$5.33	$5.33
CFLs	$6.26	$5.99	$6.52
LEDs	$7.01	$6.10	$7.91

Source: Opinion Dynamics analysis of shelf audit data.

7.2.3 Future Trends

We asked retailers and manufacturers about future trends in the lighting industry. Almost unanimously, respondents predicted further increase in LED shelf space and market shares at the expense of both CFL and halogen products. Many retailer and manufacturer contacts predicted that CFLs would be completely or nearly gone from shelves in the next 5 years. Some alluded to increased prominence of alternative technologies, such as smart bulbs or even some new unforeseen technology.

"I think [CFLs] are going to be done. They are slowly going to start trickling away…and the price points of LEDs are going to contribute to the demise of CFLs."

Market trends and developments support these finding. General Electric stopped manufacturing CFLs as of early 2017.[22] New ENERGY STAR standards, put into effect in January 2017, increased lumen per-watt standards for CFLs and relaxed lifetime standards for LEDs, meaning current CFLs lost their ENERGY STAR designation and many LEDs gained it.[23] As more LED products become ENERGY STAR certified, demand for those products is likely to increase further. Finally, EISA 2020 is not far off, which will further increase lighting energy efficiency standards and likely drive manufacturing and distribution practices away from halogens, leaving energy-efficient LEDs and CFLs as the only options in the market. However, when we asked manufacturers whether they had plans in place to change their manufacturing practices in anticipation of EISA 2020, none of the respondents said that they did, citing, among other reasons, general uncertainty related to the current political climate.

As part of the interviews, we also asked retailers and manufacturers about their expectations for the future lighting market both with and without the program. Opinions about the program's value in shifting the lighting market going forward were mixed. More than a third (36%) of store-level interviewees expected that the market would be unaffected by the program moving forward, while just over one-quarter (27%) thought customers would revert to less-efficient alternatives, and slightly less than one-quarter of respondents (23%) expected that the adoption of new technologies would be slowed somewhat in the absence of the program.

[22] http://pressroom.gelighting.com/news/leave-cfl-in-the-dark-and-light-up-your-love-for-led#.Vs56ksv2Zkg.

[23] https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2_0%20Program%20Requirements.pdf.

8. Conclusions and Recommendations

8.1 DEP EEL Program

From its inception in 2010 through the end of current evaluation period (March 2017), the DEP EEL program discounted a total of 29,520,349 CFL and LED bulbs and fixtures, of which, we estimate that 24,123,345 were purchased by DEP residential customers. If the 1.2 million DEP residential customers equally purchased the 24,122,648 bulbs, each would have purchased an average of 21 bulbs. If we were to account for CFL burnout from early program years,[24] divide the adjusted number of program bulbs by the total number of residential DEP customers, and assume that a typical home has 53 sockets, we estimate that at the end of 2016, program-discounted bulbs would be installed in close to half of all residential sockets (48%). This is a large impact on efficient bulb use. The program continued efforts to reach underserved customer segments and sockets by maintaining a relatively high share of sales through the Dollar/Discount channel (which attracts lower-income shoppers) and increasing the focus on specialty products (standard bulb sales decreased by 8% between PY2015 and PY2016–2017).

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 744 unique products across 289 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-based venues.

The transition of the lighting market in the DEP jurisdiction continued at an accelerated pace. Compared to the fall of 2012, when LED products accounted for just 10% of all general service products on the store shelves in the DEP jurisdiction, in 2016, LEDs accounted for 57% of the shelf space. Between 2015 and 2016, LEDs grew from 38% to 57% of all lighting products on store shelves.

LED prices have decreased dramatically over time. More specifically, based on the shelf audit research conducted over time, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68 in 2016, which represents a 68% drop in price. Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. These decreasing prices made LEDs more affordable and accessible to the broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs no longer eligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated in the energy-efficient lighting penetration in the DEP jurisdiction: Nearly 9 in 10 DEP customers (88%) reported having CFLs or LEDs in their homes and 42% reported having LEDs in their homes.

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among

[24] Assuming a 5-year expected useful life (EUL) for a CFL.

a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are bound to take place in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEP EEL program, will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase underserved customer segments through the mass market program design. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage products, and by adjusting program marketing and messaging to focus on underserved sockets and to increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phase of EISA to identify optimal timing for program completion.

8.2 DEC Retail LED Program

By discounting more than 1.3 million products since its inception, the DEC Retail LED program contributed to the lighting market transformation in the DEC jurisdiction. Program interventions indisputably contributed to energy-efficient bulb penetration.

Program implementation processes were smooth and effective, resulting in high levels of stakeholder and market actor satisfaction. Program staff effectively managed 384 unique products across 300 participating storefronts. Program tracking data were generally clean and well maintained. Program marketing was versatile and targeted customers both at point of purchase and through local event-base venues.

The program made efforts to reach underserved customer segments and sockets by targeting Dollar/Discount retailers (which attracts lower income shoppers), and focusing on specialty products. In PY2016–2017, 44% of program participating storefronts were Dollar/Discount, and they accounted for 10% of program sales.

Energy-efficient lighting products were prominent on the store shelves. As part of the shelf audits, we collected data on the general service and reflector lighting products present on the participating and non-participating store shelves. Close to three-quarters of the general service products on the retailer shelves (73%) were CFLs and LEDs, and 63% were LEDs. Incandescent products were not available and halogen products represented just over a quarter (27%) of all general service products.

Shelf audits conducted over time in the neighboring DEP jurisdiction show that LED prices have decreased dramatically over time. More specifically, standard LED prices dropped from $14.65 per bulb in 2014 to $4.68

in 2016, which represents a 68% drop in price.[25] Similarly, the average per-bulb price for reflector products decreased from $23.00 in 2014 to $6.92 in 2016. Average LED prices in the DEC jurisdiction, based on the results of the 2016 shelf audits, mimic DEP's, with the per-bulb price for standard LEDs averaging $4.87 and the per-bulb price for reflector LEDs averaging $7.01. These decreasing prices made LEDs more affordable and accessible to a broader population. The introduction of new ENERGY STAR 2.0 lamp specifications in 2017 rendered most CFLs no longer eligible for ENERGY STAR certification, while at the same time relaxing certification requirements for LEDs. These changes in standards helped further the prominence of LEDs.

These findings indicate that the key barriers to energy-efficient lighting adoption, such as product availability and price, have been largely mitigated, which may signal diminishing program effects moving forward. This finding is further substantiated by findings regarding overall energy-efficient lighting penetration in the DEC jurisdiction. More than 9 in 10 DEC customers (92%) reported having CFLs or LEDs in their homes and 33% reported having LEDs in their homes.[26]

That said, LEDs continue to be the most expensive lighting technology on store shelves, and program discounts help bring them on par with less expensive halogens and incandescents. Furthermore, customers who have LEDs in their homes do not have them in all of their sockets. Program opportunities continue to exist among certain customer segments, namely, older customers, renters, and customers with lower levels of education and lower incomes, where both penetration of energy-efficient products and the percent of sockets taken up by energy-efficient products is lower than average. Additionally, program opportunities continue to exist among a narrow set of product categories, such as specialty products, where a considerable share of shelf space and sockets is still taken by incandescent and halogen products.

New energy efficiency standards are bound to take place in 2020 with the second phase of EISA, which will require that most of the bulbs on the market meet the 45 lumens per watt efficacy minimum, effectively making LEDs the new baseline. Under this new phase of EISA, energy-efficient lighting programs, such as the DEC Retail LED program will no longer be cost-effective or needed. Until then, manufacturers have no plans to discontinue the production of incandescent and halogen products, and the program can help further market transformation to energy-efficient lighting.

Based on these findings, Opinion Dynamics recommends the following:

- Continue and if possible increase underserved customer segments through the mass market program design. Such efforts include targeting stores in areas with disproportionate shares of underserved customers and targeting retailers with disproportionate numbers of shoppers from underserved segments.
- Continue and if possible increase targeting specialty products by increasing the prominence of specialty products in the program product mix, including focusing on lower-wattage products, and by adjusting program marketing and messaging to focus on underserved sockets and to increase messaging relevance (such as specialty sockets in dining rooms).
- Monitor the market for retailer and manufacturer behaviors in terms of manufacturing practices and shelf stocking trends in anticipation of the second phrase of EISA to identify optimal timing for program completion.

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[25] Note that this analysis is based on the light bulbs of all wattages, including those not discounted through the DEC Retail LED program.

[26] Note that these results include LED penetration across lighting products of all wattages, and not just the wattages discounted through the program.

9. DEP EEL Program Summary Form

DEP Energy Efficient Lighting Program

Completed EMV Fact Sheet

Duke Energy Progress partners with retailers and manufacturers across North and South Carolina to provide price markdowns on efficient lighting products. The program promotes customer awareness and purchase of the program-discounted products through a range of marketing and outreach strategies and provides training to store staff. Product mix includes standard and specialty CFLs, LEDs, and ENERGY STAR fixtures, including a wide range of products in each product category. Participating retailers include a variety of retail channels including Do-It-Yourself, Club, Dollar/Discount, and Big Box stores.

