DUKE ENERGY®

Brian L. Franklin
Associate General Counsel

Duke Energy
550 South Tryon Street
Charlotte, NC 28202

Mailing Address:
DEC45A / P.O. Box 1321
Charlotte, NC 28201

o: 980.373.4465
f: 980.373.8534

brian.franklin@duke-energy.com

March 8, 2017

VIA ELECTRONIC FILING AND OVERNIGHT DELIVERY

Ms. M. Lynn Jarvis
Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4300

RE: Duke Energy Carolinas, LLC's Application for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider
Docket No. E-7, Sub 1130

Dear Ms. Jarvis:

I enclose Duke Energy Carolinas, LLC's Application for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider, together with Direct Testimonies and Exhibits of Robert P. Evans and Carolyn T. Miller, for filing in connection with the referenced matter. I will deliver fifteen (15) paper copies, as well as four (4) flash drives containing the accompanying work papers and Evaluation, Measurement & Verification reports (Evans Exhibits A through J) to the Clerk's Office by close of business on March 9, 2017.

Thank you for your attention to this matter. If you have any questions, please let me know.

Respectfully submitted,

Brian L. Franklin

Enclosures

cc: Parties of Record

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1130

In the Matter of Application of Duke Energy Carolinas, LLC for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider Pursuant to N.C. Gen. Stat. § 62-133.9 and Commission Rule R8-69	))))))	**APPLICATION OF DUKE ENERGY CAROLINAS, LLC FOR APPROVAL OF RIDER 9**

Duke Energy Carolinas, LLC ("DEC," "Company," or "Applicant"), pursuant to North Carolina General Statutes ("N.C. Gen. Stat.") § 62-133.9 and North Carolina Utilities Commission (the "Commission") Rule R8-69, hereby applies to the Commission for approval of its demand-side management ("DSM") and energy efficiency ("EE") (collectively, "DSM/EE") cost recovery rider, Rider EE, for 2018 ("Rider 9"). Rider 9 has been calculated in accordance with the Company's DSM/EE cost recovery mechanism approved by the Commission in Docket No. E-7, Sub 1032. The prospective components of Rider 9 include estimates of the revenue requirements for Vintage 2018[1] DSM/EE programs, as well as an estimate of the second year of net lost revenues for Vintage 2017 EE programs, the third year of net lost revenues for Vintage 2016 EE programs, and the final half-year of net lost revenues for Vintage 2015 EE programs. The Rider 9 Experience Modification Factor ("EMF") includes the following true-ups: a true-up of Vintage 2014 DSM/EE programs, a true-up of Vintage 2015 DSM/EE programs, and a true-up of Vintage 2016 DSM/EE programs.

---

[1] A vintage year is the twelve-month period in which a specific DSM or EE measure is installed for an individual participant or a group of participants. Each vintage is referred to by the calendar year of its respective rate period (*e.g.*, Vintage 2018).

In support of this Application, DEC respectfully shows the Commission the following:

1. The Applicant's general offices are located at 550 South Tryon Street, Charlotte, North Carolina, and its mailing address is:

Duke Energy Carolinas, LLC
P. O. Box 1006
Charlotte, North Carolina 28201-1006

2. The names and addresses of Applicant's attorneys are:

Brian L. Franklin, Associate General Counsel
Duke Energy Carolinas, LLC
DEC45A/P.O. Box 1321
550 South Tryon Street
Charlotte, North Carolina 28201
(980) 373-4465
brian.franklin@duke-energy.com

Molly McIntosh Jagannathan
Troutman Sanders LLP
One Wells Fargo, Suite 3400
301 South College Street
Charlotte, North Carolina 28202
(704) 998-4074
molly.jagannathan@troutmansanders.com

3. N.C. Gen. Stat. § 62-133.9(d) authorizes the Commission to approve an annual rider to the rates of electric public utilities to recover all reasonable and prudent costs incurred for the adoption and implementation of new DSM/EE programs. Recoverable costs include, but are not limited to, all capital costs, including cost of capital and depreciation expense, administrative costs, implementation costs, incentive payments to program participants, and operating costs. Such rider shall consist of the utility's forecasted cost during the rate period and an EMF rider to collect the difference between the utility's actual reasonable and

prudent costs incurred during the test period and actual revenues realized during the test period. The Commission is also authorized to approve incentives for adopting and implementing new DSM/EE programs, including appropriate rewards based on capitalization of a percentage of avoided costs achieved by DSM/EE measures.

4. The Company's cost recovery mechanism is described in the Agreement and Stipulation of Settlement DEC reached with the Public Staff, the North Carolina Sustainable Energy Association, Environmental Defense Fund, Southern Alliance for Clean Energy, the South Carolina Coastal Conservation League, Natural Resources Defense Council, and the Sierra Club filed with the Commission on August 19, 2013 (the "Stipulation"). The Commission approved the cost recovery mechanism as described in the Stipulation, as well as DEC's portfolio of DSM/EE programs, in its *Order Approving DSM/EE Programs and Stipulation of Settlement* issued October 29, 2013 ("Sub 1032 Order"). The approved cost recovery mechanism is designed to allow DEC to collect revenue equal to its incurred program costs for a rate period plus a Portfolio Performance Incentive based on shared savings achieved by DEC's DSM/EE programs, and to recover net lost revenues for EE programs only.

5. Rule R8-69(b) provides that the Commission will each year conduct a proceeding for each electric public utility to establish an annual DSM/EE rider to recover DSM/EE related costs.

6. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.9 and Rule R8-69, DEC requests the establishment of Rider 9 to recover: (1) a prospective component consisting of the estimated revenue requirements associated with Vintage

2018 of DEC's current portfolio of DSM/EE programs, the second year of net lost revenues for Vintage 2017 of DEC's EE programs, the third year of net lost revenues for Vintage 2016 of DEC's EE programs, and the final half-year of net lost revenues for Vintage 2015 of DEC's EE programs; and (2) an EMF component truing up Vintage 2014, Vintage 2015 and Vintage 2016 of DEC's DSM/EE programs.

7. Pursuant to the provisions of N.C. Gen. Stat. § 62-133.9 and Rule R8-69, the Company requests Commission approval of the following annual billing factors (all shown on a cents per kilowatt hour ("¢/kWh") basis, including gross receipts tax and regulatory fee):

Residential Billing Factors	**¢/kWh**
Residential Billing Factor for Rider 9 Prospective Components	0.4571
Residential Billing Factor for Rider 9 EMF Components	0.1074

Non-Residential Billing Factors for Rider 9 Prospective Components	**¢/kWh**
Vintage 2015 EE participant	0.0197
Vintage 2016 EE participant	0.0638
Vintage 2017 EE participant	0.0456
Vintage 2018 EE participant	0.2936
Vintage 2018 DSM participant	0.0778

Non-Residential Billing Factors for Rider 9 EMF Components	**¢/kWh**
Vintage 2014 EE participant	0.0005
Vintage 2014 DSM participant	(0.0006)
Vintage 2015 EE participant	0.0193
Vintage 2015 DSM participant	(0.0024)
Vintage 2016 EE participant	0.1264
Vintage 2016 DSM participant	0.0016

Consistent with the Commission's *Order on Motions for Reconsideration* issued on June 3, 2010 in Docket No. E-7, Sub 938 and the Sub 1032 Order, Rider 9 will be in effect for the twelve month period January 1, 2018 through December 31, 2018. Also in accordance with these Orders, the test period for the Vintage 2016 EMF component is the period January 1, 2016 through December 31, 2016; the test period for the Vintage 2015 EMF component is the period January 1, 2015 through December 31, 2015; the test period for the Vintage 2014 EMF component is the period January 1, 2014 through December 31, 2014.

8. The Company has attached hereto as required by Rule R8-69, the direct testimony and exhibits of witnesses Carolyn T. Miller and Robert P. Evans in support of the requested change in rates.

WHEREFORE, the Company respectfully prays:

That consistent with this Application, the Commission approves the changes to its rates as set forth in paragraph 7 above.

Respectfully submitted, this the 8th day of March 2017.

By: ______________________

Brian L. Franklin
Associate General Counsel
Duke Energy Corporation
550 South Tryon Street
DEC45A/P.O. Box 1321
Charlotte, North Carolina 28201
Telephone: 980-373-4465
brian.franklin@duke-energy.com

Molly McIntosh Jagannathan
Troutman Sanders LLP
One Wells Fargo, Suite 3400
301 South College Street
Charlotte, North Carolina 28202
Telephone: 704-998-4074
molly.jagannathan@troutmansanders.com

ATTORNEYS FOR DUKE ENERGY CAROLINAS, LLC

STATE OF NORTH CAROLINA)
) VERIFICATION
COUNTY OF MECKLENBURG)

Carolyn T. Miller, being first duly sworn, deposes and says:

That she is MANAGER, RATES AND REGULATORY STRATEGY of DUKE ENERGY CAROLINAS, LLC, applicant in the above-titled action; that she has read the foregoing Application and knows the contents thereof; that the same is true except as to the matters stated therein on information and belief; and as to those matters, she believes them to be true.

Carolyn T. Miller
Carolyn T. Miller

Sworn to and subscribed before me
this the 7th day of March, 2017.

T J Reed-Hall
Notary Public

My Commission Expires: 7-31-17

THOMAS J. REED-HALL
NOTARY PUBLIC
GASTON COUNTY, NC

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1130

In the Matter of	)	
Application of Duke Energy Carolinas, LLC	)	**DIRECT TESTIMONY OF**
for Approval of Demand-Side Management	)	**CAROLYN T. MILLER**
and Energy Efficiency Cost Recovery Rider	)	**FOR**
Pursuant to N.C. Gen. Stat. § 62-133.9 and	)	**DUKE ENERGY CAROLINAS,**
Commission Rule R8-69	)	**LLC**

I. INTRODUCTION AND PURPOSE

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Carolyn T. Miller, and my business address is 550 South Tryon Street, Charlotte, North Carolina, 28202.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am a Rates Manager for Duke Energy Corporation ("Duke Energy") supporting both Duke Energy Progress, LLC ("DEP") and Duke Energy Carolinas, LLC ("DEC" or the "Company").

Q. PLEASE SUMMARIZE YOUR EDUCATION AND PROFESSIONAL QUALIFICATIONS.

A. I graduated from the College of New Jersey in Trenton, New Jersey with a Bachelor of Science in Accountancy. I am a certified public accountant licensed in the State of North Carolina. I began my career in 1994 with Ernst & Young as a staff auditor. In 1997, I began working with Duke Energy as a Senior Business Analyst and have held a variety of positions in the Finance organization. I joined the Rates Department in 2014 as Manager, Rates and Regulatory Strategy.

Q. WHAT ARE YOUR PRESENT RESPONSIBILITIES FOR DEC?

A. I am responsible for providing regulatory support and guidance on DEC's energy efficiency cost recovery process.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THIS COMMISSION?

A. Yes. I have provided testimony in support of DEC's previous applications for approval of its demand-side management ("DSM") and energy efficiency ("EE") (collectively, "DSM/EE") cost recovery riders as well as DEP's applications for approval of its DSM/EE cost recovery riders.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to explain and support DEC's proposed DSM/EE cost recovery rider (Rider 9), including prospective and Experience Modification Factor ("EMF") components, and provide information required by Commission Rule R8-69.

Q. PLEASE DESCRIBE THE EXHIBITS ATTACHED TO YOUR TESTIMONY.

A. Miller Exhibit 1 summarizes the individual rider components for which DEC requests approval in this filing. Miller Exhibit 2 shows the calculation of revenue requirements for each vintage, with separate calculations for non-residential DSM and EE programs within each vintage. Miller Exhibit 3 presents the return calculations for Vintages 2014, 2015 and 2016. Miller Exhibit 4 shows the actual and estimated prospective amounts collected from customers via Riders 5-8 pertaining to Vintages 2014 through 2017. Miller Exhibit 5 provides the calculation of the allocation factors used to allocate system EE and DSM costs to DEC's North Carolina retail jurisdiction. Miller Exhibit 6 presents the forecasted sales for the rate period (2018), and the estimated sales related to customers that have opted out of various vintages.

These amounts are used to determine the forecasted sales to which the Rider 9 amounts will apply. Miller Exhibit 7 is the proposed tariff sheet for Rider 9.

Q. WERE MILLER EXHIBITS 1-7 PREPARED BY YOU OR AT YOUR DIRECTION AND SUPERVISION?

A. Yes.

II. GENERAL STRUCTURE OF RIDERS

Q. PLEASE DESCRIBE THE STRUCTURE OF RIDER 9.

A. Rider 9 was calculated in accordance with the Company's cost recovery mechanism described in the Agreement and Stipulation of Settlement DEC reached with the Public Staff, the North Carolina Sustainable Energy Association, Environmental Defense Fund, Southern Alliance for Clean Energy ("SACE"), the South Carolina Coastal Conservation League, Natural Resources Defense Council, and the Sierra Club, which was filed with the Commission on August 19, 2013 (the "Stipulation"), and approved in the Commission's *Order Approving DSM/EE Programs and Stipulation of Settlement* issued on October 29, 2013 ("Sub 1032 Order"). The approved cost recovery mechanism is designed to allow DEC to collect revenue equal to its incurred program costs[1] for a rate period plus a Portfolio Performance Incentive ("PPI") based on shared savings achieved by DEC's DSM/EE programs, and to recover net lost revenues for EE programs only.

[1] Program costs are defined under Rule R8-68(b)(1) as all reasonable and prudent expenses expected to be incurred by the electric public utility, during a rate period, for the purpose of adopting and implementing new DSM and EE measures previously approved pursuant to Rule R8-68.

The Company is allowed to recover net lost revenues associated with a particular vintage of an EE measure for the lesser of 36 months or the life of the measure, and provided that the recovery of net lost revenues shall cease upon the implementation of new rates in a general rate case to the extent that the new rates are set to recover net lost revenues.

The Company's cost recovery mechanism employs a vintage year concept based on the calendar year.[2] In each of its annual rider filings, DEC performs an annual true-up process for the prior calendar year vintages. The true-up will reflect actual participation and verified Evaluation, Measurement and Verification ("EM&V") results for completed vintages, applied in the same manner as agreed upon by DEC, SACE, and the Public Staff, and approved by the Commission in its *Order Approving DSM/EE Rider and Requiring Filing of Proposed Customer Notice* issued on November 8, 2011, in Docket No. E-7, Sub 979 ("EM&V Agreement").

The Company has implemented deferral accounting for over- and under-recoveries of costs that are eligible for recovery through the annual DSM/EE rider. Under the Stipulation, the balance in the deferral account(s), net of deferred income taxes, may accrue a return at the net-of-tax rate of return rate approved in DEC's then most recent general rate case. The methodology used for the calculation of interest shall be the same as that typically utilized for DEC's Existing DSM Program rider proceedings. Pursuant to Commission Rule R8-69(c)(3), DEC will not accrue a return on

[2] Each vintage is referred to by the calendar year of its respective rate period (*e.g.*, Vintage 2018).

net lost revenues or the PPI. Miller Exhibit 3, pages 1 through 12, shows the calculation performed as part of the true-up of Vintage 2014, Vintage 2015 and Vintage 2016.

The Company expects that most EM&V will be available in the time frame needed to true-up each vintage in the following calendar year. If any EM&V results for a vintage are not available in time for inclusion in DEC's annual rider filing, however, then the Company will make an appropriate adjustment in the next annual filing.

DEC calculates one integrated (prospective) DSM/EE rider and one integrated DSM/EE EMF rider for the residential class, to be effective each rate period. The integrated residential DSM/EE EMF rider includes all true-ups for each applicable vintage year. Given that qualifying non-residential customers can opt out of DSM and/or EE programs, DEC calculates separate DSM and EE billing factors for the non-residential class. Additionally, the non-residential DSM and EE EMF billing factors are determined separately for each applicable vintage year, so that the factors can be appropriately charged to non-residential customers based on their opt-in/out status and participation for each vintage year.

Q. WHAT ARE THE COMPONENTS OF RIDER 9?

A. The prospective components of Rider 9 include: (1) a prospective Vintage 2018 component designed to collect program costs and the PPI for DEC's 2018 vintage of DSM programs; (2) a prospective Vintage 2018 component to collect program costs, shared savings, and the first year of net lost revenues for DEC's 2018 vintage of EE programs; (3) a prospective Vintage 2017 component designed to collect the second year of estimated net lost revenues for DEC's 2017 vintage of EE programs; (4) a prospective Vintage 2016 component designed to collect the third year of estimated net lost revenues for DEC's 2016 vintage of EE programs; and (5) a prospective Vintage 2015 component designed to collect the final half-year of estimated net lost revenues for DEC's 2015 vintage of EE programs. The EMF components of Rider 9 include: (1) a true-up of Vintage 2014 shared savings and participation for DSM/EE programs based on additional EM&V results received; (2) a true-up of Vintage 2015 shared savings and participation for DSM/EE programs based on additional EM&V results received; (3) a true-up of Vintage 2016 program costs, shared savings and participation for DSM/EE programs.

Q. HOW DOES DEC CALCULATE THE PROPOSED BILLING FACTORS?

A. The billing factor for residential customers is computed by dividing the combined revenue requirements for DSM and EE programs by the forecasted sales for the rate period. For non-residential rates, the billing factors are computed by dividing the revenue requirements for DSM and EE programs separately by forecasted sales for the rate period. The forecasted sales exclude the estimated sales to customers who have elected to opt out of Rider EE. Because non-residential customers are allowed to opt out of DSM and/or

EE programs separately in an annual election, non-residential billing factors are computed separately for each vintage.

III. COST ALLOCATION METHODOLOGY

Q. HOW DOES DEC ALLOCATE REVENUE REQUIREMENTS TO THE NORTH CAROLINA RETAIL JURISDICTION AND TO THE RESIDENTIAL AND NON-RESIDENTIAL RATE CLASSES?