Date	July 14, 2017
Region(s)	Duke Energy Progress
Evaluation Period	January 1, 2016 – March 12, 2017
Gross Annual kWh Impact	125,001,897 kWh (89% realization rate)
Gross Coincident kW Impact	21,962 Summer kW (95% realization rate) 8,066 Winter kW (113% realization rate)
Net-to-Gross Ratio	0.40
Process Evaluation	Yes
Previous Evaluation(s)	PY2014 and PY2015

Evaluation Methodology

The evaluation team reviewed ex ante per-unit savings assumptions and verified values matched those provided as part of the program's previous evaluation. The evaluation team also performed an engineering analysis of energy and demand savings to develop evaluated savings estimates, conducted a residential lighting logger study to update residential hours of use and in-service rate for LEDs, estimated leakage based on GIS analysis, and estimated a net-to-gross ratio using sales data modeling and direct feedback from retailers and manufacturers. The evaluation team also completed a process analysis based on retailer shelf audits, interviews with program staff, program tracking data analysis, review of program materials, and interviews with retailer and manufacturer staff.

Evaluation Details

- North Carolina Utilities Commission requires that evaluations of DEP's Energy Efficient Lighting program include Carolinas-specific data.
- North Carolina Utilities Commission require that evaluations of DEP's Energy Efficient Lighting program include a discussion of the impacts of LEDs, the Energy Independence and Security Act (EISA), and other innovations in lighting technology on the calculations of measure impacts and the baseline measures used in those calculations
- The evaluation team used the most recent available Carolinas-specific energy savings estimates
- The evaluation team used the Uniform Methods Project (UMP) recommended approach to estimate gross energy savings and incorporated additional adjustments as necessary
- The evaluation team developed evaluated savings assumptions using detailed product information provided as part of the program tracking data extract
- The evaluation team used a 'discounted savings approach' to claiming savings from future installations
- Assessment of program attribution relied on a combination of results from sales data modeling and interviews with participating retailers and manufacturers

10. DEC Retail LED Program Summary Form

DEC Retail LED Program

Completed EMV Fact Sheet

Duke Energy Carolinas partners with retailers and manufacturers across North and South Carolina to provide price markdowns on efficient lighting products. The program promotes customer awareness and purchase of the program-discounted products through a range of marketing and outreach strategies and provides training to store staff. Product mix includes standard, reflector, and specialty LEDs, and ENERGY STAR fixtures, including a wide range of products in each product category. Participating retailers include a variety of retail channels including Do-It-Yourself, Club, Dollar/Discount, and Big Box stores.

Date	July 14, 2017
Region(s)	Duke Energy Carolinas
Evaluation Period	March 21, 2016 – March 12, 2017
Gross Annual kWh Impact	57,846,855 kWh (110% realization rate)
Gross Coincident kW Impact	10,676 Summer kW (121% realization rate) 4,045 Winter kW (155% realization rate)
Net-to-Gross Ratio	0.41
Process Evaluation	Yes
Previous Evaluation(s)	PY2014 and PY2015

Evaluation Methodology

The evaluation team reviewed ex ante per-unit savings assumptions and verified values matched those provided as part of the previous evaluation of the DEP Energy Efficient Lighting program. The evaluation team also performed an engineering analysis of energy and demand savings to develop evaluated savings estimates, conducted a residential lighting logger study to update residential hours of use and in-service rate for LEDs, estimated leakage based on GIS analysis, and estimated a net-to-gross ratio using sales data modeling and direct feedback from retailers and manufacturers. The evaluation team also completed a process analysis based on retailer shelf audits, interviews with program staff, program tracking data analysis, review of program materials, and interviews with retailer and manufacturer staff.

Evaluation Details

- North Carolina Utilities Commission requires that evaluations of DEP's Energy Efficient Lighting program include Carolinas-specific data.
- North Carolina Utilities Commission require that evaluations of DEP's Energy Efficient Lighting program include a discussion of the impacts of LEDs, the Energy Independence and Security Act (EISA), and other innovations in lighting technology on the calculations of measure impacts and the baseline measures used in those calculations
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For more information, please contact:

Kessie Avseikova
Director, Opinion Dynamics

617 492 1400 tel
617 497 7944 fax
kavseikova@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

Duke Energy Progress & Duke Energy Carolinas

Energy Efficient Lighting & Retail LED Programs Appendices

April 6, 2018

Contributors

Tami Buhr
Vice President, Opinion Dynamics

Kessie Avseikova
Director, Opinion Dynamics

Katherine Randazzo
Senior Director, Opinion Dynamics

Kai Zhou
Managing Consultant, Opinion Dynamics

Dan Chen
Senior Consultant, Opinion Dynamics

Evan Tincknell
Consultant, Opinion Dynamics

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Table of Contents

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Table of Tables

Appendix A. Detailed Analysis Tables

The Excel spreadsheet is provided as a separate submission and contains detailed analysis of program gross and net impacts. The data in the file are at the invoice a unique product level measure. The file contains ex ante savings, gross savings assumptions, ex post gross savings, NTGR, and ex post net savings.

Appendix B. Chart with Measure-Level Inputs for Duke Energy Analytics

The Excel spreadsheet is provided as a separate submission and contains measure-level inputs for Duke Energy Analytics. Per-measure savings values in the spreadsheet are based on the engineering estimates presented in this report. Measure life estimates are based on previous evaluations and review of relevant TRMs. Update as necessary based on source of values.

Appendix C. Retailer and Manufacturer Interview Guide

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Participating Retailer and Manufacturer Interview Guide

FINAL

October 26, 2016

The main purpose of this interview guide is to measure program impact on retailer and manufacturer stocking and sales practices to estimate program net-to-gross ratio (NTGR). As part of the interviews, we will also explore retailer satisfaction with key program processes and recommendations for program improvement.

Introduction

Hello, may I speak with <NAME>?

My name is <NAME> and I am calling from Opinion Dynamics on behalf of Duke Energy. We are currently evaluating <PROGRAM> program, and I have a few questions that I would like to ask you about your experiences with the program. Do you have 15 minutes to speak with me? Your responses will be confidential, and we will not link you or your company with anything we report to Duke Energy. I do not work for Duke Energy. I am a third-party evaluator hired to help Duke Energy evaluate their <PROGRAM> program.

[OBTAIN PERMISSION TO RECORD CONVERSATION]

1. First, can you tell me your job title and major responsibilities? How long have you held this position?
2. Prior to this interview, were you aware that Duke Energy offers discounts on energy efficient light bulbs at select retailers that reduce the purchase price for customers buying bulbs?
   a. [IF YES] What is your level of involvement with the program? What has that involvement looked like?
   b. [IF NO] Are you in contact with anyone more directly involved with the program? If so, might you be able to put us in touch?
3. When did [COMPANY] begin participating in Duke Energy <PROGRAM> program?

Product Presence

[ASK STORE MANAGERS ONLY]
I would now like to ask you a few questions about the products that you have available at your store.

4. What types of CFL and LED products did your store stock in 2016? [PROBE FOR STANDARD AND SPECIALTY, CFLS AND LEDS]
   a. What product type did your store sell the most of in 2016?
5. Did you sell standard CFLs that were not ENERGY STAR certified in 2016? What about LEDs?

Market Trends and Market Effects

6. As you probably know, Duke Energy <PROGRAM> program has been around since 2009. How effective would you say the program has been in helping to increase the market (consumer demand) for high efficiency lighting products in Duke Energy's service territory? Why do you say that?
   [IF UNABLE TO COMMENT ON DUKE ENERGY SERVICE TERRITORY, PROBE FOR THE SOUTHEAST REGION OR AT THE NATIONAL LEVEL]

[ASK OF MANUFACTURERS]

7. The types of lighting products manufactured has changed quite a bit over the past ten years. The rate of changes has accelerated in the past few years in terms of the reduction in traditional incandescents and the introduction of EISA-compliant halogens and LEDs. What have been the main factors driving these changes? [PROBE FOR RELATIVE INFLUENCE OF EISA, THE DEP PROGRAM, EE LIGHTING PROGRAMS MORE GENERALLY ACROSS THE COUNTRY, NEED TO STAY AHEAD OF COMPETITORS, TECHNOLOGICAL ADVANCEMENTS IN OTHER FIELDS (E.G. CONNECTED HOMES)].
   a. How, if at all, has the program affected your manufacturing practices? What about your distribution practices? Do you vary your product distribution by existing consumer demand in a region?
   b. What is the impact of the federal legislation, namely EISA, on the changes in the manufacturing and distribution practices?
   c. Do you currently manufacture and/or distribute EISA-affected incandescent products?
   d. If EISA legislation were to be overturned tomorrow, how likely is it that [COMPANY] would start manufacturing and distributing EISA-affected incandescent products? Why do you say that?

[ASK OF STORE MANAGERS]

8. How do you determine which products to stock at your store(s)? [PROBE FOR ABILITY OF INDIVIDUAL STORES TO INFLUENCE WHAT IS STOCKED]

9. How, if at all, has the program affected CFL and LED stocking and product availability? Why do you say that? [PROBE SEPARATELY FOR ENERGY STAR VS. NON-ENERGY STAR PRODUCTS]
   a. Would the shelf space dedicated to CFLs and LEDs be different in the absence of the program? How different would it look? [PROBE FOR STANDARD AND SPECIALTY PRODUCTS]
   b. What is the impact of the federal legislation, namely EISA, on the changes in the stocking practices?

[ASK OF CORPORATE LEVEL CHAIN RETAILER CONTACTS]

10. Do your company's stocking practices vary by store or do you stock the same types of products across all stores?
    a. Do the stocking practices differ based on whether the store is participating in the program or not? [IF DIFFER] How do the practices differ? [PROBE FOR CFLS VS. LEDS VS. LESS EFFICIENT OPTIONS, ENERGY STAR VS. NON-ENERGY STAR CFLS AND LEDS]

[ASK ALL]

11. How much customer interest is there in the market in CFLs? What about LEDs? [PROBE FOR DIFFERENCES IN INTEREST BY STANDARD AND SPECIALTY PRODUCTS]

12. What influence does the ENERGY STAR label play in customer purchase decisions? How important would you say it is for customers that CFLs and LEDs are ENERGY STAR certified? [PROBE FOR DIFFERENCES BETWEEN CFLS AND LEDS]

13. How, if at all, has the program affected customer interest and lighting preferences? Why do you say that? What other factors played a role in the change in customer interest and preferences? [PROBE FOR RETAILER/MANUFACTURER GREEN PRACTICES, ENERGY STAR MARKETING AND EDUCATIONAL EFFORTS, OTHER EFFORTS]

14. Overall, what are the main barriers to increased adoption of CFLs and LEDs? How, if at all, do they differ for CFLs versus LEDs?

15. What changes do you expect to see in the lighting market in the next five years? Why do you say that? [Probe for changes in market share of incandescents, halogens, CFLs, ENERGY STAR LEDS AND NON-ENERGY STAR LEDS. Ask if this is the same for specialty bulbs as well]

16. Looking into the future, if the program incentive and other support were to be withdrawn, what would the lighting market look like? How, if at all, would the lighting market change without future program support? How likely is it that the sales of CFLs and LEDs would sustain in the absence of the program? What about the sales of ENERGY STAR CFLs and LEDs specifically?

Program Impacts on Product Availability and Sales

17. Thinking about your sales of lighting products in 2016 so far, are there any energy efficient lighting products that <COMPANY> would not carry or would sell substantially different quantities of if it did not participate in the Duke Energy <PROGRAM> program? [PROBE BY PRODUCT TYPE: STANDARD VS. SPECIALTY, CFLS VS. LEDS]
    [IF APPLICABLE, ASK SEPARATELY FOR EACH OF THE FOLLOWING TECHNOLOGIES:
    - Standard CFLs
    - Specialty CFLs
    - Standard LEDs
    - Specialty LEDs
    - CFL or LED fixtures]

[FOR MANUFACTURERS ONLY WHERE APPLICABLE, ASK BY RETAIL CHANNEL]

18. If Duke Energy discontinued its program, do you think sales of [TECHNOLOGY] would stay the same or change?
    a. [IF SALES WOULD CHANGE] What would the percent change in sales for [TECHNOLOGY]? [IF UNABLE TO PROVIDE EXACT PERCENTAGE, PROBE FOR BEST ESTIMATE]

19. Why do you think the sales would have been [INSERT RESPONSE FROM Q18A]? How did you come up with this percent change estimate?
    [ASK IF INCREASE IN EFFICIENT BULB SALES WAS REPORTED DUE TO THE PROGRAM]

20. If the DEP program did not exist and you were selling fewer ENERGY STAR [TECHNOLOGY] as a result, what type of light bulb do you think customers would have purchased instead? Would they have purchased less efficient technologies such as incandescents and halogens, would they have shifted to non-ENERGY STAR CFLs or LEDs, or would they just purchased fewer light bulbs overall?

[ASK OF MANUFACTURERS]

21. Are there any retailers or retailer categories that would not be selling energy efficient lighting products if the program had not been available?
    a. Why do you say that?
    b. What retailers are they?

Program Satisfaction

I would now like to ask you a few questions about your satisfaction with Duke Energy <PROGRAM> program.

22. Using a scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, overall, how satisfied are you with Duke Energy program?
    a. Why do you give it this rating?
    b. What aspects of Duke Energy program work particularly well? Why do you say that?
    c. What aspects of the program do not work well and could be improved?

23. Using that same scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the variety and types of products discounted through the program?
    a. Why do you give it this rating?
    b. Are there any types of lighting you would like to see added to the program? If so, what are they? Why would you like to see these products discounted through the program?

24. Using that same scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the size of discounts provided through Duke Energy program? [IF NEEDED, PROBE FOR SATISFACTION WITH DISCOUNTS BY LIGHTING TECHNOLOGY]
    a. Why do you give it this rating?
    b. Are you ever concerned that the discounts may be so large that the increased sales won't cover your loss in topline revenue due to the discount?

25. Using that same 0 to 10 scale, how satisfied are you with the program tracking and invoicing process?
    a. Why do you give it this rating?

Marketing and Education

[SKIP FOR MANUFACTURERS]

26. Using a scale that ranges from 0 to 10 where 0 means extremely dissatisfied and 10 means extremely satisfied, how satisfied are you with the program marketing materials? [IF NEEDED, PROBE FOR POP AS WELL AS OTHER PROGRAM MARKETING]
    a. Why do you give it this rating?
    b. Do you have a sense of the impact of the signage and marketing materials on bulb sales?

27. Are there additional types of marketing that you would like the program to provide or that you think would encourage the sales of energy efficient bulbs?

Suggestions for Program Improvement

28. Do you have any other suggestions about how the Duke Energy program could be improved? What suggestions do you have to make it easier for retailers/manufacturers like <RETAILER/MANUFACTURER> to participate in the program?

These are all the questions that I have for you. Thank you very much for your time and participation.

Appendix D. Shelf Audit Data Collection Instrument

DEP Residential Energy Efficient Lighting & DEC Retail LED Lighting Programs

Retailer Lighting Shelf Audit

DRAFT

September 7, 2016

The main purpose of this data collection instrument is to collect information on the lighting products available at a sample of participating and non-participating retailers. The results will be used to adjust baseline wattages, describe shelf space dedicated to various technologies, and describe the presence of program marketing materials.

Retailer Information

S1. Enter the following information for the store you are about to visit.
- a. Utility:
- b. Retailer ID:
- c. Store Name:
- d. Store Address:
- e. Participating Retailer: Yes, No

Lighting Inventory – General Service Products

GS1. Please indicate whether each of the following lighting products are available at the store.
- a. General service medium screw-based incandescent
- b. General service medium screw-based halogen
- c. General service medium screw-based CFL
- d. General service medium screw-based LED
  1. Yes
  2. No

General Service – Incandescent

GSI1. Please indicate which incandescent wattage(s) is (are) available at this store.

	[SHOW IF GS1A=1] Incandescent Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSI2. For each of the following wattages, please provide the count of SKUs available at this store. [ONLY SHOW WATTAGES WITH YES RESPONSES TO GSI1]

	a. Count of SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]

GSI3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSI1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price	c. Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – Halogen

GSH1. Please indicate which equivalent halogen wattages are available at this store.

	[SHOW IF GS1B=1] Halogen Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSH2. For each of the following wattages, please provide the count of SKUs available at this store. [ONLY SHOW WATTAGES WITH YES RESPONSES TO GSH1]

	a. Count of SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]

GSH3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSH1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price	c. Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – CFL

GSC1. Please indicate which equivalent CFL wattages are available at this store.

	[SHOW IF GS1C=1] CFL Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSC1aa. Are there only ENERGY STAR CFLs, a mix of ENERGY STAR and non-ENERGY STAR CFLs, or only non-ENERGY STAR CFLs available?

1. Only ENERGY STAR CFLs
2. A mix of ENERGY STAR and non-ENERGY STAR CFLs
3. Only non-ENERGY STAR CFLs

[DO NOT SHOW GSC2AA IF GSC1AA=3]
[DO NOT SHOW GSC2BB IF GSC1AA=1]
GSC2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSC1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW GSC3A-C IF GSC1AA=3]
[DO NOT SHOW GSC3D-F IF GSC1AA=1]
GSC3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the CFL bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSC1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. ENERGY STAR Four-bulb Pack Price	d. Non-ENERGY STAR One-bulb Pack Price	e. Non-ENERGY STAR Two-bulb Pack Price	f. Non-ENERGY STAR Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

General Service – LED

GSL1. Please indicate which equivalent LED wattages are available at this store.

	[SHOW IF GS1D=1] LED Available
a. 100-watt	1 Yes, 2 No
b. 75-watt	1 Yes, 2 No
c. 60-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No

GSL1aa. Are there only ENERGY STAR LEDs, a mix of ENERGY STAR and non-ENERGY STAR LEDs, or only non-ENERGY STAR LEDs available?
1. Only ENERGY STAR LEDs
2. A mix of ENERGY STAR and non-ENERGY STAR LEDs
3. Only non-ENERGY STAR LEDs

[DO NOT SHOW GSL1b IF GSL1aa=1]
GSL1bb. What is the longevity of the bulb life for NON-ENERGY STAR LEDs?
1. 25 years
2. 20 years
3. 15 years
4. 10 years
5. 7 years
6. 5 years
00. (Other, please specify)

[DO NOT SHOW GSL2AA IF GSL1AA=3]
[DO NOT SHOW GSL2BB IF GSL1AA=1]
GSL2. For each of the following wattages, please provide the count of SKUs available at this store.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSL1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 100-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 75-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 60-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW GSL3A-C IF GSL1AA=3]
[DO NOT SHOW GSL3D-F IF GSL1AA=1]
GSL3. For each of the following wattages, please provide the count of SKUs available at this store and the LOWEST and the HIGHEST price for each of the bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO GSL1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. ENERGY STAR Four-bulb Pack Price	d. Non-ENERGY STAR One-bulb Pack Price	e. Non-ENERGY STAR Two-bulb Pack Price	f. Non-ENERGY STAR Four-bulb Pack Price
a. 100-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 75-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 60-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Lighting Inventory – Reflector Products

R1. Please indicate whether each of the following lighting products are available at the store.
- a. Reflector medium screw based incandescent
- b. Reflector medium screw based Halogen
- c. Reflector medium screw based CFL
- d. Reflector medium screw based LED
  1. Yes
  2. No

Reflectors – Incandescent

RI1. Please indicate which incandescent wattage(s) is (are) available at this store.