A. The Company allocates the revenue requirements related to program costs and incentives for EE programs targeted at retail residential customers across North Carolina and South Carolina to its North Carolina retail jurisdiction based on the ratio of North Carolina retail kWh sales (grossed up for line losses) to total retail kWh sales (grossed up for line losses), and then recovers them only from North Carolina residential customers. The revenue requirements related to EE programs targeted at retail non-residential customers across North Carolina and South Carolina are allocated to the North Carolina retail jurisdiction based on the ratio of North Carolina retail kWh sales (grossed up for line losses) to total retail kWh sales (grossed up for line losses), and then recovered from only North Carolina retail non-residential customers. The portion of revenue requirements related to net lost revenues for EE programs is not allocated to the North Carolina retail jurisdiction, but rather is specifically computed based on the kW and kWh savings of North Carolina retail customers.

For DSM programs, because residential and non-residential programs are similar in nature, the aggregated revenue requirement for all retail DSM programs targeted at both residential and non-residential customers across North Carolina and South Carolina are allocated to the North Carolina retail jurisdiction based on North Carolina's contribution to total retail peak demand. Both residential and non-residential customer classes are allocated a share of total system DSM revenue requirements based on each group's contribution to total retail peak demand.

The allocation factors used in DSM/EE EMF true-up calculations for each vintage are based on DEC's most recently filed Cost of Service studies at the time that the Rider EE filing incorporating the initial true-up for each vintage is made. If there are subsequent true-ups for a vintage, DEC will use the same allocation factors as those used in the original DSM/EE EMF true-up calculations.

IV. UTILITY INCENTIVES AND NET LOST REVENUES

Q. HOW DOES DEC CALCULATE THE PPI?

A. Pursuant to the Stipulation, DEC calculates the dollar amount of PPI by multiplying the shared savings achieved by the system portfolio of DSM/EE programs by 11.5%. Company witness Evans further describes the specifics of the PPI calculation in his testimony. In addition, Evans Exhibit 1, pages 1 through 3, show the revised PPI for Vintage 2014, Vintage 2015 and Vintage 2016, respectively, based on updated EM&V results, and Evans Exhibit 1, page 4, shows the estimated PPI by program type and customer class for Vintage 2018. The system amount of PPI is then allocated to North Carolina retail customer classes in order to derive customer rates.

Q. HOW DOES DEC CALCULATE THE NET LOST REVENUES FOR THE PROSPECTIVE COMPONENTS OF RIDER EE?

A. For the prospective components of Rider EE, net lost revenues are estimated by multiplying the portion of DEC's tariff rates that represent the recovery of fixed costs by the estimated North Carolina retail kW and kWh reductions applicable to EE programs by rate schedule, and reducing this amount by estimated found revenues. The Company calculates the portion of North Carolina retail tariff rates (including certain riders) representing the recovery of fixed costs by deducting the recovery of fuel and variable operation and maintenance ("O&M") costs from its tariff rates. The lost revenues totals for residential and non-residential customers are then reduced by North Carolina retail found revenues computed using the weighted average lost revenue rates for each customer class. The testimony and exhibits of Company witness Evans provide information on the actual and estimated found revenues which offset lost revenues.

Q. HOW DOES DEC CALCULATE THE NET LOST REVENUES FOR THE EMF COMPONENTS OF RIDER EE?

A. For the EMF components of Rider EE, DEC calculates the net lost revenues by multiplying the portion of its tariff rates that represent the recovery of fixed costs by the actual and verified North Carolina retail kW and kWh reductions applicable to EE programs by rate schedule, then reducing this amount by actual found revenues.

V. OPT-OUT PROVISIONS

Q. PLEASE EXPLAIN THE OPT-OUT PROCESS FOR NON-RESIDENTIAL CUSTOMERS.

A. Pursuant to the Commission's *Order Granting Waiver, in Part, and Denying Waiver, in Part* ("Waiver Order") issued April 6, 2010, in Docket No. E-7, Sub 938 and the Sub 1032 Order, the Company is allowed to permit qualifying non-residential customers[3] to opt out of the DSM and/or EE portion of Rider EE during annual election periods. If a customer opts into a DSM program (or never opted out), the customer is required to participate for three years in the approved DSM programs and rider. If a customer chooses to participate in an EE program (or never opted out), that customer is required to pay the EE-related program costs, shared savings incentive and the net lost revenues for the corresponding vintage of the programs in which it participated. Customers that opt out of DEC's DSM and/or EE programs remain opted-out unless they choose to opt back in during any of the succeeding annual election periods, which occur from November 1 to December 31 each year, or any of the succeeding annual opt-in periods in March as described below. If a customer participates in any vintage of programs, the customer is subject to all true-up provisions of the approved Rider EE for any vintage in which the customer participates.

DEC provides an additional opportunity for qualifying customers to opt in to DEC's DSM and/or EE programs during the first five business days

[3] Individual commercial customer accounts with annual energy usage of not less than 1,000,000 kWh and any industrial customer account.

of March. Customers who choose to begin participating in DEC's EE and DSM programs during the special "opt-in period" during March of each year will be retroactively billed the applicable Rider EE amounts back to January 1 of the vintage year, such that they will pay the appropriate Rider EE amounts for the full rate period.

Q. DOES DEC ADJUST THE RATE FOR NON-RESIDENTIAL CUSTOMERS TO ACCOUNT FOR THE IMPACT OF "OPT-OUT" CUSTOMERS?

A. Yes. The impact of opt-out results is considered in the development of the Rider EE billing rates for non-residential customers. Since the revenue requirements will not be recovered from non-residential customers that opt out of DEC's programs, the forecasted sales used to compute the rate per kWh for non-residential rates exclude sales to customers that have opted out of the vintage to which the rate applies. This adjustment is shown on Miller Exhibit 6.

VI. PROSPECTIVE COMPONENTS

Q. WHAT IS THE RATE PERIOD FOR THE PROSPECTIVE COMPONENTS OF RIDER 9?

A. In accordance with the Commission's *Order on Motions for Reconsideration* issued on June 3, 2010, in Docket No. E-7, Sub 938 ("Second Waiver Order") and the Sub 1032 Order, DEC has calculated the prospective components of Rider 9 using the rate period January 1, 2018 through December 31, 2018.

Q. PLEASE DESCRIBE THE BASIS FOR THE RATE PERIOD REVENUE REQUIREMENTS RELATING TO VINTAGE 2015?

A. The Company determines the estimated revenue requirements for Vintage 2015 separately for residential and non-residential customer classes, and bases them on the final half-year of net lost revenues for its Vintage 2015 EE programs. The amounts are based on estimated North Carolina retail kW and kWh reductions and DEC's rates approved in its most recent general rate case, which became effective September 25, 2013, adjusted as described above to recover only the fixed cost component.

Q. PLEASE DESCRIBE THE BASIS FOR THE RATE PERIOD REVENUE REQUIREMENTS RELATING TO VINTAGE 2016.

A. The Company determines the estimated revenue requirements for Vintage 2016 separately for residential and non-residential customer classes and bases them on the third year of net lost revenues for its Vintage 2016 EE programs. The amounts are based on estimated North Carolina retail kW and kWh reductions and DEC's rates approved in its most recent general rate case, which became effective September 25, 2013, adjusted as described above to recover only the fixed cost component.

Q. PLEASE DESCRIBE THE BASIS FOR THE RATE PERIOD REVENUE REQUIREMENTS RELATING TO VINTAGE 2017.

A. The Company determines the estimated revenue requirements for Vintage 2017 separately for residential and non-residential customer classes and bases them on the second year of net lost revenues for its Vintage 2017 EE programs. The amounts are based on estimated North Carolina retail kW and kWh reductions and DEC's rates approved in its most recent general rate case, which became effective September 25, 2013, adjusted as described above to only recover the fixed cost component.

Q. PLEASE DESCRIBE THE BASIS FOR THE RATE PERIOD REVENUE REQUIREMENTS RELATING TO VINTAGE 2018.

A. The estimated revenue requirements for Vintage 2018 EE programs include program costs, a shared savings incentive (PPI), and the first year of net lost revenues determined separately for residential and non-residential customer classes. The estimated revenue requirements for Vintage 2018 DSM programs include program costs and a shared savings incentive (PPI). The program costs and shared savings incentive are computed at the system level and allocated to North Carolina based on the allocation methodologies discussed earlier in my testimony. The net lost revenues for EE programs are based on estimated North Carolina retail kW and kWh reductions and the rates approved in DEC's most recent general rate case, which became effective September 25, 2013.

VII. EMF

Q. WHAT IS THE TEST PERIOD FOR THE EMF COMPONENT?

A. Pursuant to the Second Waiver Order and Sub 1032 Order, the "test period" for the EMF component is defined as the most recently completed vintage year at the time of DEC's Rider EE cost recovery application filing date, which in this case is Vintage 2016 (January 1, 2016 through December 31, 2016). In addition, the Second Waiver Order allows the EMF component to cover multiple test periods, so the EMF component for 2018 includes Vintage 2014 (January 2014 through December 2014) and Vintage 2015 (January 2015 through December 2015) as well.

Q. WHAT IS BEING "TRUED UP" FOR VINTAGE 2016?

A. The chart below demonstrates which components of the Vintage 2016 estimate filed in 2015 are being "trued up" in the Vintage 2016 EMF component of Rider 9. Miller Exhibit 2, page 3 contains the calculation of the true-up for Vintage 2016. The second year of net lost revenues for Vintage 2016, which are a component of Rider 8 billings during 2017, will be trued-up to actual amounts during the next rider filing.

	Vintage 2016 Estimate (2016) As Filed (Filed 2015)	**Vintage 2016 True-Up (2018) (Filed March 2017)**
	Rider 7	**Rider 9 EMF**
Participation	Estimated participation assuming January 1, 2016 sign up date	Update for actual participation for January – December 2016
EM&V	Initial assumptions of load impacts	Updated according to Commission-approved EM&V Agreement
Lost Revenues	Estimated 2016 participation using half-year convention	Update for actual participation for January – December 2016 and actual 2016 lost revenue rates
Found Revenues	Estimated according to Commission-approved guidelines	Update for actual according to Commission-approved guidelines
New Programs	Only includes programs approved prior to estimated filing	Update for any new programs and pilots approved and implemented since estimated filing

In addition, DEC has implemented deferral accounting for the under/over collection of program costs and calculated a return at the net-of-tax rate of return rate approved in DEC's most recent general rate case. The methodology used for the calculation of return is the same as that typically utilized for DEC's Existing DSM Program rider proceedings. Pursuant to Commission Rule R8-69(c)(3), DEC is not accruing a return on net lost revenues or the PPI. Please see Miller Exhibit 3, pages 1 through 12 for the calculation performed as part of the true-up of Vintage 2014, Vintage 2015 and Vintage 2016.

Q. HOW WERE THE LOAD IMPACTS UPDATED?

A. For DSM programs, the contracted amounts of kW reduction capability from participants are considered to be components of actual participation. As a result, the Vintage 2016 true-up reflects the actual quantity of demand reduction capability for the Vintage 2016 period. The load impacts for EE programs were updated in accordance with the Commission-approved EM&V Agreement.

Q. HOW WERE ACTUAL NET LOST REVENUES COMPUTED FOR THE VINTAGE 2016 TRUE-UP?

A. Net lost revenues for year one (2016) of Vintage 2016 were calculated using actual kW and kWh savings by North Carolina retail participants by customer class based on actual participation and load impacts reflecting EM&V results applied according to the EM&V Agreement. The actual kW and kWh savings were as experienced during the period January 1, 2016 through December 31,

2016. The rates applied to the kW and kWh savings are the retail rates that were in effect for the period January 1, 2016 through December 31, 2016, reduced by fuel and other variable costs. The lost revenues were then offset by actual found revenues for year one of Vintage 2016 as explained by Company witness Evans. The calculation of net lost revenues was performed by rate schedule within the residential and non-residential customer classes.

Q. WHAT IS BEING "TRUED UP" FOR VINTAGE 2015?

A. Avoided costs for Vintage 2015 DSM programs are being trued up to update participation results, and DSM program costs were updated to reflect the final results of the program cost audit conducted in 2016. Avoided costs for Vintage 2015 EE programs are being "trued up" based on updated EM&V participation results. Net lost revenues for all years were trued up for updated EM&V participation results. The actual kW and kWh savings were as experienced during the period January 1, 2015 through December 31, 2015. The rates applied to the kW and kWh savings are the retail rates that were in effect during each period the lost revenues were earned, reduced by fuel and other variable costs.

Q. WHAT IS BEING "TRUED UP" FOR VINTAGE 2014?

A. Avoided costs for Vintage 2014 EE programs are being "trued up" based on updated EM&V participation results. Net lost revenues for all years were trued up for updated EM&V participation results. The actual kW and kWh savings were as experienced during the period January 1, 2014 through December 31, 2014. The rates applied to the kW and kWh savings are the retail rates that were in effect during each period the lost revenues were earned, reduced by fuel and other variable costs.

VIII. PROPOSED RATES

Q. WHAT ARE DEC'S PROPOSED INITIAL BILLING FACTORS APPLICABLE TO NORTH CAROLINA ELECTRIC CUSTOMERS FOR THE PROSPECTIVE COMPONENTS OF RIDER 9?

A. The Company's proposed initial billing factor for the Rider 9 prospective components is 0.4571 cents per kWh for DEC's North Carolina retail residential customers. For non-residential customers, the amounts differ depending upon customer elections of participation. The following chart depicts the options and rider amounts:

Non-Residential Billing Factors for Rider 9 Prospective Components	**¢/kWh**
Vintage 2015 EE participant	0.0197
Vintage 2016 EE participant	0.0638
Vintage 2017 EE participant	0.0456
Vintage 2018 EE participant	0.2936
Vintage 2018 DSM participant	0.0778

Q. WHAT ARE DEC'S PROPOSED EMF BILLING FACTORS APPLICABLE TO NORTH CAROLINA ELECTRIC CUSTOMERS FOR THE TRUE-UP COMPONENTS OF RIDER 9?

A. The Company's proposed EMF billing factor for the true-up components of Rider 9 is 0.1074 cents per kWh for DEC's North Carolina retail residential customers. For non-residential customers, the amounts differ depending upon customer elections of participation. The following chart depicts the options and rider amounts:

Non-Residential Billing Factors for Rider 9 EMF Components	¢/kWh
Vintage 2016 EE participant	0.1264
Vintage 2016 DSM participant	0.0016
Vintage 2015 EE participant	0.0193
Vintage 2015 DSM participant	(0.0024)
Vintage 2014 EE participant	0.0005
Vintage 2014 DSM participant	(0.0006)

IX. CONCLUSION

Q. PLEASE SUMMARIZE THE SPECIFIC RATE MAKING APPROVAL REQUESTED BY DEC.

A. DEC seeks approval of the Rider 9 billing factors to be effective for 2018. As discussed above, Rider 9 contains (1) a prospective component, which includes the final half-year of net lost revenues for Vintage 2015, the third year of net lost revenues for Vintage 2016, the second year of net lost revenues for Vintage 2017, and the revenue requirements for Vintage 2018; and (2) an EMF component which represents a true-up of Vintage 2014, Vintage 2015, and Vintage 2016. Consistent with the Stipulation, for DEC's North Carolina residential customers, the Company calculated one integrated prospective billing factor and one integrated EMF billing factor for Rider 9. Also in accordance with the Stipulation, the non-residential DSM and EE billing factors have been determined separately for each vintage year and will be charged to non-residential customers based on their opt-in/out status and participation for each vintage year.