	[SHOW IF R1A=1] Incandescent Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RI2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RI1]

	a. Count of SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]

RI3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the incandescent bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RI1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – Halogen

RH1. Please indicate which equivalent halogen wattages are available at this store.

	[SHOW IF R1B=1] Halogen Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RH2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RH1]

	a. Count of SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]

RH3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the halogen bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RH1]

	a. One-bulb Pack Price	b. Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – CFL

RC1. Please indicate which equivalent CFL wattages are available at this store.

	[SHOW IF R1C=1] CFL Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

RC1aa. Are there only ENERGY STAR CFLs, a mix of ENERGY STAR and non-ENERGY STAR CFLs, or only non-ENERGY STAR CFLs available?

1. Only ENERGY STAR CFLs
2. A mix of ENERGY STAR and non-ENERGY STAR CFLs
3. Only non-ENERGY STAR CFLs

[DO NOT SHOW RC2AA IF RC1AA=3]
[DO NOT SHOW RC2BB IF RC1AA=1]
RC2. For each of the following wattages, please provide the count of SKUs available.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RC1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW RC3A-B IF RC1AA=3]
[DO NOT SHOW RC3C-D IF RC1AA=1]

RC3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the CFL bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RC1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. Non-ENERGY STAR One-bulb Pack Price	d. Non-ENERGY STAR Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Reflectors – LED

RL1. Please indicate which equivalent LED wattages are available at this store.

	[SHOW IF R1D=1] LED Available
a. 65-watt	1 Yes, 2 No
b. 55-watt	1 Yes, 2 No
c. 50-watt	1 Yes, 2 No
d. 40-watt	1 Yes, 2 No
e. 30-watt	1 Yes, 2 No

[DO NOT SHOW RL2AA IF RL1A=3]
[DO NOT SHOW RL2BB IF RL1A=1]

RL2. For each of the following wattages, please provide the count of SKUs.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RL1]

	aa. Count of ENERGY STAR SKUs	bb. Count of NON-ENERGY STAR SKUs
a. 65-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
b. 55-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
c. 50-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
d. 40-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]
e. 30-watt	[NUMERIC OPEN END 1-99]	[NUMERIC OPEN END 1-99]

[DO NOT SHOW RL3A-B IF RL1A=3]
[DO NOT SHOW RL3C-D IF RL1A=1]

RL3. For each of the following wattages, please provide the LOWEST and the HIGHEST price for each of the LED bulb pack sizes.
[ONLY SHOW WATTAGES WITH YES RESPONSES TO RL1]

	a. ENERGY STAR One-bulb Pack Price	b. ENERGY STAR Two-bulb Pack Price	c. Non-ENERGY STAR One-bulb Pack Price	d. Non-ENERGY STAR Two-bulb Pack Price
a. 65-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
b. 55-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
c. 50-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
d. 40-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]
e. 30-watt	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]	Min Price [NUMERIC OPEN END 1-199] Max Price [NUMERIC OPEN END 1-199]

Photos

PH1. Please take photos of the lighting aisle and confirm once done.
1. Confirm

Program Point-of-Purchase Marketing

[COLLECT FOR PARTICIPATING RETAILERS ONLY]

M1. Are there any Duke Energy Lighting program point-of-purchase marketing materials at this store?

1. Yes
2. No

[ASK IF M1=1]

M2. What types of materials are present at the store? Select all that apply

01. Was…now price signs
02. Shelf labels
03. End-caps
04. Sponsor signs
05. Hand tags
06. Point-of-Purchase displays
07. Wobblers
08. Shelf-hanging banners
09. Sponsor posters
10. Window clings
11. Stickers
00. Other, specify

M3. Please take photos of marketing materials and select confirm once done.

1. Confirm

This completes the visit.

Appendix E. Residential Lighting Logger Recruitment Survey

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study Recruitment Instrument

FINAL

March 30, 2016

Survey Background

The primary goal of this recruitment survey is to identify DEP and DEC residential customers who have at least one LED in their home and recruit them for the lighting logger study. In addition, we will use the survey to collect key sociodemographic and household information for sampling purposes and better planning of the lighting logger deployment site visits.

Introduction – Telephone

Hello, my name is _________ and I'm calling from Opinion Dynamics on behalf of Duke Energy. May I please speak with <CUSTOMER NAME> or the person responsible for paying your utility bills? [ASK TO SPEAK TO CORRECT PERSON: "Is there anyone else in your household who is knowledgeable about your electric bill?"]

Just to confirm, do you receive an electric bill from Duke Energy at <ADDRESS>? [IF NO, THANK AND TERMINATE]

Your household has been randomly selected to participate in a lighting study for Duke Energy. This study is a part of the energy efficiency programs that Duke Energy is administering in North and South Carolina. Your participation is very important and will help improve Duke Energy energy efficiency offerings moving forward. Your responses will be used for analytic purposes only and will remain strictly confidential. If you qualify and agree to participate in the study, we will give you $100 as a token of appreciation. Let me assure you that we are not selling anything.

[IF NEEDED: This survey will only take a few minutes of your time.]

[IF NEEDED: IF YOU HAVE QUESTIONS ABOUT THIS SURVEY OR WOULD LIKE TO VERIFY THE LEGITIMACY OF THIS STUDY, PLEASE CONTACT MELINDA GOINS at 704-382-3827 OR BY EMAIL AT MELINDA.GOINS@DUKE-ENERGY.COM]

C1. Are you currently talking to me on a regular landline phone or a cell phone?
1. Regular landline phone
2. Cell phone
8. (Don't know)
9. (Refused)

[ASK IF C2 = 2]
C2. Are you currently in a place where you can talk safely and answer my questions?
1. Yes
2. No [SCHEDULE CALL BACK]
8. (Don't know) [SCHEDULE CALL BACK]
9. (Refused) [SCHEDULE CALL BACK]

Introduction – Internet

DUKE ENERGY®

Welcome to the Duke Energy Progress survey! Thank you for participating in this important study. This study is a part of the energy efficiency programs that Duke Energy is administering in North and South Carolina. Your participation is will help improve Duke Energy efficiency offerings moving forward. If you qualify and agree to participate in this study, we will give you $100 as a token of appreciation.

Please have the person knowledgeable about your electric bill you receive at 935 Burkett Rd Dover NC, 28526 take this survey. That person can either take over the survey from you or you can close out of the survey and have that person start the survey again using the same five-digit pin number on the invitation letter or reminder letter.

QI1. To start, can you please confirm if you receive an electric bill from Duke Energy at <ADDRESS>?
1. Yes, correct
2. No, incorrect [THANK & TERMINATE]

Study Eligibility

Before I can confirm your participation, I need to ask you a few additional questions to ensure you are eligible for the study. The questions will take just a few minutes to complete.

S3. Do you have any CFLs installed inside or outside your home?

[FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] CFLs are also known as compact fluorescent lamps. The most common type is made with a glass tube bent into a spiral shape resembling soft-serve ice cream. Some CFLs may have a plastic or glass cover over the spiral tube.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
CFLs are also known as compact fluorescent lamps. The most common type is made with a glass tube bent into a spiral shape resembling soft-serve ice cream. Some CFLs may have a plastic or glass cover over the spiral tube. Below are some examples of what CFLs look like.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

[ASK IF S3=1]

S3a. Do you have CFLs installed inside your home, outside your home, or both inside and outside your home? Consider any CFLs installed in garages as installed outside your home.

1. Inside
2. Outside
3. Both inside and outside
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

[ASK IF S3=1]

S3b. About how many CFLs would you estimate you have installed both inside and outside your home in total? Your best estimate is fine. [NUMERIC OPEN END]

0000. NUMERIC OPEN END
9998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9999. (Refused)

[ASK IF S3A=1,3]

S3c. Thinking just about CFLs installed **inside** your home, do you have any of the following CFL products?

a. Standard CFLs. Standard CFLs are spiral shaped CFLs that fit into a regular light socket and can be used to replace your basic general purpose light bulbs (traditionally incandescent).
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of standard CFLs.

b. Reflector CFLs or CFL flood lights. These bulbs are generally used in recessed ceiling fixtures.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of reflector CFLs.

c. Specialty CFLs. Specialty CFLs include bulbs with small candelabra base or pin base, three-way bulbs, and globe shaped bulbs.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
Below are some examples of specialty CFLs.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

S4. Do you have any LEDs installed inside or outside your home?
[FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] LEDs or light emitting diode lamps are the newest type of bulb in the market. They often have a plastic base between the screw and the glass, sometimes with ridges. LEDs typically cost more and last longer than the other types of light bulbs.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
LEDs or light emitting diode lamps are the newest type of bulb in the market. They often have a plastic base between the screw and the glass, sometimes with ridges. Below are some examples of what LEDs look like.

Please do not include LED Christmas tree lights or LED night lights.
1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

[ASK IF S4=1]
S4a. Do you have LEDs installed inside your home, outside your home, or both inside and outside your home? Consider any LEDs installed in garages as installed outside your home.
1. Inside
2. Outside
3. Both inside and outside
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

[ASK IF S4=1]
S4b. About how many LEDs would you estimate you have installed both inside and outside your home in total? Your best estimate is fine. [NUMERIC OPEN END]
00. NUMERIC OPEN END
9998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9999. (Refused)

[ASK IF S4A=1,3]

S4c. Thinking just about LEDs installed **inside** your home, do you have any of the following LED products?

a. Standard LEDs. Standard LEDs fit into a regular light socket and can be used to replace your basic general purpose light bulbs (traditionally incandescent).

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of standard LEDs.

b. Reflector LEDs or LED flood lights. These bulbs are generally used in recessed ceiling fixtures.

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of reflector LEDs.

c. Specialty LEDs. Specialty LEDs include bulbs with small candelabra base or pin base, three-way bulbs, and globe shaped bulbs.

[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]

Below are some examples of specialty LEDs.

1. Yes
2. No
8. [SHOW IN PHONE RECRUITER] (Don’t know) [SHOW IN THE ONLINE RECRUITER] Not sure

[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]

9. (Refused)

I now have just a few questions about your residence and your household.

D1. Which of the following best describes your home/residence?
01. Single-family detached home (Not a duplex, townhome, or apartment; attached garage is OK)
02. Single family attached home (Row house or townhouse)
03. Mobile home (Single-family)
04. Apartment or condominium (Multifamily)
00. (Other, specify)
98. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 99 IN THE ONLINE RECRUITER]
99. (Refused)

[ASK IF D1 = 4]
D2. How many apartments/housing units are in your building?
1. 1
2. 2-3
3. 4-9
4. 10 or more
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

D3. Do you own or rent this residence?
1. Own
2. Rent
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

D4. Including yourself, how many people currently live in your residence year-round?
00. [NUMERIC OPEN END]
[DO NOT SHOW OPTIONS 98 AND 99 IN THE ONLINE RECRUITER]
98. (Don't know)
99. (Refused)

D5. How many people under the age of 18 live in your residence?
00. [NUMERIC OPEN END]
[DO NOT SHOW OPTIONS 98 AND 99 IN THE ONLINE RECRUITER]
98. (Don't know)
99. (Refused)

D6. Approximately, how many square feet is your residence?
00. [NUMERIC OPEN END]
99998. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 99999 IN THE ONLINE RECRUITER]
99999. (Refused)

[ASK IF D6=99998]
D7. What would you estimate the square footage of your residence to be?
1. Less than 1,000 sqft
2. Between 1,001 and 2,000 sqft
3. Between 2,001 and 3,000 sqft
4. Between 3,001 and 4,000 sqft
5. Between 4,001 and 5,000 sqft
6. Greater than 5,000 sqft
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

I have just a few final questions.

D8. In what year were you born? [RESPONSE NOT REQUIRED]
0000. [NUMERIC OPEN END 1900-2015]
[DO NOT SHOW OPTIONS 9998 AND 9999 IN THE ONLINE RECRUITER]
9998. (Don't know)
9999. (Refused)

D9. What is your highest level of education? [RESPONSE NOT REQUIRED]
1. Less than a high school degree
2. High school degree
3. Technical/trade school program
4. Associates degree or some college
5. Bachelor's degree
6. Graduate / professional degree, e.g., J.D., MBA, MD, etc.
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

D10. Which of the following best describes your current employment status? [RESPONSE NOT REQUIRED]
1. Employed full-time
2. Employed part-time
3. Retired
4. Not employed, but actively looking
5. Not employed, and not looking
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

D11. Which category best describes your annual household income in 2015? [RESPONSE NOT REQUIRED]
1. Less than $25,000
2. $25,000 to just under $50,000
3. $50,000 to just under $75,000
4. $75,000 to just under $100,000
5. $100,000 to just under $150,000
6. $150,000 or more
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

D12. [FOR PHONE RECRUITER SURVEY READ THE FOLLOWING] Record Gender. Do not ask.
[FOR ONLINE RECRUITER SURYEY INCLUDE THE FOLLOWING]
What is your gender?
1. Male
2. Female
[DO NOT SHOW OPTIONS 8 AND 9 IN THE ONLINE RECRUITER]
8. (Don't know)
9. (Refused)

[TERMINATE IF S4CA AND S4CB<>1]

Lighting Logger Study Recruitment

L1. Great, you qualify! We would like to invite you to participate in a study that will help Duke Energy Progress understand how customers like you use lighting. As a token of appreciation, we will give $100 if you participate in the study.

As part of the study, we will visit your home and install small devices called light loggers on various light fixtures in your home. These loggers simply measure lighting usage and will not interfere with how you use your lighting or affect the look or quality of your lighting. The visit will be brief and will be scheduled based on your availability. We will leave loggers in place for a few months, and will then schedule a second visit to retrieve them. Would you be willing to participate in this study?
1. Yes
2. No [THANK AND TERMINATE]
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER] [THANK AND TERMINATE]
9. (Refused) [THANK AND TERMINATE]

L2. A technician will be following up with you to schedule a site visit in the next couple of weeks. Do you have any general preference of days and/or times that would work for this visit? We are not scheduling your appointment at this time, but we will try to accommodate your preference as best we can. [PROBE: WOULD WEEKDAYS OR WEEKENDS WORK BETTER FOR YOU? ARE MORNINGS, AFTERNOONS OR NIGHTS BETTER?]
1. Yes – [RECORD PREFERENCES (INCLUDE AM/PM)]
2. No
8. [SHOW IN PHONE RECRUITER] (Don't know) [SHOW IN THE ONLINE RECRUITER] Not sure
[DO NOT SHOW OPTION 9 IN THE ONLINE RECRUITER]
9. (Refused)

L3. Thank you. Let me confirm your address.
<ADDRESS>
<CITY>
<ZIP>
Is that correct?
1. Correct
2. Incorrect

[ASK IF L3=2]
L4. What is the correct address?
00. Address:
01. City:
02. Zip:

L5. [SHOW FOR PHONE SURVEY] And is <PHONE> the best number to reach you at, or is there a better number we can use to reach you?

01. Phone number on record is the best number.
00. Alternative phone number provided [RECORD ALTERNATIVE PHONE NUMBER]

L5. [SHOW FOR WEB SURVEY] Is there a phone number we can use to reach you? [RESPONSE NOT REQUIRED]

00. [NUMERIC OPEN END]

EMAIL. [ONLY SHOW FOR PHONE SURVEY]

00. Would you like to provide an email address we can use to schedule the visit?
99. (Does not wish to provide email)

[ASK IF NAME IS AVAILABLE]

L6. When calling back to schedule an appointment, should we ask for you or is there someone else that we could also schedule the appointment with?

01. Just me
00. [RECORD THE NAME]

[ASK IF NAME IS NOT AVAILABLE]

L7. When calling back to schedule an appointment, who should we ask for?

00. [OPEN END]

Those are all the questions I have for you. Thank you very much for your time. If you are selected, a technician will be contacting you within the next couple of weeks to schedule an appointment for the visit.
IF NEEDED: If you have any questions about the study, please feel free to contact Dan Chen at 617-301-4636.
IF NEEDED: To verify this study, please contact Melinda Goins at Duke Energy at 704-382-3827 or by email at melinda.goins@duke-energy.com

Thank you again for your time. Duke Energy greatly appreciates your participation.

Appendix F. Residential Lighting Logger Deployment Instrument

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study Onsite Data Collection Instrument

Final

March 30, 2016

Survey Background

The primary goal of this instrument is to support lighting inventory and logger deployment in residential homes in Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) jurisdictions.

General Information

[FIELD TECHNICIANS CAN FILL THIS SECTION PRIOR TO THE START OF THE VISIT]

I1. Please enter customer's ODCID number: [NUMERIC 10000-99999]

I2. Please enter inspector's name.

I3. Please enter the customer's name. [OPEN RESPONSE]

I4. Please enter address of the residence.

Building Information

B1. What is the residence type? [IF NEEDED, CONFIRM WITH THE CUSTOMER]
- 01. Single-family detached building
- 02. Mobile Home/Manufactured home
- 03. Condominium
- 04. Duplex/Two-family
- 05. Multi-family building (3 or more units)
- 06. Townhouse
- 00. Other, specify [OPEN END]
- 99. Can't assess

[ASK IF B1=3 OR B1 = 5]
B2. How many units are in this building? [IF NEEDED, CONFIRM WITH THE HOMEOWNER]
1. Between 3 to 5 units
2. Between 6 to 10 units
3. Greater than 10 units
8. Don't know
9. Can't assess

[ASK CUSTOMER]
B3. Approximately how many square feet is this residence? [NUMERIC OPEN END]
99998. Don't know
99999. Can't assess

[ASK IF B3=99998]
[ASK CUSTOMER]
B4. What would you estimate the square footage of your residence to be?
1. Less than 1,000 sqft
2. Between 1,001 and 2,000 sqft
3. Between 2,001 and 3,000 sqft
4. Between 3,001 and 4,000 sqft
5. Between 4,001 and 5,000 sqft
6. Greater than 5,000 sqft
8. Don't know
9. Can't assess

[ASK CUSTOMER]
B5. Does this home have central air conditioning?
1. Yes
2. No
9. Can't assess

[ASK CUSTOMER]
B6. What is the primary heating fuel used to heat this home?
01. Electric
02. Gas
03. Propane
04. Oil
00. Other, specify [OPEN END]
99. Can't assess

[ASK IF B6=1]
[ASK CUSTOMER]
B6a. Which of the following is the system used to heat the majority of your home?
01. Heat pump
02. Electric resistance heat
00. Other, specify [OPEN END]
99. Can't assess

Socket Selection for Logger Placement

B7a. Please conduct an initial walk-through of the home and record rooms that contain at least one LOGGABLE switch.