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

Duke Energy Carolinas, LLC
DSM/EE Cost Recovery Rider 9
Docket Number E-7 Sub 1130
Exhibit Summary for Rider EE Exhibits and Factors

Residential Billing Factors

Residential Billing Factor for Rider 9 True-up (EMF) Components

Line				
1	Year 2014 EE/DSM True-Up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 1 Line 15		357,695
2	Year 2015 EE/DSM True-Up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 2 Line 15		4,451,079
3	Year 2016 EE/DSM True-Up (EMF Revenue Requirement	Miller Exhibit 2 pg. 3 Line 15		18,002,211
4	Total True-up (EMF) Revenue Requirement	Sum Lines 1-3	$	22,810,985
5	Projected NC Residential Sales (kWh) for rate period	Miller Exhibit 6 pg. 1, Line 1		21,243,226,519
6	*EE/DSM Revenue Requirement EMF Residential Rider EE (cents per kWh)*	Line 4 / Line 5 * 100		**0.1074**

Residential Billing Factor for Rider 9 Prospective Components

7	Vintage 2015 Total EE/DSM Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 2, Line 15		3,431,636
8	Vintage 2016 Total EE/DSM Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 3, Line 1		7,765,323
9	Vintage 2017 Total EE/DSM Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 4, Line 1		4,202,002
10	Vintage 2018 Total EE/DSM Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 5, Line 11		81,694,800
11	Total Prospective Revenue Requirement	Sum Lines 7-10	$	97,093,760
12	Projected NC Residential Sales (kWh) for rate period	Miller Exhibit 6 pg. 1, Line 1		21,243,226,519
13	*EE/DSM Revenue Requirement Prospective Residential Rider EE (cents per kWh)*	Line 11 / Line 12 * 100		**0.4571**
	Total Revenue Requirements in Rider 9 from Residential Customers			
14	Total True-up (EMF) Revenue Requirement	Line 4	$	22,810,985
15	Total Prospective Revenue Requirement	Line 11		97,093,760
16	***Total EE/DSM Revenue Requirement for Residential Rider EE***	Line 14 + Line 15	**$**	**119,904,745**
17	***Total EE/DSM Revenue Requirement for Residential Rider EE (cents per kWh)***	Line 6 + Line 13		**0.5645**

Non-Residential Billing Factors for Rider 9 True-up (EMF) Components

1	Vintage Year 2014 EE True-up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 1, Line 25	$	118,573
2	Projected Year 2014 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 4		21,655,074,211
3	*EE Revenue Requirement Year 2014 EMF Non-Residential Rider EE (cents per kWh)*	Line 25/Line 26 * 100		**0.0005**
4	Vintage Year 2014 DSM True-up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 1, Line 35	$	(136,250)
5	Projected Year 2014 DSM Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 5		21,099,155,104
6	*DSM Revenue Requirement Year 2014 EMF Non-Residential Rider EE (cents per kWh)*	Line 28/Line 29 * 100		**(0.0006)**
7	Vintage Year 2015 EE True-up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 2, Line 25	$	4,112,049
8	Projected Year 2015 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 6		21,269,625,317
9	*EE Revenue Requirement Year 2015 EMF Non-Residential Rider EE (cents per kWh)*	Line 30/Line 31 * 100		**0.0193**
10	Vintage Year 2015 DSM True-up (EMF) Revenue Requirement	Miller Exhibit 2 pg. 2, Line 35	$	(501,086)
11	Projected Year 2015 DSM Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 7		20,868,768,758
12	*DSM Revenue Requirement Year 2015 EMF Non-Residential Rider EE (cents per kWh)*	Line 34/Line 35 * 100		**(0.0024)**
13	*Vintage Year 2016 EE True-up (EMF) Revenue Requirement*	Miller Exhibit 2 pg. 3, Line 35	$	26,507,528
14	*Projected Year 2016 EE Participants NC Non-Residential Sales (kwh) for rate period*	Miller Exhibit 6 pg. 1, Line 8		20,972,612,690
15	*EE Revenue Requirement Year 2016 EMF Non-Residential Rider EE (cents per kWh)*	Line 34/Line 35 * 100		**0.1264**
16	*Vintage Year 2016 DSM True-up (EMF) Revenue Requirement*	Miller Exhibit 2 pg. 3, Line 35	$	323,496
17	*Projected Year 2016 DSM Participants NC Non-Residential Sales (kwh) for rate period*	Miller Exhibit 6 pg. 1, Line 9		20,571,098,575
18	*DSM Revenue Requirement Year 2016 EMF Non-Residential Rider EE (cents per kWh)*	Line 34/Line 35 * 100		**0.0016**

Non-Residential Billing Factors for Rider 9 Prospective Components

19	Vintage Year 2015 EE Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 2, Line 25	$	4,183,188
20	Projected Program Year 2015 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 6		21,269,625,317
21	*EE Revenue Requirement Vintage 2015 Prospective Component for Non-Residential Rider EE (cents per kWh)*	Line 40/Line 41 * 100		**0.0197**
22	Vintage Year 2016 EE Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 3, Line 4	$	13,375,187
23	Projected Program Year 2016 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 8		20,972,612,690
24	*EE Revenue Requirement Vintage 2016 Prospective Component for Non-Residential Rider EE (cents per kWh)*	Line 43/Line 44 * 100		**0.0638**
25	Vintage Year 2017 EE Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 4, Line 18	$	9,466,867
26	Projected Program Year 2017 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 10		20,747,917,488
27	*EE Revenue Requirement Vintage 2017 Prospective Component for Non-Residential Rider EE (cents per kWh)*	Line 46/Line 47 * 100		**0.0456**
28	Vintage Year 2018 EE Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 5, Line 18	$	60,923,928
29	Projected Vintage 2018 EE Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 12		20,747,917,488
30	*EE Revenue Requirement Vintage 2018 Prospective Component for Non-Residential Rider EE (cents per kWh)*	Line 49/Line 50 * 100		**0.2936**
31	Vintage Year 2018 DSM Prospective Amounts Revenue Requirement	Miller Exhibit 2 pg. 5, Line 25	$	15,986,235
32	Projected Vintage 2018 DSM Participants NC Non-Residential Sales (kwh) for rate period	Miller Exhibit 6 pg. 1, Line 13		20,547,742,049
33	*DSM Revenue Requirement Vintage 2018 Prospective Component for Non-Residential Rider EE (cents per kWh)*	Line 49/Line 50 * 100		**0.0778**
	Total EMV Rate			**0.1448**
	Total Prospective Rate			**0.5005**

Total Revenue Requirements in Rider 9 from Non-Residential Customers

34	Vintage Year 2014 EE True-up (EMF) Revenue Requirement	Line 1		118,573
35	Vintage Year 2014 DSM True-up (EMF) Revenue Requirement	Line 4		(136,250)
36	Vintage Year 2015 EE True-up (EMF) Revenue Requirement	Line 7		4,112,049
37	Vintage Year 2015 DSM True-up (EMF) Revenue Requirement	Line 10		(501,086)
38	Vintage Year 2016 EE True-up (EMF) Revenue Requirement	Line 13		26,507,528
39	Vintage Year 2016 DSM True-up (EMF) Revenue Requirement	Line 16		323,496
40	Vintage Year 2015 EE Prospective Amounts Revenue Requirement	Line 19		4,183,188
41	Vintage Year 2016 EE Prospective Amounts Revenue Requirement	Line 22		13,375,187
42	Vintage Year 2017 EE Prospective Amounts Revenue Requirement	Line 25		9,466,867
43	Vintage Year 2018 EE Prospective Amounts Revenue Requirement	Line 28		60,923,928
44	Vintage Year 2018 DSM Prospective Amounts Revenue Requirement	Line 31		15,986,235
	Total Non-Residential Revenue Requirement in Rider 9	Sum (Lines 34-44)	**$**	**134,359,714**

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
True up Year 1, 2 and 3 for Vintage Year 2014

RESIDENTIAL
Energy Efficiency Programs

Line		Reference	E-7 Sub 1031 Rider 5 Original Estimate	E-7 Sub 1050 Rider 6 Year 2 Lost Revenue Estimate	E-7 Sub 1073 Rider 7 - True up of Year 1	E-7 Sub 1073 Rider 7 - Estimate of Year 3 Lost Revenue	E-7 Sub 1105 Rider 8 - True up of Lost Revenues and EM&V	E-7 Sub 1105 Rider 8 - Estimate of Year 4 Lost Revenues	E-7 Sub 1130 Rider 9 True up	Year 2014
1	Residential EE Program Cost	Evans Exhibit 1 pg. 1, Line 10 * NC Alloc. Factor	$ 29,754,660		$ (1,844,170)		$ 1		$ 0	$ 27,910,491
2	Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 1, Line 10 * NC Alloc. Factor	2,242,156		2,715,537		88,645		274	5,046,612
3	Return on undercollection of Residential EE Program Costs	Miller Exhibit 3 pg 1			53,935		140,851		71,702	266,488
4	Total EE Program Cost and Incentive Components	Line 1 + Line 2 + line 3	31,996,816		925,302		229,497		71,976	33,223,591
5	Residential DSM Program Cost	Evans Exhibit 1 pg. 1, Line 11 * NC Alloc. Factor	13,143,935		(2,535,104)		(0)		-	10,608,831
6	Residential DSM Earned Utility Incentive	Evans Exhibit 1 pg. 1, Line 11 * NC Alloc. Factor	3,240,520		(12,767)		(25,251)		(0)	3,202,502
7	Return on overcollection of Residential DSM Program Costs	Miller Exhibit 3 pg 2			(69,597)		(136,468)		(64,670)	(270,735)
8	Total DSM Program Cost and Incentive Components	Line 5 + Line 6 + Line 7	16,384,455		(2,617,468)		(161,719)		(64,670)	13,540,598
9	Total EE/DSM Program Cost and Incentive Components	Line 4 + Line 8	48,381,271		(1,692,166)		67,778		7,306	46,764,189
10	Revenue-related taxes and regulatory fees factor **	Miller Exhibit 2, pg. 6	1.017953		1.001442		1.001402		1.001402	
11	Total EE/DSM Program Cost and Incentive Revenue Requirement	Line 9 * Line 10	49,249,860		(1,694,606)		67,873		7,316	47,630,443
12	Residential Net Lost Revenues	Evans Exhibit 2 pg. 1	8,435,982	3,810,949	3,065,327	9,895,892	6,287,758	5,005,380	217,145	36,718,433
13	Total Residential EE/DSM Revenue Requirement	Line 11 + Line 12	57,685,842	3,810,949	1,370,721	9,895,892	6,355,631	5,005,380	224,462	84,348,877
14	Total Collected for Vintage Year 2014 (through estimated Rider 8)	Miller Exhibit 4 Line 1								83,991,181
15	**Total Residential EE/DSM Revenue Requirement**	Line 11 + Line 12								$ 357,695

See Miller Exhibit A for rate

NON-RESIDENTIAL
Energy Efficiency Programs

		Reference	E-7 Sub 1031 Rider 5 Original Estimate	E-7 Sub 1050 Rider 6 Year 2 Lost Revenue Estimate	E-7 Sub 1073 Rider 7 - True up of Year 1	E-7 Sub 1073 Rider 7 - Estimate of Year 3 Lost Revenue	E-7 Sub 1105 Rider 8 - True up of Lost Revenues & EM&V	E-7 Sub 1105 Rider 8 - Estimate of Year 4 Lost Revenues	E-7 Sub 1130 Rider 9 True up	Year 2014
16	Non- Residential EE Program Cost	Evans Exhibit 1 pg. 1, Line 24 * NC Alloc. Factor	16,206,358		(1,398,648)		-		1	14,807,711
17	Non-Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 1, Line 24 * NC Alloc. Factor	5,782,942		2,021,277		35,872		45,754	7,885,845
18	Return on undercollection of Non-residential EE Program Costs	Miller Exhibit 3 page 3			94,850		130,948		73,379	299,177
19	Total EE Program Cost and Incentive Components	Line 16 + Line 17 + Line 18	21,989,300		717,479		166,820		119,134	22,992,733
20	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 6	1.017953		1.001442		1.001402		1.001402	
21	Total Non-Residential EE Program Cost and Incentive Revenue Requireme	Line 19 * Line 20	22,384,074		718,514		167,054		119,301	23,388,942
22	Non-Residential Net Lost Revenues	Evans Exhibit 2 pg. 1	1,831,641	4,837,353	1,222,389	6,094,150	1,203,734	3,150,271	(853,990)	17,485,548
23	Total Non-Residential EE Revenue Requirement	Line 21 + Line 22	24,215,715	4,837,353	1,940,903	6,094,150	1,370,788	3,150,271	(734,689)	40,874,490
24	Total Collected for Year 2014 (through Estimated Rider 8)	Miller Exhibit 4 Line 6								40,755,917
25	Non-Residential EE Revenue Requirement True-Up Amount	Line 23 - Line 24								118,573
26	Projected NC Residential Sales (kWh)	Miller Exhibit 6, pg. 1, Line 4								21,655,074,211
27	**NC Non-Residential EE billing factor (Cents/kWh)**	Line 25/Line 26*100								**0.0005**

DSM Programs

		Reference	E-7 Sub 1031 Rider 5 Original Estimate	E-7 1073 Rider 7 - True up of Year 1	E-7 Sub 1105 Rider 8 - True up	E-7 Sub 1130 Rider 9 True up	Year 2014
28	Non-Residential DSM Program Cost	Evans Exhibit 1, pg. 1 Line 25 * NC Alloc. Factor	15,046,160	(2,195,319)	(0)	-	12,850,841
29	Non-Residential DSM Earned Utility Incentive	Evans Exhibit 1, pg. 1 Line 25 * NC Alloc. Factor	3,709,497	200,391	(30,588)	-	3,879,300
30	Return on overcollection of Non-residential DSM Program Costs	Miller Exhibit 3 page 4		(19,939)	(82,394)	(52,597)	(154,930)
31	Total Non-Residential DSM Program Cost and Incentive Components	Line 28 + Line 29 + Line 30	18,755,657	(2,014,867)	(112,982)	(52,597)	16,575,211
32	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 6	1.017953	1.001442	1.001402	1.001402	
33	Total Non-Residential DSM Revenue Requirement	Line 31 * Line 32	19,092,377	(2,017,772)	(113,141)	(52,671)	16,908,793
34	Total Revenue Collected for DSM Programs Year 2014	Miller Exhibit 4 Line 9					17,045,043
35	Non-Residential DSM Revenue Requirement True up Amount	Line 33- Line 34					(136,250)
36	Projected NC Non-Residential Sales (kWh)	Miller Exhibit 6 pg. 2, Line 5					21,099,155,104
37	**NC Non-Residential DSM billing factor**	Line 35/Line 36*100					**(0.0006)**

** Actual regulatory fee rate in effect in year of collection. May differ from original filed estimates.

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Year 4 Lost Revenue and True Up of Year 1 and 2 Vintage Year 2015

RESIDENTIAL
Energy Efficiency Programs

Line		Reference	Year 2015 Yr 4 LR Estimate	E-7 Sub 1050 Rider 6 Original Estimate	E-7 Sub 1073 Rider 7 Year 2 Lost Revenues	E-7 Sub 1105 Rider 8 True up of Year 1	E-7 Sub 1105 Rider 8 Year 3 Lost Revenues	E-7 Sub 1130 Rider 9 True up of Lost Revenues & EM&V	Year 2015 Year 1
1	Residential EE Program Cost	Evans Exhibit 1 pg. 2, Line 10 * NC Alloc. Factor		$ 30,685,449		$ (2,726,335)		$ -	$ 27,959,114
2	Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 2, Line 10 * NC Alloc. Factor		2,374,641		2,431,922		125,671	4,932,234
3	Return on undercollection of Residential EE Program Costs	Miller Exhibit 3 pg 5				49,064		77,792	126,856
4	Total EE Program Cost and Incentive Components	Line 1 + Line 2 + line 3		33,060,090		(245,348)		203,463	33,018,205
5	Residential DSM Program Cost	Evans Exhibit 1 pg. 2, Line 11 * NC Alloc. Factor		12,532,432		(2,137,589)		(1,252)	10,393,591
6	Residential DSM Earned Utility Incentive	Evans Exhibit 1 pg. 2, Line 11 * NC Alloc. Factor		3,275,217		(676,007)		(12,280)	2,586,930
7	Return on overcollection of Residential DSM Program Costs	Miller Exhibit 3 pg 6				(10,786)		23,451	12,666
8	Total DSM Program Cost and Incentive Components	Line 5 + Line 6 + Line 7		15,807,649		(2,824,381)		9,919	12,993,186
9	Total EE/DSM Program Cost and Incentive Components	Line 4 + Line 8		48,867,739		(3,069,730)		213,382	46,011,391
10	Revenue-related taxes and regulatory fees factor **	Miller Exhibit 2, pg. 6		1.001417		1.001402		1.001402	
11	Total EE/DSM Program Cost and Incentive Revenue Requirement	Line 9 * Line 10		48,936,985		(3,074,034)		213,681	46,076,632
12	Residential Net Lost Revenues	Evans Exhibit 2 pg. 1	$ 3,431,636	9,169,840	4,071,955	5,563,184	8,090,365	4,191,232	31,086,577
13	Total Residential EE/DSM Revenue Requirement	Line 11 + Line 12	3,431,636	58,106,825	4,071,955	2,489,151	8,090,365	4,404,913	77,163,209
14	Total Collected for Vintage Year 2015 (through estimated Rider 8)	Miller Exhibit 4 Line 2							72,712,130
15	**Total Residential EE/DSM Revenue Requirement**	Line 11 + Line 12	$ 3,431,636						$ 4,451,079

See Miller Exhibit A for rate

NON-RESIDENTIAL
Energy Efficiency Programs

Line		Reference	Year 2015 Yr 4 LR Estimate	E-7 Sub 1050 Rider 6 Original Estimate	E-7 Sub 1073 Rider 7 Year 2 Lost Revenues	E-7 Sub 1105 Rider 8 True up of Year 1	E-7 Sub 1105 Rider 8 Year 3 Lost Revenues	E-7 Sub 1130 True up	Year 2015 Year 1
16	Non- Residential EE Program Cost	Evans Exhibit 1 pg. 2, Line 24 * NC Alloc. Factor		17,348,807		11,904,051		0	29,252,858
17	Non-Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 2, Line 24 * NC Alloc. Factor		6,214,226		3,351,028		846,899	10,412,153
18	Return on undercollection of Non-residential EE Program Costs	Miller Exhibit 3 page 7				457,891		838,299	1,296,190
19	Total EE Program Cost and Incentive Components	Line 16 + Line 17 + Line 18		23,563,033		15,712,970		1,685,198	40,961,201
20	Revenue-related taxes and regulatory fees factor	Miller Exhibit 3, pg. 7		1.001417		1.001402		1.001402	
21	Total Non-Residential EE Program Cost and Incentive Revenue Requirements	Line 19 * Line 20		23,596,422		15,735,000		1,687,560	41,018,982
22	Non-Residential Net Lost Revenues	Evans Exhibit 2 pg. 4	4,183,188	2,523,480	8,194,003	2,547,914	9,483,428	2,426,543	25,175,368
23	Total Non-Residential EE Revenue Requirement	Line 21 + Line 22	4,183,188	26,119,902	8,194,003	18,282,914	9,483,428	4,114,103	66,194,349
24	Total Collected for Year 2015 (through estimated Rider 8)	Miller Exhibit 4 Line 6							62,082,300
25	Non-Residential EE Revenue Requirement	Line 23 - Line 24	4,183,188						4,112,049
26	Projected NC Residential Sales (kWh)	Miller Exhibit 6, pg. 2, Line 6	21,269,625,317						21,269,625,317
27	**NC Non-Residential EE billing factor (Cents/kWh)**	Line 25/Line 26*100	**0.0197**						**0.0193**

DSM Programs

Line		Reference	E-7 Sub 1050 Rider 6 Original Estimate	E-7 Sub 1005 Rider 8 Original True Up	E-7 Sub 1130 Rider 9 True Up	Year 2015 Year 1
28	Non-Residential DSM Program Cost	Evans Exhibit 1, pg. 2 Line 25 * NC Alloc. Factor	16,493,488	(2,925,873)	(1,635)	13,565,981
29	Non-Residential DSM Earned Utility Incentive	Evans Exhibit 1, pg. 2 Line 25 * NC Alloc. Factor	4,310,397	(917,841)	(16,029)	3,376,527
30	Return on overcollection of Non-residential DSM Program Costs	Miller Exhibit 3 page 8		(107,297)	(202,876)	(310,173)
31	Total Non-Residential DSM Program Cost and Incentive Components	Line 28 + Line 29 + Line 30	20,803,885	(3,951,011)	(220,540)	16,632,334
32	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 13	1.001417	1.001402	1.001402	
33	Total Non-Residential DSM Revenue Requirement	Line 31 * Line 32	20,833,364	(3,956,550)	(220,849)	16,655,965
34	Total Revenue Collected for DSM Programs Year 2015	Miller Exhibit 4 Line 10				17,157,051
35	Non-Residential EE Revenue Requirement True-up Amount	Line 33- Line 34				(501,086)
36	Projected NC Non-Residential Sales (kWh)	Miller Exhibit 6 pg. 1, Line 7				20,868,768,758
37	**NC Non-Residential DSM billing factor**	Line 35/Line 36*100				**(0.0024)**

** Actual regulatory fee rate in effect in year of collection. May differ from original filed estimates.

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Year 3 Lost Revenue and True Up of Year 1 for Vintage Year 2016

RESIDENTIAL
Energy Efficiency Programs

Line		Reference	Year 2016 Yr 3 LR Estimate	E-7 Sub 1073 Rider 7 Original Estimate	E-7 Sub 1105 Rider 8 Year 2 Lost Revenues	E-7 Sub 1130 True up	Year 2016 Year 1
1	Residential EE Program Cost	Evans Exhibit 1 pg. 3, Line 10 * NC Alloc. Factor		$ 31,056,079		$ 9,011,328	$ 40,067,407
2	Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 3, Line 10 * NC Alloc. Factor		2,392,652		4,356,940	6,749,592
3	Return on undercollection of Residential EE Program Costs	Miller Exhibit 3 pg 5				273,601	273,601
4	Total EE Program Cost and Incentive Components	Line 1 + Line 2 + line 3		33,448,731		13,641,870	47,090,601
5	Residential DSM Program Cost	Evans Exhibit 1 pg. 3, Line 11 * NC Alloc. Factor		10,613,016		(1,001,333)	9,611,683
6	Residential DSM Earned Utility Incentive	Evans Exhibit 1 pg. 3, Line 11 * NC Alloc. Factor		2,887,418		(130,889)	2,756,529
7	Return on overcollection of Residential DSM Program Costs	Miller Exhibit 3 pg 6				(26,063)	(26,063)
8	Total DSM Program Cost and Incentive Components	Line 5 + Line 6 + Line 7		13,500,434		(1,158,285)	12,342,149
9	Total EE/DSM Program Cost and Incentive Components	Line 4 + Line 8		46,949,165		12,483,585	59,432,750
10	Revenue-related taxes and regulatory fees factor **	Miller Exhibit 2, pg. 6		1.001442		1.001402	
11	Total EE/DSM Program Cost and Incentive Revenue Requirement	Line 9 * Line 10		47,016,866		12,501,087	59,517,953
12	Residential Net Lost Revenues	Evans Exhibit 2 pg. 4	$ 7,765,323	11,873,767	5,723,916	4,795,359	22,393,042
13	Total Residential EE/DSM Revenue Requirement	Line 11 + Line 12	7,765,323	58,890,633	5,723,916	17,296,447	81,910,995
14	Total Collected for Vintage Year 2016 (through estimated Rider 8)	Miller Exhibit 4 Line 2					63,908,784
15	**Total Residential EE/DSM Revenue Requirement**	Line 11 + Line 12	$ 7,765,323				$ 18,002,211

See Miller Exhibit A for rate

NON-RESIDENTIAL
Energy Efficiency Programs

Line		Reference	Year 2016 Yr 3 LR Estimate	E-7 Sub 1073 Rider 7 Original Estimate	E-7 Sub 1105 Rider 8 Year 2 Lost Revenues	E-7 Sub 1130 True up	Year 2016 Year 1
16	Non- Residential EE Program Cost	Evans Exhibit 1 pg. 3, Line 25 * NC Alloc. Factor		36,494,611		13,573,238	50,067,849
17	Non-Residential EE Earned Utility Incentive	Evans Exhibit 1 pg. 3, Line 25 * NC Alloc. Factor		10,105,721		4,254,953	14,360,674
18	Return on undercollection of Non-residential EE Program Costs	Miller Exhibit 3 page 7				379,815	379,815
19	Total EE Program Cost and Incentive Components	Line 16 + Line 17 + Line 18		46,600,332		18,208,007	64,808,339
20	Revenue-related taxes and regulatory fees factor	Miller Exhibit 3, pg. 7		1.001442		1.001402	
21	Total Non-Residential EE Program Cost and Incentive Revenue Requirements	Line 19 * Line 20		46,667,530		18,233,534	64,901,064
22	Non-Residential Net Lost Revenues	Evans Exhibit 2 pg. 4	13,375,187	4,745,315	8,309,444	2,524,047	15,578,806
23	Total Non-Residential EE Revenue Requirement	Line 21 + Line 22	13,375,187	51,412,845	8,309,444	20,757,581	80,479,870
24	Total Collected for Vintage Year 2016 (through estimated Rider 8)	Miller Exhibit 4 Line 6					53,972,341
25	Non-Residential EE Revenue Requirement	Line 23 - Line 24	13,375,187				26,507,528
26	Projected NC Residential Sales (kWh)	Miller Exhibit 6, pg. 1, Line 8	20,972,612,690				20,972,612,690
27	**NC Non-Residential EE billing factor (Cents/kWh)**	Line 25/Line 26*100	**0.0638**				**0.1264**

DSM Programs

Line		Reference	E-7 Sub 1073 Rider 7 Original Estimate	E-7 Sub 1130 True up	Year 2016 Year 1
28	Non-Residential DSM Program Cost	Evans Exhibit 1, pg. 3 Line 26 * NC Alloc. Factor	12,855,910	(1,247,998)	11,607,912
29	Non-Residential DSM Earned Utility Incentive	Evans Exhibit 1, pg. 3 Line 26 * NC Alloc. Factor	3,497,628	(168,602)	3,329,026
30	Return on overcollection of Non-residential DSM Program Costs	Miller Exhibit 3 page 8		2,085	2,085
31	Total Non-Residential DSM Program Cost and Incentive Components	Line 28 + Line 29 + Line 30	16,353,538	(1,414,515)	14,939,023
32	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 13	1.001442	1.001402	
33	Total Non-Residential DSM Revenue Requirement	Line 31 * Line 32	16,377,120	(1,416,498)	14,960,622
34	Total Revenue Collected for DSM Programs Year 2016	Miller Exhibit 4 Line 10			14,637,127
35	Non-Residential EE Revenue Requirement True-up Amount	Line 33- Line 34			323,496
36	Projected NC Non-Residential Sales (kWh)	Miller Exhibit 6 pg. 1, Line 9			20,571,098,575
37	**NC Non-Residential DSM billing factor**	Line 35/Line 36*100			**0.0016**

** Actual regulatory fee rate in effect in year of collection. May differ from original filed estimates.

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Year 2 Lost Revenues for Vintage Year 2017

RESIDENTIAL

Line		Reference	2018
1	Residential Net Lost Revenues	Evans Exhibit 2 pg. 4 Line 88	4,202,002
2	Projected NC Residential Sales (kWh)	Miller Exhibit 6 pg 1	$ 21,243,226,519
3	**NC Residential EE Billing Factor (Cents/kWh)**	**Line 1/Line 2*100**	**0.0198**

NON-RESIDENTIAL
Energy Efficiency Programs

Line		Reference	2018
4	Non-Residential Net Lost Revenues	Evans Exhibit 2 pg. 2 Line 104	9,466,867
5	Projected NC Non-Residential Sales (kWh)	Miller Exhibit 6, pg. 1	20,747,917,488
6	**NC Non-Residential EE billing factor (Cents/kWh)**	Line 4/Line 5*100	**0.0456**

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Program Costs, Earned Incentive and Lost Revenues for Vintage Year 2018

RESIDENTIAL

Line		Reference	2018
1	Residential EE Program Cost	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	$ 41,623,609
2	Residential EE Earned Utility Incentive	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	7,153,029
3	Total EE Program Cost and Incentive Components	Line 1 + Line 2, Evans Exhibit 1, Line 10	48,776,639
4	Residential DSM Program Cost	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	9,903,130
5	Residential DSM Earned Utility Incentive	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	3,315,397
6	Total DSM Program Cost and Incentive Components	Line 4 + Line 5, Evans Exhibit 1, Line 11	13,218,527
7	Total EE/DSM Program Cost and Incentive Components	Line 3 + Line 6	61,995,166
8	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 6	1.001402
9	Total EE/DSM Program Cost and Incentive Revenue Requirement	Line 7 * Line 8	62,082,083
10	Residential Net Lost Revenues	Evans Exhibit 2 pg. 3 Line 115	19,612,717
11	**Total Residential EE Revenue Requirement**	**Line 9 + Line 10**	**$ 81,694,800**
			See Miller Exhibit 1 for rate

NON-RESIDENTIAL
Energy Efficiency Programs

Line		Reference	2018
12	Non- Residential EE Program Cost	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	$ 40,592,949
13	Non-Residential EE Earned Utility Incentive	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	15,085,664
14	Total EE Program Cost and Incentive Components	Line 12 + Line 13, Evans Exhibit 1, Line 25	55,678,613
15	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 6	1.001402
16	Total Non-Residential EE Program Cost and Incentive Revenue Requirements	Line 14 * Line 15	55,756,675
17	Non-Residential Net Lost Revenues	Evans Exhibit 2 pg. 3 Line 131	5,167,253
18	Total Non-Residential EE Revenue Requirement	Line 16 + Line 17	$ 60,923,928
19	Projected NC Residential Sales (kWh)	Miller Exhibit 6, pg. 1, Line 12	20,747,917,488
20	**NC Non-Residential EE billing factor (Cents/kWh)**	Line 18/Line 19*100	**0.2936**

DSM Programs

Line		Reference	2018
21	Non-Residential DSM Program Cost	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	$ 11,959,889
22	Non-Residential DSM Earned Utility Incentive	Evans Exhibit 1, pg. 4 * NC Alloc. Factor	4,003,965
23	Total Non-Residential DSM Program Cost and Incentive Components	Line 21 + Line 22, Evans Exhibit 1, Line 26	15,963,853
24	Revenue-related taxes and regulatory fees factor	Miller Exhibit 2, pg. 13	1.001402
25	Total Non-Residential DSM Revenue Requirement	Line 23 * Line 24	15,986,235
26	Projected NC Non-Residential Sales (kWh)	Miller Exhibit 6, pg. 1, Line 13	20,547,742,049
27	**NC Non-Residential DSM billing factor**	Line 25/Line 26*100	**0.0778**

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Gross Receipts Tax Years 2014 through estimated 2018

	Year		Actual GRT Rate In Effect
	2014	Jan - June	1.034554
		July - Dec	1.001352
Rider 5	2014	Weighted Average	1.017953
	2015	Jan - June	1.001352
		July - Dec	1.001482
Rider 6	2015	Weighted Average	1.001417
Rider 7	2016	Jan - June	1.001482
		July - Dec	1.001402
		Weighted Average	1.001442
Rider 8	2017		1.001402
Rider 9	2018		1.001402

Note: the current rate is used as the estimate for 2017 and 2018. This will be subject to true-up based on actual rates in effect.

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential EE Programs Vintage 2014

NC Residential EE		Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	updated with formula for Jan. NC Residential Revenue Collected(EEC2)	NC Residential EE Program Collection %	EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5 pg. 1, Line 4			PY calculation		
Beginning Balance - source f		**38,254,486**	**72.9600473%**	**27,910,491**	**41,513,726**	**62.0990603%**	**25,779,634**	**2,130,857**
2016	January		72.9600473%	-	520,013	16.1629712%	(84,049)	(84,049)
2016	February		72.9600473%	-	1,306,295	16.1629712%	(211,136)	(211,136)
2016	March		72.9600473%	-	1,093,456	16.1629712%	(176,735)	(176,735)
2016	April		72.9600473%	-	813,083	16.1629712%	(131,418)	(131,418)
2016	May		72.9600473%	-	791,818	16.1629712%	(127,981)	(127,981)
2016	June		72.9600473%	-	1,058,878	16.1629712%	(171,146)	(171,146)
2016	July		72.9600473%	-	1,345,945	16.1629712%	(217,545)	(217,545)
2016	August		72.9600473%	-	1,409,493	16.1629712%	(227,816)	(227,816)
2016	September		72.9600473%	-	1,360,106	16.1629712%	(219,833)	(219,833)
2016	October		72.9600473%	-	895,876	16.1629712%	(144,800)	(144,800)
2016	November		72.9600473%	-	789,690	16.1629712%	(127,637)	(127,637)
2016	December		72.9600473%	-	1,871,304	16.1629712%	(302,458)	(302,458)
		-		-	13,255,956			(11,699)

Program Cost Allocation Calculation	
Program Cost Over/Under Collection	2,130,857
Total V2014 Revenue Requirement for EE only Requested in Rider 7	13,183,574
	16.16%
see Miller Exhibit 2, page 5 Docket No. E-7 Sub 1073	
for total revenue requirement, less DSM true-up requested	

NC Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648 (1-.341352)	
Beginning Balance - Rider 7		**2,130,857**	**0.383471**		**817,122**	**1,313,735**					
2016	January	2,046,808	0.345235	(29,017)	788,105	1,258,703	0.005850	7,524	7,524	0.658648	11,424
2016	February	1,835,672	0.345235	(72,892)	715,214	1,120,458	0.005850	6,959	14,483	0.658648	21,990
2016	March	1,658,937	0.345235	(61,015)	654,199	1,004,738	0.005850	6,216	20,700	0.658648	31,427
2016	April	1,527,518	0.345235	(45,370)	608,828	918,690	0.005850	5,626	26,326	0.658648	39,969
2016	May	1,399,537	0.345235	(44,184)	564,645	834,893	0.005850	5,129	31,455	0.658648	47,757
2016	June	1,228,391	0.345235	(59,086)	505,559	722,832	0.005850	4,556	36,011	0.658648	54,674
2016	July	1,010,846	0.345235	(75,104)	430,455	580,391	0.005850	3,812	39,823	0.658648	60,462
2016	August	783,030	0.345235	(78,650)	351,805	431,225	0.005850	2,959	42,782	0.658648	64,954
2016	September	563,197	0.345235	(75,894)	275,911	287,286	0.005850	2,102	44,884	0.658648	68,145
2016	October	418,397	0.345235	(49,990)	225,921	192,476	0.005850	1,403	46,287	0.658648	70,276
2016	November	290,759	0.345235	(44,065)	181,856	108,904	0.005850	882	47,169	0.658648	71,614
2016	December	(11,699)	0.345235	(104,419)	77,437	(89,136)	0.005850	58	47,226	0.658648	71,702
								47,226			71,702

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential DSM Programs Vintage 2014

NC Residential DSM		Total System NC DSM Program Costs Incurred	NC Residential DSM Allocation %	NC Allocated DSM Residential Program Costs	NC Residential Revenue Collected(EEC2)	NC Residential DSM Program Collection %	DSM Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5, pg 1 Line 9			PY calculation		
Beginning Balance - from Ri		**31,183,185**	**34.0209980%**	**10,608,831**	**16,876,548**	**75.0945971%**	**12,673,376**	**(2,064,545)**
2015	January		34.0209980%	-	(110,891)	78.7620782%	87,340	87,340
2015	February		34.0209980%	-	(278,564)	78.7620782%	219,403	219,403
2015	March		34.0209980%	-	(233,176)	78.7620782%	183,655	183,655
2015	April		34.0209980%	-	(173,388)	78.7620782%	136,564	136,564
2015	May		34.0209980%	-	(168,853)	78.7620782%	132,992	132,992
2015	June		34.0209980%	-	(225,803)	78.7620782%	177,847	177,847
2015	July		34.0209980%	-	(287,019)	78.7620782%	226,062	226,062
2015	August		34.0209980%	-	(300,570)	78.7620782%	236,735	236,735
2015	September		34.0209980%	-	(290,039)	78.7620782%	228,440	228,440
2015	October		34.0209980%	-	(191,043)	78.7620782%	150,469	150,469
2015	November		34.0209980%	-	(168,399)	78.7620782%	132,635	132,635
2015	December		34.0209980%	-	(399,050)	78.7620782%	314,300	314,300
		-		-	(2,826,795)			161,898

Program Cost Allocation Calculation

Over/Under Collection	(2,064,545)
Total V2014 Revenue Requirement Requested in Rider 7	(2,621,242)
	78.76%

see Miller Exhibit 2, page 5 Docket No. E-7 Sub 1073
DSM True-up only

NC Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
Beginning Balance - from Ri		**(2,064,545)**	**0.383471**		**(791,693)**	**(1,272,852)**					
2015	January	(1,977,205)	0.345235	30,153	(761,540)	(1,215,665)	0.005850	(7,279)	(7,279)	0.658648	(11,051)
2015	February	(1,757,802)	0.345235	75,745	(685,795)	(1,072,008)	0.005850	(6,691)	(13,970)	0.658648	(21,211)
2015	March	(1,574,148)	0.345235	63,404	(622,391)	(951,757)	0.005850	(5,920)	(19,890)	0.658648	(30,198)
2015	April	(1,437,584)	0.345235	47,147	(575,244)	(862,340)	0.005850	(5,306)	(25,196)	0.658648	(38,254)
2015	May	(1,304,592)	0.345235	45,914	(529,331)	(775,261)	0.005850	(4,790)	(29,986)	0.658648	(45,527)
2015	June	(1,126,745)	0.345235	61,399	(467,932)	(658,813)	0.005850	(4,195)	(34,181)	0.658648	(51,895)
2015	July	(900,683)	0.345235	78,045	(389,887)	(510,796)	0.005850	(3,421)	(37,602)	0.658648	(57,089)
2015	August	(663,947)	0.345235	81,729	(308,158)	(355,790)	0.005850	(2,535)	(40,137)	0.658648	(60,938)
2015	September	(435,507)	0.345235	78,866	(229,292)	(206,215)	0.005850	(1,644)	(41,780)	0.658648	(63,434)
2015	October	(285,037)	0.345235	51,947	(177,345)	(107,693)	0.005850	(918)	(42,699)	0.658648	(64,828)
2015	November	(152,403)	0.345235	45,790	(131,555)	(20,848)	0.005850	(376)	(43,075)	0.658648	(65,399)
2015	December	161,898	0.345235	108,507	(23,047)	184,945	0.005850	480	(42,595)	0.658648	(64,670)
								(42,595)			(64,670)