B7. Please enter the number of rooms with loggable switches (MUST CONTAIN AT LEAST ONE LED BULB). [NUMERIC 0-20; 98= Not available, 99=Can't assess]
1. Kitchen (Up to 2)
2. Living room (Up to 3)
3. Bedroom (Up to 6)
4. Bathroom (Up to 4)
5. Dining room (Up to 2)
6. Basement (Up to 2)
7. Other (Hallway/Laundry/Office/Storage/Closet) (Up to 9)

[CREATE A TABLE BASED ON <B7 RESPONSE>]

B8. Please record the LOGGABLE switches in the following LOGGABLE rooms.
[NUMERIC 0-20; 98= Not available, 99=Can't assess]
NUMBER OF SWITCHES PER ROOM (UP TO 10 EACH)

[CREATE UP TO 8 RANDOM SELECTIONS OF LOGGABLE SWITCHES FOR LOGGER INSTALLATION]

B9. Please record the randomly selected switches on the paper form and take a photo of the form.
1. Confirm
0. Other, specify [OPEN END]

Lighting in Storage

LS1. Are there any light bulbs in storage? [IF NECESSARY: ASK HOMEOWNER]
1. Yes
2. No
9. Can't assess

LS2. Please record the following information for each bulb in storage with the same base type, bulb type, and bulb shape.

[SKIP TO R1 IF LS1 = 2 OR 9]
SS1. Please select the base type of bulb in storage:
1 Medium screw-based
2. Small/Candelabra screw-based
3. Large/Mogul screw-based
4. Pin-based
0. Other, specify [OPEN END]
9. Can't assess

SS2. Please select the bulb type:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
0. Other, specify [OPEN END]
9. Can't assess

SS3. Please select the bulb shape:
1. Standard shape/A Lamp/Pear shape [HIDE IF SS2 = 3]
2. Twist/Spiral [ALLOW IF SS2 = 0, SS2 =2]
3. Globe [HIDE IF SS2 = 3]
4. Bullet/Torpedo/Candelabra [HIDE IF SS2 = 3]
5. Bug light [HIDE IF SS2 = 3]
6. Spot/Reflector/Flood [HIDE IF SS2 = 3]
0. Other, specify [OPEN END]
9. Can't assess

SS5. How many total bulbs in storage are exactly like this one? (SAME BASE TYPE, BULB TYPE, AND BULB SHAPE) [NUMERIC OPEN END, 0 – 100]

SS6. Is there another type of bulb in storage?
1. Yes
2. No

[GO THROUGH LOOP SS1 – SS6 IF SS6=1, IF NOT SKIP TO R1]

Interior Lighting Inventory

TR1. Please go through the house room by room recording the following information for each room.

[BEGIN ROOM BY ROOM LIGHTING INVENTORY AND LIGHTING LOGGING LOOP]
R1. Please select a room type to collect lighting inventory:
01. Basement (finished)
02. Basement (unfinished)
03. Foyer/Hallway
04. Bathroom
05. Laundry
06. Bedroom
07. Kitchen
08. Living room/Family room
09. Garage
10. Office
11. Dining room
12. Enclosed porch/Sunroom/3 season room
13. Storage
14. Closets
15. Attic
16. Crawlspace
00. Other, specify [OPEN END]
99. Can't assess

R2. Do you have access to this room to collect lighting data?
1. Yes
2. No (provide reasons)

[ASK IF R2=1, ELSE SKIP TO END OF LOOP]
R3. Is there a window in this room?
1. Yes
2. No
9. Can't assess

R4. How many total light switches are in this room? [NUMERIC OPEN END]

S1. Please record the following information for each switch in the room.
S2. What is the control type of this switch?
1. On/off switch
2. Dimmable
3. 3-way
4. Motion sensor
5. Timer
0. Other, specify [OPEN END]
9. Can't assess

S3. Are there any empty sockets on this switch?
1. Yes
2. No
9. Can't assess

[ASK IF S3=1]
S4. How many empty sockets are there on this switch? [NUMERIC OPEN END]

Questions S5-S9 are about each unique socket type on this switch. [EACH SOCKET TYPE SHOULD HAVE THE SAME CONTROL, SOCKET TYPE, BULB TYPE, AND BULB SHAPE]

S5. Please select the socket type on this switch: [IF MORE THAN ONE SOCKET TYPE, RESPOND FOR FIRST, THEN FOR ADDITIONAL TYPES IN QUESTION S9]
1. Medium screw-based
2. Small/Candelabra screw-based
3. Large/Mogul screw-based
4. Pin-based
0. Other, specify [OPEN END]
9. Can't assess

S6. Please select the bulb type in this socket:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
6. Infrared
0. Other, specify [OPEN END]
9. Can't assess

S7. Please select the bulb shape for this socket:
1. A-Lamp
2. Twist/Spiral
3. Globe
4. Bullet/Torpedo/Candelabra
5. Spot/Reflector/Flood
0. Other, specify [OPEN END]
9. Can't assess

S7a. Please select the fixture type:
- 01. Recessed ceiling fixture
- 02. Non-recessed ceiling fixture
- 03. Ceiling fan
- 04. Table/Desk lamp
- 05. Floor Lamp/Torchiere
- 06. Wall mounted
- 07. Track lighting
- 08. Garage door
- 10. Chandelier
- 11. Pendant
- 00. Other, specify [OPEN END]
- 99. Can't assess

S8. How many total sockets on this switch are exactly like this one? [NUMERIC OPEN END] [NOTE TO AUDITOR: "LIKE" SOCKETS SHOULD HAVE THE SAME CONTROLS, SOCKET TYPE, BULB TYPE, AND BULB SHAPE.]

S9. Is there another socket type on this switch?
1. Yes
2. No

[IF S9=1 REPEAT LOOP S5-S9 (UP TO 3 TIMES), ELSE GO TO S10]

[CALCULATE S8_SUM = SUM OF RESPONSES FROM S8]

S10. Please confirm that there is a total of <S8_SUM> bulbs on this switch.
- 1. Yes
- 2. No [GO BACK TO S5]
- 9. Can't assess

S11. Is this a randomly selected switch for logger installation?
- 01. Yes
- 02. Yes, but logger cannot be placed (light is too high in the ceiling, configuration does not allow for logger placement, customer prefers not to log the switch).
- 03. No, switch is not randomly selected
- 00. Other, specify [OPEN END]

[ASK IF S11=1]
P1. Record the serial number of the logger you are placing on this switch. [OPEN END]

P2. Please enter a description of the lamp/fixture that the you are placing this logger on. [OPEN END]

P3. Please calibrate the logger and confirm.
0. Calibration confirmed.

P4. Please take photos of the socket the logger was placed on and a close-up photo of the logger ID and confirm.
0. Photo confirmed.

S12. Is there lighting in this room controlled by other switches?
1. Yes
2. No

R5. Are there any more rooms?
1. Yes
2. No

[IF S12=1 REPEAT LOOP S1-S12, ELSE GO TO EL1]

Exterior Lighting Inventory

EL1. Does the home exterior have any light sockets? [DO NOT AUDIT LIGHT BULBS THE RESIDENT DOES NOT PAY FOR, SUCH AS EXTERIOR LIGHTING AT AN APARTMENT COMPLEX].
1. Yes
2. No
9. Can't assess

EL2. What type of bulb(s) is/are in the primary exterior light fixture? [MULTIPLE RESPONSE]
1. CFL
2. Incandescent
3. Halogen
4. LED
0. Other, specify [OPEN END]
9. Can't assess

EX1. Please select the socket type for each exterior light socket.
1. Screw-based
2. Pin-based
0. Other, specify [OPEN END]

EX2. Please select the control type for this socket:
1. On-Off
2. Dimmable
3. 3-Way
4. Motion Sensor
5. Programmable
0. Other, specify [OPEN END]
9. Can't assess

EX3. Please select the bulb type in this socket:
1. Incandescent
2. CFL
3. Fluorescent
4. LED
5. Halogen
6. Empty [SKIP TO EX6]
0. Other, specify [OPEN END]

EX4. Please select the bulb shape for this socket:
- 01. Standard shape/ A lamp /pear shape [HIDE IF EX3 = 3]
- 02. Twist/Spiral [ALLOW IF EX3 = 2]
- 03. Globe [HIDE IF EX3 = 3]
- 04. Bullet/Torpedo/Candelabra [HIDE IF EX3 = 3]
- 05. Bug light [HIDE IF EX3 = 3]
- 06. Spot/Reflector/Flood [HIDE IF EX3 = 3]
- 00. Other, specify [OPEN END]
- 98. Not applicable
- 99. Can't assess