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Non- Residential EE Programs Vintage 2014

NC Non- Residential EE		Non-Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	NC Residential Revenue Collected(EEC14)	NC Non-Residential EE Program Collection %	Non-Residential EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5. pg 1, Line 4			See calc. at right		
Beginning Balance - from Rider 7		**20,295,644**	**0.729600473**	**14,807,711**	**22,574,937**	**56.818171%**	**12,826,666**	**1,981,045**
2015	January		72.9600473%	-	220,829	20.4742977%	(45,213)	(45,213)
2015	February		72.9600473%	-	701,819	20.4742977%	(143,692)	(143,692)
2015	March		72.9600473%	-	694,277	20.4742977%	(142,148)	(142,148)
2015	April		72.9600473%	-	674,296	20.4742977%	(138,057)	(138,057)
2015	May		72.9600473%	-	698,152	20.4742977%	(142,942)	(142,942)
2015	June		72.9600473%	-	788,017	20.4742977%	(161,341)	(161,341)
2015	July		72.9600473%	-	835,441	20.4742977%	(171,051)	(171,051)
2015	August		72.9600473%	-	878,353	20.4742977%	(179,837)	(179,837)
2015	September		72.9600473%	-	898,806	20.4742977%	(184,024)	(184,024)
2015	October		72.9600473%	-	748,268	20.4742977%	(153,203)	(153,203)
2015	November		72.9600473%	-	701,517	20.4742977%	(143,631)	(143,631)
2015	December		72.9600473%	-	982,689	20.4742977%	(201,199)	(201,199)
		-		-	8,822,463			174,708

Program Cost Allocation Calculation	
Over/Under Collection	1,981,045
Total V2014 Revenue Requirement	
Requested in Rider 7	9,675,766
	20.47%
See Miller Exhibit 2, page 5	
Docket. No. E-7 1073	

NC Non-Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
Beginning Balance - From Rider 7		**1,981,045**	**0.383471**		**759,673**	**1,221,372**		**58,887**			
2015	January	1,935,832	0.345235	(15,609.18)	744,064	1,191,768	0.005850	7,058	7,058	**0.658648**	10,717
2015	February	1,792,139	0.345235	(49,607.66)	694,457	1,097,683	0.005850	6,697	13,755	**0.658648**	20,884
2015	March	1,649,991	0.345235	(49,074.57)	645,382	1,004,609	0.005850	6,149	19,904	**0.658648**	30,220
2015	April	1,511,934	0.345235	(47,662.23)	597,720	914,214	0.005850	5,613	25,517	**0.658648**	38,741
2015	May	1,368,992	0.345235	(49,348.48)	548,371	820,621	0.005850	5,074	30,591	**0.658648**	46,445
2015	June	1,207,651	0.345235	(55,700.52)	492,671	714,981	0.005850	4,492	35,083	**0.658648**	53,265
2015	July	1,036,601	0.345235	(59,052.68)	433,618	602,983	0.005850	3,855	38,938	**0.658648**	59,118
2015	August	856,764	0.345235	(62,085.87)	371,532	485,232	0.005850	3,183	42,121	**0.658648**	63,951
2015	September	672,740	0.345235	(63,531.61)	308,001	364,739	0.005850	2,486	44,607	**0.658648**	67,725
2015	October	519,537	0.345235	(52,890.90)	255,110	264,428	0.005850	1,840	46,447	**0.658648**	70,519
2015	November	375,907	0.345235	(49,586.31)	205,523	170,383	0.005850	1,272	47,719	**0.658648**	72,450
2015	December	174,708	0.345235	(69,460.85)	136,062	38,645	0.005850	611	48,331	**0.658648**	73,379
								48,331			73,379

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation -Non - Residential DSM Programs Vintage 2014

NC Non- Residential DSM		Total System NC DSM Program Costs Incurred	NC Non-Residential DSM Allocation %	NC Allocated DSM Non-Residential Program Costs	Incentives Earned & GRT remitted (Allocated based on WA of Program Costs Incurred)	Total DSM Revenue Requirement	NC Non-Residential DSM Revenue Collected(DS14)	NC Non-Residential DSM Program Collection %	Non-Residential DSM Program Costs Revenue Collected	(Over)/Under Collection
			See Miller Exhibit 5 pg. 1, Line 10		calculated interest on entire balance due to over-collection in total			100% used due to over-collection of entire vintage		
Beginning Balance - from Rider 7		**31,183,185**	**41.2108021%**	**12,850,841**	**4,243,911**	**17,094,752**	**18,317,282**	**100.0000000%**	**(18,317,282)**	**(1,222,530)**
2015	January		41.2108021%	-		-	(14,392)	100.0000000%	14,392	14,392
2015	February		41.2108021%	-		-	(73,036)	100.0000000%	73,036	73,036
2015	March		41.2108021%	-		-	(72,953)	100.0000000%	72,953	72,953
2015	April		41.2108021%	-		-	(71,594)	100.0000000%	71,594	71,594
2015	May		41.2108021%	-		-	(72,662)	100.0000000%	72,662	72,662
2015	June		41.2108021%	-		-	(83,009)	100.0000000%	83,009	83,009
2015	July		41.2108021%	-		-	(88,592)	100.0000000%	88,592	88,592
2015	August		41.2108021%	-		-	(91,552)	100.0000000%	91,552	91,552
2015	September		41.2108021%	-		-	(94,763)	100.0000000%	94,763	94,763
2015	October		41.2108021%	-		-	(78,545)	100.0000000%	78,545	78,545
2015	November		41.2108021%	-		-	(73,926)	100.0000000%	73,926	73,926
2015	December		41.2108021%	-		-	(114,223)	100.0000000%	114,223	114,223
										(293,283)

Program Cost Allocation Methodology
No program cost allocation is needed because the vintage was overcollected in total and interest due was calculated on the entire vintage.

Therefore, 100% of all revenues offset the overcollected balance.

NC Non-Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016 tax rate				7.02%			0.658648	
Beginning Balance - from Rider 8		**(1,222,530)**	**various**		**(460,926)**	**(761,604)**	**0.005850**				
2015	January	(1,208,138)	0.345235	4,968	(455,958)	(752,181)	0.005850	(4,428)	(4,428)	0.658648	(6,723)
2015	February	(1,135,103)	0.345235	25,214	(430,743)	(704,360)	0.005850	(4,260)	(8,688)	0.658648	(13,191)
2015	March	(1,062,150)	0.345235	25,186	(405,557)	(656,593)	0.005850	(3,981)	(12,669)	0.658648	(19,235)
2015	April	(990,556)	0.345235	24,717	(380,840)	(609,715)	0.005850	(3,704)	(16,373)	0.658648	(24,858)
2015	May	(917,894)	0.345235	25,086	(355,755)	(562,139)	0.005850	(3,428)	(19,801)	0.658648	(30,063)
2015	June	(834,884)	0.345235	28,658	(327,097)	(507,787)	0.005850	(3,130)	(22,930)	0.658648	(34,814)
2015	July	(746,293)	0.345235	30,585	(296,512)	(449,780)	0.005850	(2,801)	(25,731)	0.658648	(39,066)
2015	August	(654,740)	0.345235	31,607	(264,905)	(389,835)	0.005850	(2,456)	(28,187)	0.658648	(42,795)
2015	September	(559,977)	0.345235	32,716	(232,190)	(327,788)	0.005850	(2,099)	(30,286)	0.658648	(45,982)
2015	October	(481,432)	0.345235	27,117	(205,073)	(276,359)	0.005850	(1,767)	(32,053)	0.658648	(48,665)
2015	November	(407,506)	0.345235	25,522	(179,551)	(227,955)	0.005850	(1,475)	(33,528)	0.658648	(50,905)
2015	December	(293,283)	0.345235	39,434	(140,118)	(153,166)	0.005850	(1,115)	(34,643)	0.658648	(52,597)
								(34,643)			(52,597)

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential EE Programs Vintage 2015

NC Residential EE		Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	NC Residential Revenue Collected(EEC2)	NC Residential EE Program Collection %	EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5 pg. 2, Line 4			see calc. at right		
Beginning Balance - source		**38,323,008**	**72.9564706%**	**27,959,114**	**45,638,078**	**58.8068%**	**26,837,675**	**1,121,440**
2015	January		72.9564706%	-		58.8068%	-	-
2015	February		72.9564706%	-		58.8068%	-	-
2015	March		72.9564706%	-		58.8068%	-	-
2015	April		72.9564706%	-		58.8068%	-	-
2015	May		72.9564706%	-		58.8068%	-	-
2015	June		72.9564706%	-		58.8068%	-	-
2015	July		72.9564706%	-		58.8068%	-	-
2015	August		72.9564706%	-		58.8068%	-	-
2015	September		72.9564706%	-		58.8068%	-	-
2015	October		72.9564706%	-		58.8068%	-	-
2015	November		72.9564706%	-		58.8068%	-	-
2015	December		72.9564706%	-		58.8068%	-	-
		-		-	-			-

EE Program Costs	-
EE Revenue Requirement	4,071,955
% Revenue related to Program Costs	0%

Note: Vintage Year 2015 collections in 2016 stem from Rider 7. Rider 7 only had an estimate for Year 2 lost revenues to be collected. Therefore, no funds received are allocated toward program costs.

NC Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
Beginning Balance - source		**1,121,440**	**0.349155**		**391,556**	**729,884**					
2015	January	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	4,270	0.658648	6,483
2015	February	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	8,540	0.658648	12,965
2015	March	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	12,809	0.658648	19,448
2015	April	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	17,079	0.658648	25,931
2015	May	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	21,349	0.658648	32,414
2015	June	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	25,619	0.658648	38,896
2015	July	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	29,889	0.658648	45,379
2015	August	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	34,159	0.658648	51,862
2015	September	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	38,428	0.658648	58,344
2015	October	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	42,698	0.658648	64,827
2015	November	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	46,968	0.658648	71,310
2015	December	1,121,440	0.345235	-	391,556	729,884	0.005850	4,270	51,238	0.658648	77,792
								51,238			77,792

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential DSM Programs Vintage 2015

NC Residential DSM		Total System NC DSM Program Costs Incurred	NC Residential DSM Allocation %	NC Allocated DSM Residential Program Costs	NC Residential Revenue Collected(EEC2)	NC Residential DSM Program Collection %	DSM Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5, pg 2 Line 9			See calc. at right		
Beginning Balance - from Ri		**31,962,633**	**32.5218612%**	**10,394,843**	**12,589,085**	**79.8848533%**	**10,056,772**	**338,071**
2015	January		32.5218612%	-		0.0000000%	-	-
2015	February		32.5218612%	-		0.0000000%	-	-
2015	March		32.5218612%	-		0.0000000%	-	-
2015	April		32.5218612%	-		0.0000000%	-	-
2015	May		32.5218612%	-		0.0000000%	-	-
2015	June		32.5218612%	-		0.0000000%	-	-
2015	July		32.5218612%	-		0.0000000%	-	-
2015	August		32.5218612%	-		0.0000000%	-	-
2015	September		32.5218612%	-		0.0000000%	-	-
2015	October		32.5218612%	-		0.0000000%	-	-
2015	November		32.5218612%	-		0.0000000%	-	-
2015	December		32.5218612%	-		0.0000000%	-	-
		-		-	-		-	-

Note: No true up was included in Rider 7 for 2015 DSM costs.
Therefore, no revenue was returned to the customer in 2016.
as part of the residential tariff rates.
Interest will continue to be calculated at original over-collected balance.

NC Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
Beginning Balance - from Ri		**338,071**	**0.349155**		**118,039**	**220,032**					
2015	January	338,071	0.345235	-	118,039	220,032	0.005850	1,287	1,287	0.658648	1,954
2015	February	338,071	0.345235	-	118,039	220,032	0.005850	1,287	2,574	0.658648	3,909
2015	March	338,071	0.345235	-	118,039	220,032	0.005850	1,287	3,862	0.658648	5,863
2015	April	338,071	0.345235	-	118,039	220,032	0.005850	1,287	5,149	0.658648	7,817
2015	May	338,071	0.345235	-	118,039	220,032	0.005850	1,287	6,436	0.658648	9,771
2015	June	338,071	0.345235	-	118,039	220,032	0.005850	1,287	7,723	0.658648	11,726
2015	July	338,071	0.345235	-	118,039	220,032	0.005850	1,287	9,010	0.658648	13,680
2015	August	338,071	0.345235	-	118,039	220,032	0.005850	1,287	10,297	0.658648	15,634
2015	September	338,071	0.345235	-	118,039	220,032	0.005850	1,287	11,585	0.658648	17,589
2015	October	338,071	0.345235	-	118,039	220,032	0.005850	1,287	12,872	0.658648	19,543
2015	November	338,071	0.345235	-	118,039	220,032	0.005850	1,287	14,159	0.658648	21,497
2015	December	338,071	0.345235	-	118,039	220,032	0.005850	1,287	15,446	0.658648	23,451
								15,446			23,451

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Non- Residential EE Programs Vintage 2015

NC Non- Residential EE		Non-Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	NC Residential Revenue Collected(EEC15)	NC Non-Residential EE Program Collection %	Non-Residential EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5. pg 2, Line 4			See calc. at right		
2015 Beginning Balance		**40,096,318**	**72.9564706%**	**29,252,858**	**25,791,031**	**66.566216%**	**17,168,113**	**12,084,745**
2015	January		72.9564706%	-		0.0000000%	-	-
2015	February		72.9564706%	-		0.0000000%	-	-
2015	March		72.9564706%	-		0.0000000%	-	-
2015	April		72.9564706%	-		0.0000000%	-	-
2015	May		72.9564706%	-		0.0000000%	-	-
2015	June		72.9564706%	-		0.0000000%	-	-
2015	July		72.9564706%	-		0.0000000%	-	-
2015	August		72.9564706%	-		0.0000000%	-	-
2015	September		72.9564706%	-		0.0000000%	-	-
2015	October		72.9564706%	-		0.0000000%	-	-
2015	November		72.9564706%	-		0.0000000%	-	-
2015	December		72.9564706%	-		0.0000000%	-	-
		-		-	-		-	-

2016 Revenue Requirement	
Non-Res EE Program Costs	-
Non-Res EE Revenue Requirement	8,194,003
% Revenue related to Program Costs	0%

Note: Vintage Year 2015 collections in 2016 stem from Rider 7. Rider 7 only had an estimate for Year 2 lost revenues to be collected. Therefore, no funds received are allocated toward program costs.

NC Non-Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
Beginning Balance from Rider 8		**12,084,745**	**0.349155**		**4,219,449**	**7,865,296**					
2015	January	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	46,012	0.658648	69,858
2015	February	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	92,024	0.658648	139,716
2015	March	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	138,036	0.658648	209,575
2015	April	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	184,048	0.658648	279,433
2015	May	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	230,060	0.658648	349,291
2015	June	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	276,072	0.658648	419,149
2015	July	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	322,084	0.658648	489,008
2015	August	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	368,096	0.658648	558,866
2015	September	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	414,108	0.658648	628,724
2015	October	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	460,120	0.658648	698,582
2015	November	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	506,132	0.658648	768,440
2015	December	12,084,745	0.345235	-	4,219,449	7,865,296	0.005850	46,012	552,144	0.658648	838,299
								552,144			838,299

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation -Non - Residential DSM Programs Vintage 2015

NC Non- Residential DSM		Total System NC DSM Program Costs Incurred	NC Non-Residential DSM Allocation %	NC Allocated DSM Non-Residential Program Costs	Incentives Earned & GRT remitted (Allocated based on WA of Program Costs Incurred)	Total DSM Revenue Requirement	NC Non-Residential DSM Revenue Collected(DS15)	NC Non-Residential DSM Program Collection %	Non-Residential DSM Program Costs Revenue Collected	(Over)/Under Collection
			See Miller Exhibit 5 pg. 2, Line 10		calculated interest on entire balance due to over-collection in total			100% used due to over-collection of entire vintage		
Beginning Balance		**31,962,633**	**42.4483655%**	**13,567,615**	**3,416,338**	**16,983,953**	**19,579,477**	**100.000000%**	**19,579,477**	**(2,595,524)**
2015	January	-	42.4483655%	-		-	339,640	100.000000%	339,640	(339,640)
2015	February	-	42.4483655%	-		-	(0)	100.000000%	(0)	0
2015	March	-	42.4483655%	-		-	2,600	100.000000%	2,600	(2,600)
2015	April	-	42.4483655%	-		-	(91)	100.000000%	(91)	91
2015	May	-	42.4483655%	-		-	623	100.000000%	623	(623)
2015	June	-	42.4483655%	-		-	247	100.000000%	247	(247)
2015	July	-	42.4483655%	-		-	4,420	100.000000%	4,420	(4,420)
2015	August	-	42.4483655%	-		-	(166)	100.000000%	(166)	166
2015	September	-	42.4483655%	-		-	(163)	100.000000%	(163)	163
2015	October	-	42.4483655%	-		-	(33)	100.000000%	(33)	33
2015	November	-	42.4483655%	-		-	(153)	100.000000%	(153)	153
2015	December	-	42.4483655%	-		-	(66,371)	100.000000%	(66,371)	66,371
		-		-		-	19,860,030			(2,876,077)

Note: No true up was included in Rider 7 for 2015 DSM costs.
Therefore, no revenue was returned to the customer in 2016.
as part of the residential tariff rates.
Interest will continue to be calculated at original over-collected balance.

NC Non-Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016 tax rate				7.02%			0.658648	
Beginning Balance - from Rider 8		**(2,595,523)**	**0.349155**		**(906,240)**	**(1,689,283)**					
2015	January	(2,935,163)	0.345235	(117,256)	(1,023,495)	(1,911,667)	0.005850	(10,533)	(10,533)	0.658648	(15,992)
2015	February	(2,935,163)	0.345235	0	(1,023,495)	(1,911,667)	0.005850	(11,183)	(21,716)	0.658648	(32,971)
2015	March	(2,937,763)	0.345235	(898)	(1,024,393)	(1,913,370)	0.005850	(11,188)	(32,904)	0.658648	(49,957)
2015	April	(2,937,672)	0.345235	31	(1,024,362)	(1,913,310)	0.005850	(11,193)	(44,097)	0.658648	(66,951)
2015	May	(2,938,295)	0.345235	(215)	(1,024,577)	(1,913,718)	0.005850	(11,194)	(55,291)	0.658648	(83,947)
2015	June	(2,938,543)	0.345235	(85)	(1,024,662)	(1,913,880)	0.005850	(11,196)	(66,487)	0.658648	(100,945)
2015	July	(2,942,963)	0.345235	(1,526)	(1,026,188)	(1,916,774)	0.005850	(11,205)	(77,692)	0.658648	(117,956)
2015	August	(2,942,796)	0.345235	57	(1,026,131)	(1,916,666)	0.005850	(11,213)	(88,905)	0.658648	(134,980)
2015	September	(2,942,633)	0.345235	56	(1,026,074)	(1,916,559)	0.005850	(11,212)	(100,117)	0.658648	(152,003)
2015	October	(2,942,600)	0.345235	11	(1,026,063)	(1,916,537)	0.005850	(11,212)	(111,329)	0.658648	(169,026)
2015	November	(2,942,447)	0.345235	53	(1,026,010)	(1,916,437)	0.005850	(11,211)	(122,540)	0.658648	(186,048)
2015	December	(2,876,076)	0.345235	22,914	(1,003,097)	(1,872,980)	0.005850	(11,084)	(133,624)	0.658648	(202,876)
								$\boxed{(133,624)}$			$\boxed{(202,876)}$

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential EE Programs Vintage 2016

NC Residential EE		Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	NC Residential Revenue Collected	NC Residential EE Program Collection %	EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5 pg. 3, Line 4			see calc. at right		
2016	January	1,543,310	73.0962827%	1,128,102	1,758,298	63.0456%	(1,108,529)	19,574
2016	February	3,408,145	73.0962827%	2,491,227	4,416,924	63.0456%	(2,784,674)	(293,447)
2016	March	3,315,392	73.0962827%	2,423,428	3,697,258	63.0456%	(2,330,957)	92,471
2016	April	4,225,495	73.0962827%	3,088,680	2,749,245	63.0456%	(1,733,277)	1,355,403
2016	May	3,401,551	73.0962827%	2,486,408	2,677,342	63.0456%	(1,687,945)	798,463
2016	June	4,044,700	73.0962827%	2,956,525	3,580,343	63.0456%	(2,257,247)	699,278
2016	July	5,962,212	73.0962827%	4,358,155	4,550,990	63.0456%	(2,869,197)	1,488,959
2016	August	5,960,283	73.0962827%	4,356,746	4,765,862	63.0456%	(3,004,664)	1,352,081
2016	September	5,236,583	73.0962827%	3,827,747	4,598,871	63.0456%	(2,899,384)	928,364
2016	October	6,083,579	73.0962827%	4,446,870	3,029,190	63.0456%	(1,909,770)	2,537,101
2016	November	4,613,110	73.0962827%	3,372,012	2,670,149	63.0456%	(1,683,410)	1,688,602
2016	December	7,020,202	73.0962827%	5,131,506	6,327,366	63.0456%	(3,989,123)	1,142,383
		54,814,562		40,067,407	44,821,836			11,809,231

EE Program Costs	40,067,407
EE Revenue Requirement	63,553,101
% Revenue related to Program Costs	63.0456%

NC Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016 tax rate				7.02%			0.658648	
2016	January	19,574	0.345235	6,758	6,758	12,816	0.005850	37	37	0.658648	57
2016	February	(273,873)	0.345235	(101,308)	(94,551)	(179,323)	0.005850	(487)	(450)	0.658648	(683)
2016	March	(181,402)	0.345235	31,924	(62,626)	(118,776)	0.005850	(872)	(1,321)	0.658648	(2,006)
2016	April	1,174,001	0.345235	467,933	405,306	768,695	0.005850	1,901	580	0.658648	880
2016	May	1,972,464	0.345235	275,657	680,963	1,291,500	0.005850	6,026	6,606	0.658648	10,029
2016	June	2,671,742	0.345235	241,415	922,379	1,749,363	0.005850	8,895	15,500	0.658648	23,533
2016	July	4,160,700	0.345235	514,041	1,436,419	2,724,281	0.005850	13,085	28,586	0.658648	43,400
2016	August	5,512,782	0.345235	466,786	1,903,205	3,609,577	0.005850	18,527	47,112	0.658648	71,528
2016	September	6,441,145	0.345235	320,504	2,223,709	4,217,436	0.005850	22,894	70,006	0.658648	106,288
2016	October	8,978,246	0.345235	875,896	3,099,605	5,878,641	0.005850	29,531	99,537	0.658648	151,123
2016	November	10,666,848	0.345235	582,964	3,682,569	6,984,279	0.005850	37,624	137,161	0.658648	208,247
2016	December	11,809,231	0.345235	394,391	4,076,960	7,732,271	0.005850	43,046	180,207	0.658648	273,601
								180,207			273,601

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Residential DSM Programs Vintage 2016

NC Residential DSM		Total System NC DSM Program Costs Incurred	NC Residential DSM Allocation %	NC Allocated DSM Residential Program Costs	NC Residential Revenue Collected	NC Residential DSM Program Collection %	DSM Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5, pg 3 Line 9			See calc. at right		
2016	January	989,919	33.7973480%	334,566	524,213	77.6006095%	(406,793)	(72,226)
2016	February	1,790,508	33.7973480%	605,144	1,316,847	77.6006095%	(1,021,881)	(416,737)
2016	March	2,206,373	33.7973480%	745,696	1,102,288	77.6006095%	(855,382)	(109,687)
2016	April	2,048,138	33.7973480%	692,216	819,651	77.6006095%	(636,054)	56,162
2016	May	2,086,242	33.7973480%	705,094	798,214	77.6006095%	(619,419)	85,676
2016	June	1,923,645	33.7973480%	650,141	1,067,431	77.6006095%	(828,333)	(178,192)
2016	July	3,310,442	33.7973480%	1,118,842	1,356,817	77.6006095%	(1,052,898)	65,944
2016	August	3,055,191	33.7973480%	1,032,574	1,420,878	77.6006095%	(1,102,610)	(70,037)
2016	September	3,630,231	33.7973480%	1,226,922	1,371,092	77.6006095%	(1,063,976)	162,946
2016	October	3,527,381	33.7973480%	1,192,161	903,112	77.6006095%	(700,821)	491,341
2016	November	2,849,995	33.7973480%	963,223	796,069	77.6006095%	(617,754)	345,468
2016	December	1,021,098	33.7973480%	345,104	1,886,420	77.6006095%	(1,463,873)	(1,118,769)
		28,439,164		9,611,683	13,363,032		(10,369,794)	(758,111)

DSM Program Costs	9,611,683
DSM Revenue Requirement	12,386,093
% Revenue related to Program Costs	78%

-

NC Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
2016	January	(72,226)	0.345235	(24,935)	(24,935)	(47,291)	0.005850	(138)	(138)	0.658648	(210)
2016	February	(488,963)	0.345235	(143,872)	(168,807)	(320,156)	0.005850	(1,075)	(1,213)	0.658648	(1,842)
2016	March	(598,650)	0.345235	(37,868)	(206,675)	(391,975)	0.005850	(2,083)	(3,296)	0.658648	(5,004)
2016	April	(542,487)	0.345235	19,389	(187,286)	(355,202)	0.005850	(2,185)	(5,482)	0.658648	(8,322)
2016	May	(456,812)	0.345235	29,578	(157,707)	(299,104)	0.005850	(1,914)	(7,395)	0.658648	(11,228)
2016	June	(635,004)	0.345235	(61,518)	(219,226)	(415,778)	0.005850	(2,091)	(9,486)	0.658648	(14,403)
2016	July	(569,060)	0.345235	22,766	(196,460)	(372,601)	0.005850	(2,306)	(11,792)	0.658648	(17,904)
2016	August	(639,097)	0.345235	(24,179)	(220,639)	(418,458)	0.005850	(2,314)	(14,106)	0.658648	(21,417)
2016	September	(476,151)	0.345235	56,255	(164,384)	(311,767)	0.005850	(2,136)	(16,242)	0.658648	(24,660)
2016	October	15,190	0.345235	169,628	5,244	9,946	0.005850	(883)	(17,125)	0.658648	(26,000)
2016	November	360,658	0.345235	119,268	124,512	236,146	0.005850	720	(16,405)	0.658648	(24,907)
2016	December	(758,111)	0.345235	(386,238)	(261,726)	(496,384)	0.005850	(761)	(17,166)	0.658648	(26,063)
								(17,166)			(26,063)

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation - Non- Residential EE Programs Vintage 2016

NC Non- Residential EE		Non-Residential EE Program Costs Incurred	NC Allocation %	NC Allocated EE Program Costs	NC Residential Revenue Collected	NC Non-Residential EE Program Collection %	Non-Residential EE Program Costs Revenue Collected	(Over)/Under Collection
			Miller Exhibit 5. pg 3, Line 4			See calc. at right		
2016	January	2,513,905	73.0962827%	1,837,571	1,694,574	69.7420185%	(1,181,830)	655,741
2016	February	4,385,932	73.0962827%	3,205,953	3,541,962	69.7420185%	(2,470,236)	735,717
2016	March	4,230,812	73.0962827%	3,092,567	3,600,134	69.7420185%	(2,510,806)	581,761
2016	April	4,190,307	73.0962827%	3,062,958	3,500,532	69.7420185%	(2,441,341)	621,617
2016	May	4,854,942	73.0962827%	3,548,782	3,543,422	69.7420185%	(2,471,254)	1,077,528
2016	June	4,871,937	73.0962827%	3,561,205	4,064,344	69.7420185%	(2,834,555)	726,650
2016	July	4,317,546	73.0962827%	3,155,966	4,355,731	69.7420185%	(3,037,775)	118,191
2016	August	5,046,256	73.0962827%	3,688,626	4,491,169	69.7420185%	(3,132,232)	556,394
2016	September	7,938,032	73.0962827%	5,802,406	4,647,939	69.7420185%	(3,241,567)	2,560,839
2016	October	7,360,985	73.0962827%	5,380,606	3,840,655	69.7420185%	(2,678,550)	2,702,056
2016	November	8,381,644	73.0962827%	6,126,670	3,601,279	69.7420185%	(2,511,604)	3,615,066
2016	December	10,403,455	73.0962827%	7,604,539	4,781,156	69.7420185%	(3,334,475)	4,270,064
		68,495,753		50,067,849	45,662,897		(31,846,226)	18,221,623

Non-Res EE Program Costs	50,067,849
Non-Res EE Revenue Requirement	71,790,078
% Revenue related to Program Costs	70%

NC Non-Residential EE		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016				7.02%			0.658648	
2016	January	655,741	0.345235	226,384.61	226,385	429,356	0.005850	1,256	1,256	0.658648	1,907
2016	February	1,391,458	0.345235	253,995.38	480,380	911,078	0.005850	3,921	5,177	0.658648	7,859
2016	March	1,973,219	0.345235	200,844.10	681,224	1,291,994	0.005850	6,444	11,621	0.658648	17,643
2016	April	2,594,835	0.345235	214,603.92	895,828	1,699,007	0.005850	8,749	20,369	0.658648	30,926
2016	May	3,672,364	0.345235	372,000.49	1,267,829	2,404,535	0.005850	12,003	32,372	0.658648	49,149
2016	June	4,399,013	0.345235	250,864.88	1,518,693	2,880,320	0.005850	15,458	47,830	0.658648	72,619
2016	July	4,517,204	0.345235	40,803.55	1,559,497	2,957,707	0.005850	17,076	64,907	0.658648	98,545
2016	August	5,073,598	0.345235	192,086.58	1,751,584	3,322,014	0.005850	18,368	83,275	0.658648	126,433
2016	September	7,634,437	0.345235	884,091.42	2,635,675	4,998,762	0.005850	24,338	107,613	0.658648	163,385
2016	October	10,336,493	0.345235	932,844.23	3,568,519	6,767,974	0.005850	34,418	142,031	0.658648	215,640
2016	November	13,951,559	0.345235	1,248,047.23	4,816,566	9,134,992	0.005850	46,516	188,547	0.658648	286,264
2016	December	18,221,623	0.345235	1,474,175.66	6,290,742	11,930,881	0.005850	61,618	250,165	0.658648	379,815
								250,165			379,815

Duke Energy Carolinas, LLC
Docket No. E-7, Sub 1130
Estimated Return Calculation -Non - Residential DSM Programs Vintage 2016

NC Non- Residential DSM		Total System NC DSM Program Costs Incurred	NC Non-Residential DSM Allocation %	NC Allocated DSM Non-Residential Program Costs	NC Non-Residential DSM Revenue Collected	NC Non-Residential DSM Program Collection %	Non-Residential DSM Program Costs Revenue Collected	(Over)/Under Collection
			See Miller Exhibit 5 pg. 3, Line 10			100% used due to over-collection of entire vintage		
2016	January	989,919	40.8166437%	404,052	532,572	77.6005993%	(413,279)	(9,227)
2016	February	1,790,508	40.8166437%	730,825	1,165,805	77.6005993%	(904,671)	(173,846)
2016	March	2,206,373	40.8166437%	900,568	1,164,403	77.6005993%	(903,583)	(3,016)
2016	April	2,048,138	40.8166437%	835,981	1,141,641	77.6005993%	(885,920)	(49,939)
2016	May	2,086,242	40.8166437%	851,534	1,143,177	77.6005993%	(887,112)	(35,578)
2016	June	1,923,645	40.8166437%	785,167	1,304,117	77.6005993%	(1,012,003)	(226,835)
2016	July	3,310,442	40.8166437%	1,351,211	1,389,165	77.6005993%	(1,078,000)	273,211
2016	August	3,055,191	40.8166437%	1,247,026	1,435,185	77.6005993%	(1,113,712)	133,314
2016	September	3,630,231	40.8166437%	1,481,739	1,488,514	77.6005993%	(1,155,096)	326,643
2016	October	3,527,381	40.8166437%	1,439,759	1,231,324	77.6005993%	(955,515)	484,244
2016	November	2,849,995	40.8166437%	1,163,272	1,160,503	77.6005993%	(900,557)	262,715
2016	December	1,021,098	40.8166437%	416,778	1,480,722	77.6005993%	(1,149,049)	(732,271)
		28,439,164		11,607,912	14,637,127			249,414

DSM Program Costs	11,607,912
DSM Revenue Requirement	14,958,534
% Revenue related to Program Costs	78%

NC Non-Residential DSM		Cumulative (Over)/Under Recovery	Current Income Tax Rate	Monthly Deferred Income Tax	Cumulative Deferred Income Tax	Net Deferred After Tax Balance	Monthly Return	Monthly A/T Return on Deferral	YTD After Tax Interest	Gross up of Return to Pretax Rate	Gross up of Return to Pretax
			2016 tax rate				7.02%			0.658648	
2016	January	(9,227)	0.345235	(3,186)	(3,186)	(6,042)	0.005850	(18)	(18)	0.658648	(27)
2016	February	(183,074)	0.345235	(60,018)	(63,203)	(119,870)	0.005850	(368)	(386)	0.658648	(586)
2016	March	(186,090)	0.345235	(1,041)	(64,245)	(121,845)	0.005850	(707)	(1,093)	0.658648	(1,659)
2016	April	(236,029)	0.345235	(17,241)	(81,485)	(154,543)	0.005850	(808)	(1,901)	0.658648	(2,887)
2016	May	(271,607)	0.345235	(12,283)	(93,768)	(177,839)	0.005850	(972)	(2,874)	0.658648	(4,363)
2016	June	(498,442)	0.345235	(78,311)	(172,080)	(326,362)	0.005850	(1,475)	(4,348)	0.658648	(6,602)
2016	July	(225,231)	0.345235	94,322	(77,757)	(147,473)	0.005850	(1,386)	(5,734)	0.658648	(8,706)
2016	August	(91,916)	0.345235	46,025	(31,733)	(60,184)	0.005850	(607)	(6,342)	0.658648	(9,628)
2016	September	234,727	0.345235	112,769	81,036	153,691	0.005850	274	(6,068)	0.658648	(9,213)
2016	October	718,970	0.345235	167,178	248,214	470,757	0.005850	1,827	(4,242)	0.658648	(6,440)
2016	November	981,685	0.345235	90,698	338,912	642,773	0.005850	3,257	(985)	0.658648	(1,495)
2016	December	249,414	0.345235	(252,806)	86,107	163,308	0.005850	2,358	1,373	0.658648	2,085
								1,373			2,085

Miller Exhibit 4

Duke Energy Carolinas, LLC
DSM/EE Actual Revenues Collected from Years 2014-2016 (By Vintage)
and Estimated 2017 Collections from Rider 8 (by Vintage)
Docket Number E-7, Sub 1130
For Vintage Year 2014-2017 Estimate and True Up Calculations