[ASK IF EX4 = 1]
EX4a. Please select the fixture type:
- 1. Recessed ceiling fixture
- 2. Non-recessed ceiling fixture
- 3. Wall mounted
- 4. Lamp post or other free standing light
- 0. Other, specify [OPEN END]
- 9. Can't assess

EX5. How many total exterior sockets are exactly like this one? [NUMERIC OPEN END] (NOTE TO AUDITOR THAT A SOCKET TYPE SHOULD HAVE THE SAME BULB TYPE, BULB SHAPE, AND CONTROL TYPE)

EX6. Is there another socket type on the exterior of the home?
- 1. Yes
- 2. No

[GO THROUGH LOOP EX1-EX6 IF EX6=1, IF NOT SKIP TO LR1]

LED Replacement

LR1. Approximately when did you first install LEDs in your home? [RECORD YEAR AND MONTH] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

LR1a. What prompted you to try LEDs over other bulb types? [OPEN END]

LR2. Did you install all of your LEDs at the same time or did you install them over time?
- 1. Same time
- 2. Over time
- 8. Can't recall

LR3. When was the most recent time that you installed an LED? [RECORD YEAR AND MONTH] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

LR4. I would also like to know what was in the sockets before you installed LEDs in them. Did you replace working light bulbs with LEDs, did you replace burnt out bulbs with LEDs, or did you install LEDs in empty sockets? [MULTIPLE RESPONSE]
- 1. Replaced working bulbs
- 2. Replaced burnt out bulbs
- 3. Installed in empty sockets
- 8. Can't recall

[ASK IF LR4=1]
LR5. If you were to estimate, how many sockets had working bulbs in them before you installed LEDs in them? [NUMERIC OPEN END] [IF NEEDED: YOUR BEST ESTIMATE IS FINE]

[ASK IF LR4=1 OR 2]
LR6. And what type or types of bulbs did the LEDs replace? [MULTIPLE RESPONSE]

1. Incandescents
2. Halogens
3. CFLs

[ASK IF LR6=3]
LR7. Approximately, how many LEDs were installed in sockets with CFLs in them? [NUMERIC OPEN END] [IF NEEDED: YOUR BEST ESTIMATE IS FINE] [IF NEEDED: CFLS ARE ALSO KNOWN AS COMPACT FLUORESCENT LAMPS. THE MOST COMMON TYPE IS MADE WITH A GLASS TUBE BENT INTO A SPIRAL SHAPE RESEMBLING SOFT-SERVE ICE CREAM. SOME CFLS MAY HAVE A PLASTIC OR GLASS COVER OVER THE SPIRAL TUBE.]

[ASK IF LR7=9998]
LR8. Would you say you had CFLs in most, some, or just a few of the sockets where you installed LEDs?

1. Most
2. Some
3. Just a few
4. Can't recall

Closing

Thank you very much for participating in this study. I have a $50 gift card for you, and we will be in touch in about 6 months to come and retrieve the loggers we installed today. Upon retrieval of those loggers, you will receive another $50 gift card. Thank you again for taking the time to be a part of this important study.

G1. Record gift card number [Numeric 00000000-99999999].

Appendix G. Residential Lighting Logger Retrieval Instrument

Duke Energy Progress and Duke Energy Carolinas Retail Lighting Program

Residential Lighting Logger Study On-Site Logger Retrieval Instrument

FINAL

October 25, 2016

Study Background

The residential lighting logger study is a part of the impact evaluation of the PY2017 Duke Energy Progress (DEP) Energy Efficient Lighting program and Duke Energy Carolinas (DEC) Energy Efficient Appliances and Devices program. The key goal of the study is to estimate hours of use and coincidence factors for LEDs among residential customers in DEP and DEC jurisdictions. As part of the study, we will also develop updated estimates of LED in-service rate (ISR). The results from this study will be used to estimate program energy and demand savings impacts for PY2017 and beyond.

This data collection instrument will guide the retrieval of lighting loggers deployed in the spring 2016.

General Information

[FIELD TECHNICIANS CAN FILL THIS SECTION PRIOR TO THE START OF THE VISIT]

I1. Please enter customer's ODCID number. [NUMERIC OPEN END]

I2. Please enter field technician's name. [OPEN END]

I3. Please enter the customer's name. [OPEN RESPONSE]

I4. Please enter the address of the residence. [OPEN RESPONSE]

Logger Retrieval

L0. [ASK CUSTOMER] Now, I'm going to remove all of the loggers we placed in your home. Would you please accompany me?

[PLEASE DO NOT RETRIEVE OR MOVE THE LOGGER UNTIL AFTER TESTING ITS SENSITIVITY IN ITS CURRENT POSITION]

Please select the switch of the logger you are about to retrieve.
[LIST OF SWITCH NAMES BY ROOM TYPE, SWITCH TYPE, AND LOGGER ID; 97=Switch not listed (1) 98=Switch not listed (2); 99=No more loggers to collect]

[REPEAT L1A-L10 FOR ALL SWITCHES WITH LOGGERS]

[SKIP TO L11 IF L0=99]

[ASK IF L0<>97,98]
L1a. Please confirm the room type where this logger is installed.
[READ IN ROOM TYPE]
1. Confirm that the room type is correct
2. Room type is different

[ASK IF L0=97,98 OR L1a=2]
L2a. Please select the room type from which you are retrieving this logger.
01. Basement (finished)
02. Basement (unfinished)
03. Foyer/Hallway
04. Bathroom
05. Laundry
06. Bedroom
07. Kitchen
08. Living room/Family room
09. Garage
10. Office
11. Dining room
12. Enclosed porch/Sunroom/3 season room
13. Storage
14. Closets
15. Attic
16. Crawlspace
00. Other, specify [OPEN END]

[ASK IF L0<>97, 98]
L1b. Please confirm the control type associated with this logged switch.
[READ IN SWITCH TYPE]
1. Confirm that the control type is correct
2. Control type is different

[ASK IF L0=97,98 OR L1B=2]
L2b. What is the control type on this switch?
1. On/off switch
2. Dimmable
3. 3-way
4. Motion sensor
5. Timer
0. Other, specify [OPEN END]

[ASK IF L0<>97, 98]
L1c. Please confirm that the following bulbs are associated with this logged switch.
[READ IN BULB COUNTS BY BULB TYPE]
1. Confirm that the bulb count by technology is correct
2. Bulb type by technology is different

[ASK IF L0=97,98 OR L1C=2]
L2c. Please record the current counts of bulbs on this switch by technology.

Incandescents	Halogens	CFLs	LEDs	Other	Cannot Assess	Empty Sockets
a.	b.	c.	d.	e.	f.	g.

L1d. [ASK CUSTOMER] During the time the logger was installed or since [LOGGER INSTALL DATE], how often did you turn on this switch?
1. Never
2. Occasionally
3. Every day
4. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)
0. Other, specify [OPEN END]

L1e. [ASK CUSTOMER] Is it possible that this light was turned on either ALL the time or MOST of the time since [LOGGER INSTALL DATE]?
1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

L1f. Is there a potential for light interference that the logger can be picking up on?
00. Yes – please describe [OPEN END]
02. No
99. Cannot assess

L3. Please retrieve the logger. Prior to retrieving, please test the logger's ability (in its current position) to sense whether the switch is on or off. As currently installed, does the logger correctly register whether the switch is on or off?
1. Yes
2. No, registers as ON when switch is OFF
3. No, registers as OFF when switch is ON
4. No, logger does not register ON or OFF
0. Other, specify

L4. What is the current condition of this logger?
1. Functioning normally
2. Dead battery (blank screen)
3. Melted
4. Otherwise broken/non-operational
0. Other, specify

[ASK IF L0<>97, 98]
L5. Please confirm the logger ID.
[READ IN LOGGER ID]
1. Confirm that the logger ID is accurate
2. Logger ID is different

[ASK IF L0=97,98 OR L5=2]
L6. Please enter logger ID. [OPEN END]

L7. [ASK CUSTOMER] Did you or anyone else in your household remove the logger at any point since the installation?
1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF L7=1]

L8. [ASK CUSTOMER] When was the logger removed? [RECORD DAY AND MONTH] [IF NECESSARY: AN APPROXIMATE DATE IS FINE]

1. [OPEN END]
2. Don't remember
9. Cannot assess (customer unable to provide an answer)

[ASK IF L7=1]

L9. [ASK CUSTOMER] When was the logger reinstalled? [RECORD DAY AND MONTH] [IF NECESSARY: AN APPROXIMATE DATE IS FINE]

1. [OPEN END]
2. Don't remember
9. Cannot assess (customer unable to provide an answer)

L10. [ASK CUSTOMER] Who reattached this logger?

01. Field representative
02. Customer/household member
00. Other; specify
98. Not sure (customer response)
99. Cannot assess (customer unable to provide an answer)

[LOOP BACK TO QL0 FOR NEXT LOGGER OR TO MARK IF DONE]

L11. [ASK CUSTOMER] Are there any loggers that were removed and not reattached?