Line		Vintage	Actual 2014 Rider 5	Actual 2015 Rider 6	Actual 2016 Rider 7	Estimated 2017 Rider 8 [1]	Total
	Residential						
1	EE/DSM	Year 2014	58,390,274	3,829,621	10,429,161	11,342,126	83,991,181
2		Year 2015		58,227,163	4,026,042	10,458,925	72,712,130
3		Year 2016			58,184,868	5,723,916	63,908,784
4		Year 2017				63,508,411	63,508,411
5	**Total Residential**		$ 58,390,274	$ 62,056,784	$ 72,640,070	$ 91,033,378	$ 284,120,506
	Non-Residential						
6	EE	Year 2014	22,574,937	5,169,897	8,822,463	4,188,621	40,755,917
7		Year 2015	-	25,791,031	8,194,784	28,096,486	62,082,300
8		Year 2016			45,662,897	8,309,444	53,972,341
		Year 2017				54,250,339	54,250,339
9							
10	DSM	Year 2014	18,087,702	210,549	(929,247)	(323,961)	17,045,043
11		Year 2015		19,579,477	280,553	(2,702,979)	17,157,051
12		Year 2016			14,637,127		14,637,127
		Year 2017				17,118,417	17,118,417
13							
14	**Total Non-Residential**		$ 40,662,639	$ 50,750,953	$ 76,668,577	$ 108,936,367	$ 259,900,119
15	**Total Revenue**		**$ 99,052,912**	**$ 112,807,737**	**$ 149,308,648**	**$ 199,969,745**	**$ 544,020,625**

(1) Rider 8 estimates are based on Rider 8 E-7 Sub 1105

Duke Energy Carolinas, LLC
Vintage Year 2014 Allocation for the Period January 1, 2014
Docket Number E-7, Sub 1130
Allocation Factors

Line	New Mechanism Sales Allocator at Generator		MWH		
1	NC Retail MWH Sales Allocation	Company Records	58,149,791		
2	SC Retail MWH Sales Allocation	Company Records	21,551,077		
3	Total Retail	Line 1 + Line 2	79,700,868		
	Allocation 1 to state based on kWh sales				
4	NC Retail	Line 1 / Line 3	**72.9600473%**		
	Demand Allocators		**NC**	**SC**	**Total**
5	Residential	Company Records	5,051,778	1,502,084	6,553,862
6	Non Residential	Company Records	6,119,392	2,175,746	8,295,138
7	Total	Line 5 + Line 6	11,171,170	3,677,830	14,849,000
	Allocation 2 to state based on peak demand				
8	NC Retail	Line 7, NC / Line 7 Total	**75.2318001%**		
	Allocation 3 NC res vs non-res Peak Demand to retail system peak				
9	NC Residential	Line 5 NC/ Line 7 Total	**34.0209980%**		
10	NC Non-residential	Line 6 NC/ Line 7 Total	**41.2108021%**		

Duke Energy Carolinas, LLC
Vintage Year 2015 Allocation Factors for the Period January 1, 2015 to December 31, 2015
Docket Number E-7, Sub 1130
Allocation Factors

Line			MWH		
	New Mechanism Sales Allocator at Generator				
1	NC Retail MWH Sales Allocation	Company Records	59,567,575		
2	SC Retail MWH Sales Allocation	Company Records	22,080,529		
3	Total Retail	Line 1 + Line 2	81,648,104		
	Allocation 1 to state based on kWh sales				
4	NC Retail	Line 1 / Line 3	**72.9564706%**		
	Demand Allocators		**NC**	**SC**	**Total**
5	Residential	Company Records	4,994,057	1,469,714	6,463,771
6	Non Residential	Company Records	6,518,371	2,373,858	8,892,229
7	Total	Line 5 + Line 6	11,512,428	3,843,572	15,356,000
	Allocation 2 to state based on peak demand				
8	NC Retail	Line 7, NC / Line 7 Total	**74.9702266%**		
	Allocation 3 NC res vs non-res Peak Demand to retail system peak				
9	NC Residential	Line 5 NC/ Line 7 Total	**32.5218612%**		
10	NC Non-residential	Line 6 NC/ Line 7 Total	**42.4483655%**		

Duke Energy Carolinas, LLC
Vintage Year 2016 Allocation Factors for the Period January 1, 2016 to December 31, 2018
Docket Number E-7, Sub 1130
Allocation Factors

Line			MWH		
	New Mechanism Sales Allocator at Generator				
1	NC Retail MWH Sales Allocation	Company Records	60,762,752		
2	SC Retail MWH Sales Allocation	Company Records	22,364,255		
3	Total Retail	Line 1 + Line 2	83,127,007		
	Allocation 1 to state based on kWh sales				
4	NC Retail	Line 1 / Line 3	**73.0962827%**		
	Demand Allocators		**NC**	**SC**	**Total**
5	Residential	Company Records	5,403,520	1,714,752	7,118,272
6	Non Residential	Company Records	6,525,765	2,343,963	8,869,728
7	Total	Line 5 + Line 6	11,929,285	4,058,715	15,988,000
	Allocation 2 to state based on peak demand				
8	NC Retail	Line 7, NC / Line 7 Total	**74.6139917%**		
	Allocation 3 NC res vs non-res Peak Demand to retail system peak				
9	NC Residential	Line 5 NC/ Line 7 Total	**33.7973480%**		
10	NC Non-residential	Line 6 NC/ Line 7 Total	**40.8166437%**		

NOTE: These allocation factors are used for vintages 2016-2018 based on the most recently filed Cost of Service Study (May 2016)

Miller Exhibit 6

Duke Energy Carolinas, LLC
DSM/EE Cost Recovery Rider 9
Docket Number E-7 Sub 1130
Forecasted 2018 kWh Sales for Rate Period for Vintage Years 2014-2018

Fall 2016 Sales Forecast - kWhs

Line	North Carolina Retail:	Total 2017
1	Residential	**21,243,226,519**
2	Non-Residential	**36,366,140,923**
3	Total Retail	**57,609,367,442**

Line	NC Opt Out Sales	Total Usage	Opt-Outs	Net Usage
	Vintage 2014 Actual Opt Out			
4	EE	36,366,140,923	14,711,066,712	21,655,074,211
5	DSM	36,366,140,923	15,266,985,819	21,099,155,104
	Vintage 2015 Actual Opt Out			
6	EE	36,366,140,923	15,096,515,606	21,269,625,317
7	DSM	36,366,140,923	15,497,372,165	20,868,768,758
	Vintage 2016 Actual Opt Out			
8	EE	36,366,140,923	15,393,528,233	20,972,612,690
9	DSM	36,366,140,923	15,795,042,348	20,571,098,575
	Vintage 2017 Estimated Opt Out			
10	EE	36,366,140,923	15,618,223,435	20,747,917,488
11	DSM	36,366,140,923	15,818,398,874	20,547,742,049
	Vintage 2018 Estimated Opt Out			
12	EE	36,366,140,923	15,618,223,435	20,747,917,488
13	DSM	36,366,140,923	15,818,398,874	20,547,742,049

Rider EE (NC)
ENERGY EFFICIENCY RIDER

APPLICABILITY (North Carolina Only)
Service supplied under the Company's rate schedules is subject to approved adjustments for new energy efficiency and demand-side management programs approved by the North Carolina Utilities Commission (NCUC). The Rider Adjustments are not included in the Rate Schedules of the Company and therefore, must be applied to the bill as calculated under the applicable rate.

As of January 1, 2018, cost recovery under Rider EE relates to the Company's energy efficiency and demand-side management programs from 2014-2018. This Rider applies to service supplied under all rate schedules, except rate schedules OL, FL, PL, GL and NL for program years 2014-2018.

GENERAL PROVISIONS
This Rider will recover the cost of new energy efficiency and demand-side management programs beginning January 1, 2014, using the method approved by the NCUC as set forth in Docket No. E-7 Sub 1032, Order dated October 29, 2013.

TRUE-UP PROVISIONS
Rider amounts will initially be determined based on estimated kW and kWh impacts related to expected customer participation in the programs, and will be trued-up as actual customer participation and actual kW and kWh impacts are verified. If a customer participates in any vintage of programs, the customer is subject to the true-ups as discussed in this section for any vintage of programs in which the customer participated.

RIDER EE OPT OUT PROVISION FOR QUALIFYING NON-RESIDENTIAL CUSTOMERS
The Rider EE increment applicable to energy efficiency programs and/or demand-side management programs will not be applied to the energy charge of the applicable rate schedule for customers qualified to opt out of the programs where:

a. The customer has notified the Company that it has implemented, or has plans for implementing, alternative energy efficiency measures in accordance with quantifiable goals.
b. Electric service to the customer must be provided under:
    1. An electric service agreement where the establishment is classified as a "manufacturing industry" by the Standard Industrial Classification Manual published by the United States Government and where more than 50% of the electric energy consumption of such establishment is used for its manufacturing processes. Additionally, all other agreements billed to the same entity associated with the manufacturing industry located on the same or contiguous properties are also eligible to opt out.
    2. An electric service agreement for general service as provided for under the Company's rate schedules where the customer's annual energy use is 1,000,000 kilowatt hours or more. Additionally, all other agreements billed to the same entity with lesser annual usage located on the same or contiguous properties are also eligible to opt out.

Rider EE (NC)
ENERGY EFFICIENCY RIDER

The following additional provisions apply for qualifying customers who elect to opt out:

For customers who elect to opt out of energy efficiency programs, the following provisions also apply:

- Qualifying customers may opt out of the Company's energy efficiency programs each calendar year only during the annual two-month enrollment period between November 1 and December 31 immediately prior to a new Rider EE becoming effective on January 1. (Qualifying new customers have sixty days after beginning service to opt out).
- Customers may not opt out of individual energy efficiency programs offered by the Company. The choice to opt out applies to the Company's entire portfolio of energy efficiency programs.
- If a customer participates in any vintage of energy efficiency programs, the customer, irrespective of future opt out decisions, remains obligated to pay the remaining portion of the lost revenues for each vintage of energy efficiency programs in which the customer participated.
- Customers who elect to opt out during the two-month annual enrollment period immediately prior to the new Rider EE becoming effective may elect to opt in to the Company's energy efficiency programs during the first 5 business days of March each calendar year. Customers making this election will be back-billed retroactively to the effective date of the new Rider EE.

For customers who elect to opt out of demand-side management programs, the following provisions also apply:

- Qualifying customers may opt out of the Company's demand-side management program during the enrollment period between November 1 and December 31 immediately prior to a new Rider EE becoming effective on January 1 of the applicable year. (Qualifying new customers have sixty days after beginning service to opt out).
- If a customer elects to participate in a demand-side management program, the customer may not subsequently choose to opt out of demand-side management programs for three years.
- Customers who elect to opt out during the two-month annual enrollment period immediately prior to the new Rider EE becoming effective may elect to opt in to the Company's demand-side management program during the first 5 business days of March each calendar year. Customers making this election will be back-billed to the effective date of the new Rider EE.

Any qualifying non-residential customer that has not participated in an energy efficiency or demand-side management program may opt out during any enrollment period, and has no further responsibility to pay Rider EE amounts associated with the customer's opt out election for energy efficiency and/or demand-side management programs.

ENERGY EFFICIENCY RIDER ADJUSTMENTS (EEA) FOR ALL PROGRAM YEARS

The Rider EE amounts applicable to the residential and nonresidential rate schedules for the period January 1, 2018 through December 31, 2018 including utility assessments are as follows:

Residential	Vintage 2014[1],2015[1], 2016[1]	0.1074¢ per kWh
	Vintage 2015[2], 2016[2], 2017, 2018	0.4571¢ per kWh
	Total Residential Rate	0.5645¢ per kWh
Nonresidential		
Vintage 2014[3]		
	Energy Efficiency	0.0005¢ per kWh
	Demand Side Management	(0.0006)¢ per kWh
Vintage 2015[3]		
	Energy Efficiency	0.0390¢ per kWh
	Demand Side Management	(0.0024)¢ per kWh
Vintage 2016[3]		
	Energy Efficiency	0.1902¢ per kWh
	Demand Side Management	0.0016¢ per kWh

Rider EE (NC)
ENERGY EFFICIENCY RIDER

Vintage 2017[3]	
Energy Efficiency	0.0456¢ per kWh
Demand Side Management	N/A
Vintage 2018[3]	
Energy Efficiency	0.2936¢ per kWh
Demand Side Management	0.0778¢ per kWh
Total Nonresidential	0.6453¢ per kWh

[1] Includes the true-up of program costs, shared savings and lost revenues from Year 1 of Vintage 2016 and Year 2 of Vintage 2015, and Year 3 of 2014.
[2] Includes prospective component of Vintage 2015 and 2016.
[3] Not Applicable to Rate Schedules OL, FL, PL, GL, and NL.

Each factor listed under Nonresidential is applicable to nonresidential customers who are not eligible to opt out and to eligible customers who have not opted out. If a nonresidential customer has opted out of a Vintage(s), then the applicable energy efficiency and/or demand-side management charge(s) shown above for the Vintage(s) during which the customer has opted out, will not apply to the bill.

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-7, SUB 1130

In the Matter of	)	
Application of Duke Energy Carolinas, LLC	)	**DIRECT TESTIMONY OF**
for Approval of Demand-Side Management	)	**ROBERT P. EVANS**
and Energy Efficiency Cost Recovery Rider	)	**FOR**
Pursuant to N.C. Gen. Stat. § 62-133.9 and	)	**DUKE ENERGY CAROLINAS, LLC**
Commission Rule R8-69	)	

I. INTRODUCTION AND PURPOSE

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND POSITION WITH DUKE ENERGY.

A. My name is Robert P. Evans, and my business address is 150 Fayetteville Street, Raleigh, North Carolina 27602. I am employed by Duke Energy Corporation ("Duke Energy") as Senior Manager-Strategy and Collaboration for the Carolinas in the Market Solutions Regulatory Strategy and Evaluation group.

Q. PLEASE BRIEFLY STATE YOUR EDUCATIONAL BACKGROUND AND EXPERIENCE.

A. I graduated from Iowa State University ("ISU") in 1978 with a Bachelor of Science Degree in Industrial Administration and a minor in Industrial Engineering. As a part of my undergraduate work, I participated in both the graduate level Regulatory Studies Programs sponsored by American Telephone and Telegraph Corporation, and graduate level study programs in Engineering Economics. Subsequent to my graduation from ISU, I received additional Engineering Economics training at the Colorado School of Mines, completed the National Association of Regulatory Utility Commissioners Regulatory Studies program at Michigan State, and completed the Advanced American Gas Association Ratemaking program at the University of Maryland. Upon graduation from ISU, I joined the Iowa State Commerce Commission (now known as the Iowa Utility Board ("IUB")) in the Rates and Tariffs Section of the Utilities Division. During my tenure with the IUB, I held several positions, including Senior Rate Analyst in charge of Utility Rates and Tariffs, and Assistant Director of the Utility Division. In those positions, I provided testimony in gas, electric, water, and telecommunications proceedings as an expert witness in the areas of rate design, service rules, and tariff applications. In 1982, I accepted employment with City Utilities of Springfield, Missouri, as an Operations Analyst. In that capacity, I provided support for rate-related matters associated with the municipal utility's gas, electric, water, and sewer operations. In addition, I worked closely with its load management and energy conservation programs. In 1983, I joined the Rate Services staff of the Iowa Power and Light Company, now known as MidAmerican Energy, as a Rate Engineer. In this position, I was responsible for the preparation of rate-related filings and presented testimony on rate design, service rules, and accounting issues before the IUB. In 1986, I accepted employment with Tennessee-Virginia Energy Corporation (now known as the United Cities Division of Atmos Energy) as Director of Rates and Regulatory Affairs. While in this position, I was responsible for regulatory filings, regulatory relations, and customer billing. In 1987, I went to work for the Virginia State Corporation Commission in the Division of Energy Regulation as a Utilities Specialist. In this capacity, I worked on electric and natural gas issues and provided testimony on cost of service and rate design matters brought before that regulatory body. In 1988, I joined North Carolina Natural Gas Corporation ("NCNG") as its Manager of Rates and Budgets. Subsequently, I was promoted to Director-Statistical Services in NCNG's Planning and Regulatory Compliance Department. In that position, I performed a variety of work associated with financial, regulatory, and statistical analysis and presented testimony on several issues brought before the North Carolina Utilities Commission ("Commission"). I held that position until the closing of NCNG's merger with Carolina Power and Light Company, the predecessor of Progress Energy, Inc. ("Progress"), on July 15, 1999.

From July 1999 through January 2008, I was employed in Principal and Senior Analyst roles by the Progress Energy Service Company, LLC. In these roles, I provided NCNG, Progress Energy Carolinas, Inc. (now Duke Energy Progress, LLC or "DEP"), and Progress Energy Florida, Inc. with rate and regulatory support in their state and federal venues. From 2008 through the merger of Duke Energy and Progress, I provided regulatory support for demand-side management ("DSM") and energy efficiency ("EE") (collectively, "DSM/EE") programs. Subsequent to the Progress merger with Duke Energy, I obtained my current position.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY IN MATTERS BROUGHT BEFORE THIS COMMISSION?

A. Yes. I have provided testimony to this Commission in matters concerning revenue requirements, avoided costs, cost of service, rate design, and the recovery of costs associated with DSM/EE programs and related accounting matters.

Q. WHAT ARE YOUR CURRENT RESPONSIBILITIES?

A. I am responsible for the regulatory support of DSM/EE programs in North Carolina for both Duke Energy Carolinas, LLC ("DEC" or the "Company") and DEP.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony supports DEC's Application for approval of its DSM/EE Cost Recovery Rider, Rider EE, for 2018 ("Rider 9"), which encompasses the Company's currently effective cost recovery and incentive mechanism ("Mechanism") and portfolio of programs approved in the Commission's *Order Approving DSM/EE Programs and Stipulation of Settlement* issued October 29, 2013, in Docket No. E-7, Sub 1032 ("Sub 1032 Order"). My testimony provides (1) a discussion of items the Commission specifically directed the Company to address in this proceeding; (2) an overview of the Commission's Rule R8-69 filing requirements; (3) a synopsis of the DSM/EE programs included in this filing; (4) a discussion of program results; (5) an explanation of how these results have affected the Rider 9 calculations; (6) information on DEC's Evaluation Measurement & Verification ("EM&V") activities; (7) an overview of the calculation of the Portfolio Performance Incentive ("PPI"); and (8) review of the Mechanism approved in the Sub 1032 Order.