1. Yes
2. No
3. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF L11=1]

L12. List logger ID, approximate date of logger removal and any notes related to logger removal, such as the room type the logger was installed in, the switch information, if available, etc.
[REPEAT FOR UP TO 4 LOGGERS] [ALLOW TO SKIP OUT STARTING AT SECOND LOGGER IF JUST ONE]
Logger ID [OPEN END]
Date of removal [DAY AND MONTH]
Relevant notes [OPEN END]

[ASK IF NUMBER OF RETRIEVED LOGGERS (INCLUDING L12 LOGGERS) IS LESS THAN THE NUMBER OF DEPLOYED LOGGERS]

L13. Our records show that the total of [DEPLOYED LOGGER COUNT] were deployed in this home and so far, [RETRIEVED LOGGER COUNT] were retrieved. Please record the reasons for the missing loggers. [ASK HOMEOWNER IF NEEDED] [OPEN END. PROVIDE SPECIFICS FOR EACH MISSING LOGGER IF NEEDED]

Occupancy

[ASK CUSTOMER]

O1. During the time that loggers were installed or since [LOGGER INSTALL DATE] were there any people at home all or most weekdays?

1. Yes
2. No
3. Cannot remember (customer response)
9. Cannot assess (customer unable to provide an answer)

O2. Since the loggers were installed on <DEPLOYDATE>, has there been any change(s) to your schedule that kept you away from home more than usual, such as business travel, vacations, or other changes?
1. Yes
2. No
3. Cannot remember (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF O2=1]
O2A. When did these changes to your routine happen?
1. Period 1: [START MONTH] to [END MONTH]
2. Period 2: [START MONTH] to [END MONTH]; 98=No more periods to list
3. Period 3: [START MONTH] to [END MONTH]; 98=No more periods to list

Lighting Purchases

LP1. Since [LOGGER INSTALL DATE], did you purchase any light bulbs for use in your home?
1. Yes
2. No
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP1=1]
LP2. What light bulbs did you purchase? [MULTIPLE RESPONSE. READ RESPONSE OPTIONS IF NEEDED. EXPLAIN WHAT EACH TYPE OF TECHNOLOGY IS]
1. Incandescents/halogens
2. CFLs
3. LEDs
0. Other, specify
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP1=1]
LP3. Did you install all some or none of the bulbs that you purchased?
1. All
2. Some
3. None
8. Not sure (customer response)
9. Cannot assess (customer unable to provide an answer)

[ASK IF LP2=3]
LP4. Why did you purchase LEDs and not other bulb types such as incandescents or CFLs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=2]
LP5. Why did you purchase CFLs and not other bulb types such as incandescents or LEDs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=1]
LP6. Why did you purchase incandescent bulbs and not other bulb types such as CFLs or LEDs? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]]

[ASK IF LP2=2 AND LP2=3]
LP7. Why did you purchase CFLs and LEDs and not incandescents? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

[ASK IF LP2=1 AND LP2=2 OR LP2=3]
LP8. Why did you purchase a mix of incandescents and [CFLs/LEDs] and not just [CFLs/LEDs]? [OPEN END, 98-Not sure (customer response), 99-Cannot assess (customer unable to provide an answer)]

Closing

Thank you very much for participating in this study. I have a $50 gift card for you in exchange for your participation. Thank you again for taking the time to be a part of this important study.

[REMINDER] Please collect customer's signature on the "Duke Energy Lighting Logger Study Gift Card Receipts" form.

G1. Record gift card number [Numeric 00000000-99999999].

Appendix H. Retailer and Manufacturer Interview Results

The Excel spreadsheets are provided as a separate submission and contain tabulated and anonymized responses from retailer and manufacturer interviews as well as the calculation of NTG ratios from the retailer and manufacturer interviews.

Appendix I. Shelf Audit Results

We provide the final shelf audit data package as a separate submission. As part of the package, we provide a data file in Stata and Excel accompanied by a data dictionary.

Appendix J. Residential Lighting Logger Study Results

We provide the residential lighting logger study package as a separate submission. As part of the package, we provide the following data files in Stata and Excel with associated data dictionaries:

- Hourly logger data file
- Logger-level data file

Appendix K. Sales Data Modeling Datafile

We provide the final sales data used for sales data modeling as a separate submission. As part of the package, we provide a data file in Stata and Excel accompanied by a data dictionary.

Appendix L. Leakage Rate Analysis Results

We provide the final data used for leakage rate analysis as a separate submission. As part of the package, we provide data files in Stata and Excel accompanied by a data dictionary.

Appendix M. Ex Ante Savings Assumptions and Their Sources

Table M-1 details ex ante savings assumptions and their sources for the DEP EEL and DEC Retail LED programs.

Table M-1. Ex Ante Savings Assumptions and Their Sources

Assumption	Residential Savings Assumption	Commercial Savings Assumption	Residential Assumption Source	Commercial Assumption Source
Sales to residential/ commercial customers*	0.823	0.10	• 2011 and 2012 DEP Intercept Surveys	
Leakage rate	0.077			
Delta watts	Baseline wattage – efficient wattage		• Program tracking data • 2015 Retailer Shelf Audit	
HOU	2.922	6.930 (CFLs) 5.783 (LEDs)	• 2012 DEP Residential Metering Study	• 2015–2016 DEP Commercial Lighting Logger Study
CF	Summer: 0.1138 Winter: 0.0960	Summer: 0.497 (CFLs) 0.547 (LEDs) Winter: 0.174 (CFLs) 0.120 (LEDs)		
Interactive effects	0.94 (Energy savings) 1.27 (Summer peak demand savings) 0.50 (Winter peak demand savings)	1	• 2012 DOE2 Simulation Models	• No interactive effects applied
First-year ISR and carryover savings	0.795 (CFLs) 0.744 (LEDs) 1.00 (Fixtures)	0.879 (CFLs) 0.979 (LEDs) 1.00 (Fixtures)	• 2013 General Population Survey (for CFLs and LEDs) • Assumed value (for fixtures) • 2014 Storage Log Study (for carryover savings trajectory)	

* Together with the leakage rate, these values add up to 1.

Appendix N. Residential Lighting Logger Study – Additional Results

Overall average daily HOU for LEDs from the residential lighting logger study are 2.88 hours, the average summer peak CF is 0.128, and the average winter peak CF is 0.145. Table N-1 provides HOU and CF estimates from the study, along with the standard errors and relative precision surrounding the estimates.

Table N-1. HOU and Coincidence Factor Estimates

Statistic	Result	Standard Error	Relative Precision
HOU	2.881	0.151	9%
Summer CF	0.1283	0.010	12%
Winter CF	0.1451	0.011	12%

HOU and CFs vary by room type, with living rooms, kitchens, and dining rooms generating the highest HOU and CF values and bedrooms, bathrooms, and other room types generating the lowest HOU and CF values. Table N-2 provides HOU and CF estimates by room, as well as percent of sockets with LEDs in each room.

Table N-2. HOU and Coincidence Factor Estimates by Room

Room Type	# of Loggers	% of Sockets with LEDs	HOU	Summer CF	Winter CF
Dining room	20	17%	4.27	0.235	0.198
Kitchen	35	45%	4.26	0.220	0.266
Basement	2	14%	3.75	0.335	0.230
Living room	85	32%	3.23	0.115	0.110
Bedroom	49	16%	1.83	0.055	0.095
Bathroom	27	20%	1.51	0.050	0.080
Other	44	18%	1.91	0.084	0.097
Total	262	30%	2.88	0.128	0.145

HOU vary considerably by home type, homeownership, education, and income, as can be seen in Table N-3, HOU are much higher in multifamily homes, in homes that are rented, and in homes occupied with customers with higher income levels and higher levels of education.

Table N-3. HOU Estimates by Customer Characteristics

Room Type	n	% of Sockets with LEDs	HOU	Relative Precision
Home type				
Single-family	100	24%	2.76	8%
Multi-family	7	30%	5.05	38%
Homeownership				
Own	90	23%	2.82	8%
Rent	17	31%	3.23	32%
Income				
<$50,000	32	24%	2.15	17%
$50,000–$100,000	41	22%	3.22	11%
$100,000+	32	25%	3.04	15%
Education				
Less than college	45	24%	2.68	14%

Room Type	n	% of Sockets with LEDs	HOU	Relative Precision
Bachelor's degree	33	31%	2.62	12%
Graduate degree	28	33%	3.36	17%

To place the HOU estimates derived through this study in perspective, Opinion Dynamics compiled the results from the other HOU studies from across the country. Table N-4 presents the results. As can be seen in the table, the HOU from this study are within the range of the other studies' estimates.

Table N-4. Comparison of HOU Estimates across Studies

Study Name	Study Timing	n	HOU Result	Notes
New England HOU Study	2013	848	3.0	Efficient bulbs
Pennsylvania Statewide Residential Light Metering Study	2014	206	3.0	Efficient bulbs
DEP 2012 CFL HOU Study	2012	100	2.92	CFLs only
DEP-DEC Residential Lighting Logger Study	2016	107	2.88	LEDs only
Indiana Statewide CFL HOU Study	2012-2013	67	2.47	CFLs
EmPOWER Maryland HOU Metering Study	2014	111	2.46	Efficient bulbs
ComEd PY5/PY6 Lighting Logger Study	2014	85	2.32	Standard CFLs

For more information, please contact:

Kessie Avseikova
Director

617 492 1400 tel
617 497 7944 fax
kavseikova@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451

San Francisco Bay

510 444 5050 tel
510 444 5222 fax

1999 Harrison Street
Suite 1420
Oakland, CA 94612

Salt Lake City, UT

385 375 8802 tel
801 335 6544 fax

3006 Highland Drive
Suite 100
Orem, UT 84057