Q. PLEASE DESCRIBE THE EXHIBITS ATTACHED TO YOUR TESTIMONY.

A. Evans Exhibit 1 supplies, for each program, load impacts and avoided cost revenue requirements by vintage. Evans Exhibit 2 contains a summary of net lost revenues for the period January 1, 2014 through December 31, 2018. Evans Exhibit 3 contains the actual program costs for North Carolina for the period January 1, 2014 through December 31, 2016. Evans Exhibit 4 contains the found revenues used in the net lost revenues calculations. Evans Exhibit 5 supplies evaluations of event-based programs. Evans Exhibit 6 contains information about and the results of DEC's programs and a comparison of actual impacts to previous estimates. Evans Exhibit 7 contains the projected program and portfolio cost-effectiveness results for the Company's current portfolio of programs. Evans Exhibit 8 contains a summary of 2016 program performance and an explanation of the variances between the expected program results and the actual results. Evans Exhibit 9 is a list of DEC's industrial and large commercial customers that have opted out of participation in its DSM or EE programs and a listing of those customers that have elected to participate in new measures after having initially notified the Company that they declined to participate, as required by Commission Rule R8-69(d)(2). Evans Exhibit 10 contains the projected shared savings incentive associated with Vintage 2018. Evans Exhibit 11 provides a summary of the estimated activities and timeframe for completion of EM&V by program. Evans Exhibit 12 provides the actual and expected dates when the EM&V for each program or measure will become effective. Evans Exhibits A through J provide the detailed completed EM&V reports or updates for the following programs: Residential Income-Qualified EE and Weatherization Assistance for Residential Neighborhoods Program 2015 (Evans Exhibit A); Residential Multi-Family EE Program 2014-2015 (Evans Exhibit B); Power Manager Load Control Service Program 2015 (Evans Exhibit C); Non-Residential Smart $aver Energy Efficient Products and Assessment Program - Custom Projects 2013-2015 (Evans Exhibit D); Non-Residential Smart $aver Energy Efficient Products and Assessment Program - Prescriptive 2012-2014 (Evans Exhibit E); Non-Residential Smart $aver Energy Efficient Products and Assessment – Prescriptive 2013-2015 (Evans Exhibit F); PowerShare Non-Residential Load Curtailment 2014 (Evans Exhibit G); PowerShare Non-Residential Load Curtailment 2015 (Evans Exhibit H); Residential Energy Efficient Appliances and Devices – Save Energy and Water Kit 2014-2015 (Evans Exhibit I); and Small Business Energy Saver 2015 (Evans Exhibit J).

Q. WERE EVANS EXHIBITS 1-12 PREPARED BY YOU OR AT YOUR DIRECTION AND SUPERVISION?

A. Yes, they were.

II. ACTIONS ORDERED BY THE COMMISSION

Q. PLEASE DESCRIBE THE ACTIONS THE COMMISSION DIRECTED DEC TO TAKE IN THE COMMISSION'S ORDER IN DOCKET NO. E-7, SUB 1105.

A. In its August 26, 2016 *Order Approving DSM/EE Rider and Requiring Filing of Proposed Customer Notice* in Docket No. E-7, Sub 1105 ("Sub 1105

Order”), the Commission ordered: (1) that the Company shall incorporate the recommendations made by Public Staff witness Jack Floyd into future EM&V reports filed with the Commission in subsequent DSM/EE rider proceedings; and (2) that the Collaborative should (a) continue to discuss how to increase program participation and impacts with an emphasis on increasing the participation of opt-out eligible customers; (b) discuss the specific recommendations made by Southern Alliance for Clean Energy (“SACE”) witness Jennifer Weiss regarding new programs or enhancements to existing programs; (c) discuss the costs of EE programs, both over time, and as participation increases, as outlined by witness Weiss; and (d) continue to review recommendations for improving programs and increasing participation provided by the Company’s EM&V consultants.

A. <u>PUBLIC STAFF’S EM&V RECOMMENDATIONS</u>

Q. PLEASE DESCRIBE PUBLIC STAFF WITNESS FLOYD’S RECOMMENDATIONS THAT THE COMMISSION ORDERED DEC TO INCORPORATE INTO FUTURE EM&V REPORTS.

A. In Docket No. E-7, Sub 1105, Public Staff witness Floyd recommended that the Company implement certain recommendations in its future EM&V studies, subject to the consideration of whether the cost would outweigh the benefit. These recommendations were as follows:

(1) Future evaluations of the Energy Efficient Education Program should consider including a control group in the billing analysis to better explain naturally occurring savings and to more accurately assign

program savings to either EE improvements or behavioral changes. If DEC's evaluator does not use a control group, then DEC should provide the rationale and analysis supporting the decision not to do so in a future evaluation plan. In addition, to the extent available, DEC's evaluator should incorporate North Carolina-specific assumptions and data when possible, or explain why it did not.

(2) DEC's Multi-Family EE Program evaluator should investigate the feasibility of collecting baseline data on a prospective basis in order to improve the accuracy of the baseline assumptions used in the evaluation. In addition, DEC should investigate the feasibility of assessing vacancy rates at participating properties in order to determine if all measures installed are generating savings, and provide an update on the status of this investigation in its annual rider filing.

(3) From its review of DEC's Residential Energy Efficient Appliances and Devices Program's CFL Lighting report, the Public Staff noted that instead of using primary data to derive certain values central to calculating CFL savings such as hours-of-use, the EM&V relied on secondary data from other EM&V reports for other utilities, including a 2012 CFL EM&V report for DEP. Use of primary data, such as metering or survey data for the specific population and program, can provide a greater confidence level in the results of EM&V. However, DEC's evaluator indicated that it found the use of the secondary data to be reasonable. Pursuant to the EM&V Agreement, the impacts derived

through this EM&V will be applied beginning in April 2015. As indicated previously, DEC has in 2016 transitioned from CFL to LED measures for this program. Therefore, witness Floyd recommended that the Commission accept the findings of this report, and apply the impacts for all free CFL measures distributed through DEC's direct-ship CFL and online store channels from April 2015 through the end of 2015. For its LED measures, witness Floyd recommended that DEC develop LED-specific impacts and apply those impacts beginning in January 2016. Witness Floyd further recommended that future evaluations of bulbs distributed through any of DEC's free bulb direct-ship channels should be consistent with the Uniform Methods Project ("UMP") and include evaluations of the baseline wattages, hours-of-use, in-service-rates, and other key variables. These evaluations should be based on primary data to the extent feasible. In the event DEC's evaluator deviates from the UMP, it should provide support for its decision. In addition, witness Floyd indicated that reviews of shelf-stocking studies indicate that lighting technologies are evolving so quickly that CFLs could become the baseline sooner than expected. If that occurs, programs, such as EE Appliances and Devices, that offer free LED measures may yield less savings than originally expected, become obsolete, or need to be targeted at particular populations. Therefore, DEC should conduct a shelf-stocking survey to study the progression of market transformation for lighting in the DEC service territory. The study can be part of the LED study currently underway, or a separate study as appropriate. The results of this study should be used to inform decision making in regard to baseline efficiency assumptions as well as free ridership.

(4) If DEC resumes offering the Appliance Recycling Program, the next EM&V evaluation for this program should investigate the feasibility of completing a primary metering study as recommended by the UMP to estimate per-unit energy consumption. If a primary metering study is cost prohibitive, the evaluator should use the alternative method recommended by the UMP, i.e., using other metering data collected as part of other recycling program evaluations that occurred within the previous five years to estimate the per-unit energy consumption. Should this alternative be used, the evaluation should discuss the other program evaluations considered, whether it made any adjustments to the per-unit energy consumption data, and if so, provide an explanation of each adjustment.

(5) DEC filed a revised EM&V report on May 17, 2016, Residential Energy Efficient Appliances and Devices Program's Save Energy and Water Kit ("Exhibit E") that corrected errors that had been identified by the evaluator. In response to a Public Staff data request, DEC indicated that Tables 3, 14, 15, 23, 26, 27, 29, 30, 32, 34, and 36 in Exhibit E needed to be revised. As a result, the Public Staff will continue to

evaluate the measures associated with Exhibit E and address any concerns or make adjustments in the next DSM/EE rider proceeding.

(6) If feasible, any evaluations completed after the Sub 1105 Order should use the same methodology to evaluate identical measures or measures performing the identical function in separate programs within a customer class. If different methodologies are selected by DEC's independent evaluator, then the rationale for the different methodologies should be provided.

(7) If DEC's evaluator relies upon the findings of a prior DEP EM&V report to support the future evaluation of a DEC EE program or measure, the evaluator should provide support for its decision to do so, including a comparison of the programs/measures, populations, delivery channels, identification of potential sources of uncertainty, and reasons why a cross-application of EM&V is appropriate. In the case that a DEC EM&V report leverages a prior DEP EM&V report of similar EE programs that provide identical measures or those performing the identical function through different delivery channels, the EM&V evaluator should analyze these differences and their impact on inputs in the savings calculations, including hours of use and installation rates.

Q. HAS DEC HAD THE OPPORTUNITY TO ADDRESS WITNESS FLOYD'S EM&V RECOMMENDATIONS?

A. Yes. The Company has communicated witness Floyd's recommendations to its independent third-party evaluators. His recommendations have been and are being adopted to the extent that the additional costs associated with his recommendations are outweighed by the benefits.

Q. HAS THE COMPANY DEEMED ANY OF WITNESS FLOYD'S RECOMMENDATIONS AS BEING OUTWEIGHED BY THE COSTS?

A. Yes. The Company determined that for one of witness Floyd's recommendations relating to DEC's Multi-Family EE Program, the additional costs associated with implementing this recommendation would outweigh the benefits. The Program staff and vendor investigated the feasibility of assessing vacancy rates at participating properties to determine if all measures installed are generating savings. It was determined that vacant units become occupied relatively quickly, and, consequently, savings would be impacted only marginally.

Q. HAS DEC ADDRESSED WITNESS FLOYD'S OTHER RECOMMENDATION ASSOCIATED WITH ITS MULTI-FAMILY EE PROGRAM?

A. Yes. Pursuant to witness Floyd's other recommendation, the Multi-Family EE Program is now collecting baseline data information during the installation process. This data is provided to DEC's evaluator to improve the accuracy of the baseline assumptions used in the evaluation.

Q. HAS DEC ADDRESSED WITNESS FLOYD'S RECOMMENDATIONS REGARDING ITS ENERGY EFFICIENT EDUCATION PROGRAM?

A. Yes. The Company has communicated witness Floyd's recommendations to its independent evaluator, subject to the consideration of whether the cost would outweigh the benefit.

Q. HAS DEC ADDRESSED WITNESS FLOYD'S RECOMMENDATIONS REGARDING LIGHTING MEASURES OFFERED AS A PART OF ITS RESIDENTIAL ENERGY EFFICIENT APPLIANCES AND DEVICES PROGRAM?

A. Yes. DEC developed LED-specific impacts and began applying those impacts in January 2016. In addition, the Company has communicated witness Floyd's recommendations to its independent evaluator. The DEC free LED evaluation adheres to the UMP, and baseline wattages, hours-of-use, and coincident factor assumptions are updated due to a residential lighting logger study that was completed in January 2017. In addition, the evaluation will determine in-service rates from the participant survey.

Q. HAS DEC ADDRESSED WITNESS FLOYD'S RECOMMENDATIONS REGARDING ITS APPLIANCE RECYCLING PROGRAM?

A. At this time, the Company's Appliance Recycling Program remains inactive. Upon the resumption of this Program, the Company will communicate witness Floyd's recommendations to its independent evaluator.

Q. PLEASE DESCRIBE THE REVISIONS TO THE SAVE ENERGY AND WATER KIT EM&V REPORT.

A. As witness Floyd pointed out, DEC filed a revised EM&V report for the Save Energy and Water Kit Measures in its Residential Energy Efficient Appliances and Devices Program on May 17, 2016, which corrected errors that had been identified by the evaluator. In response to a Public Staff data request, DEC indicated that Tables 3, 14, 15, 23, 26, 27, 29, 30, 32, 34, and 36 in the report needed to be revised as a result of the evaluator's errors. Corrections to Tables 3, 23, 26, 29, 30, 32, 34, and 36 are already reflected in the revised Save Energy and Water Kit EM&V report filed on May 17, 2016. Tables 14 and 15 contained participation data, and no adjustments were necessary. Table 27 did not change since there were no changes to the algorithm assumptions for faucet aerators. In addition to the aforementioned modifications, the evaluator also made changes to Tables 24, 33, 35, 37, and 38. The EM&V report for the Save Energy and Water Kit Measures reflecting these additional changes has been included in the Company's filing as Evans Exhibit I.

Q. HAS DEC ADDRESSED WITNESS FLOYD'S OTHER EM&V RELATED RECOMMENDATIONS?

A. Yes. The Company has communicated witness Floyd's other recommendations, 6 and 7, to its independent evaluator.

B. SACE RECOMMENDATIONS

Q. HAS THE COLLABORATIVE CONTINUED TO DISCUSS HOW TO INCREASE PROGRAM PARTICIPATION AND IMPACTS WITH AN EMPHASIS ON INCREASING PARTICIPATION OF OPT-OUT ELIGIBLE CUSTOMERS?

A. Yes. During the course of 2016, the DEC Collaborative discussed upcoming program modifications to existing programs intended to increase program participation and impacts. More specifically, the Collaborative discussed modifications to the My Home Energy Report program to allow multi-family customers to participate, a customer eligibility increase for the Small Business Energy Saver Program to allow a greater number of small business customers to participate, and a variety of technology changes to promote the most efficient equipment currently in the market place. The DEC Collaborative also discussed the addition of new programs and existing program modifications that target large opt-out eligible customers. The result of these discussions led to the addition of a "Fast Track" option for the Non-Residential Smart $aver Custom program, as well as the addition of a new Non-Residential Smart $aver Performance program, both of which were approved in Docket No. E-7, Sub 1032. The DEC Collaborative also had a presentation on Strategic Energy Management and will continue discussions on this and other technical assistance programs for commercial and industrial customers. The DEC Collaborative continues to have ongoing discussions about the increase in eligible customer opt-outs with the intent of designing new programs and modifications to existing programs that are specifically tailored to opt-out eligible customers in an effort to increase overall program participation and impacts.

Q. HAS THE COLLABORATIVE DISCUSSED THE SPECIFIC RECOMMENDATIONS MADE BY SACE WITNESS WEISS REGARDING NEW PROGRAMS OR ENHANCEMENTS TO EXISTING PROGRAMS?

A. Yes. In her testimony, witness Weiss recommended that the Company should adopt new programs based on best practices from around the country, including on-bill financing programs, an enhanced multi-family affordable housing program, and additional lower-income residential EE programs. For existing programs, witness Weiss indicated that additional savings could be achieved by bundling programs and encouraging cross-participation. Because this issue is relevant to both DEC and DEP, topics surrounding new programs and enhancements to existing program were discussed in one or both of the Collaboratives throughout 2016 with future discussions planned for 2017. The discussions covered topics on low-income programs, multi-family programs, and on-bill finance programs. As a result of these discussions the Company has continued work with the On-Bill Finance Working Group, which includes stakeholders from DEC and DEP, North Carolina Public Staff, South Carolina Office of Regulatory Staff, Natural Resources Defense Council ("NRDC"), SACE, South Carolina Coastal Conservation League, Appalachian Voices, and North Carolina Sustainable

Energy Association. Following the Multi-Family EE Summit held on October 28, 2016, a Multi-Family Regulatory Task Force (comprised of stakeholders including, without limitation, DEC and DEP, the Commission, National Housing Trust, NRDC, North Carolina Justice Center, Southern Environmental Law Center, and SACE) has begun regular meetings to facilitate the positive advancement of multi-family regulation and the possible implementation of DSM/EE programs that cater to this customer segment. The Company also has a new construction presentation planned for 2017 by one of the Collaborative stakeholders. As indicated previously, the Collaborative continues to discuss a vast range of potential new programs and upcoming modifications to existing programs for both residential and non-residential customers. The Company believes this to be the most efficient avenue for adding new programs and enhancing the existing suite of DSM and EE programs.

Q. HAS THE COLLABORATIVE DISCUSSED THE COSTS OF EE PROGRAMS BOTH OVER TIME, AND AS PARTICIPATION INCREASES, AS OUTLINED BY WITNESS WEISS?

A. Yes. Due to overlapping membership and common programs, this discussion was held in the fourth quarter DEP Collaborative. The Collaborative membership had an in-depth discussion of how forecasting for future program performance is undertaken by the Company. The discussions resulted in recommendations that the Company provide more clarity on how cost-effectiveness scores are reported, by aligning the reporting structure for

DEC and DEP (the Company has already moved to align the format of both the DEC and DEP annual cost recovery filings) and providing guidance on where specific cost and program information can be found in the annual cost recovery filings.

Q. HAS THE COLLABORATIVE CONTINUED TO REVIEW RECOMMENDATIONS FOR IMPROVING PROGRAMS AND INCREASING PARTICIPATION BY THE COMPANY'S EM&V CONSULTANTS?

A. Yes. During the fourth quarter DEC Collaborative, the Company provided an overview of the Company's EM&V recommendation tracking template, which includes recommendations from the Company's EM&V consultants and the resulting action(s) taken or to be taken by the Company. The document is updated as EM&V reports are provided to the Company, and the Company will continue to share this information with the Collaborative membership.

III. <u>RULE R8-69 FILING REQUIREMENTS</u>

Q. WHAT INFORMATION DOES DEC PROVIDE IN RESPONSE TO THE COMMISSION'S FILING REQUIREMENTS?

A. The information for Rider 9 is provided in response to the Commission's filing requirements contained in R8-69(f)(1) and can be found in the testimony and exhibits of Company witnesses Evans and Miller as follows:

R8-69(f)(1)		Items	Location in Testimony
(i)		Projected NC retail sales for the rate period	Miller Exhibit 6
(ii)		For each measure for which cost recovery is requested through Rider 9:	
(ii)	a.	Total expenses expected to be incurred during the rate period	Evans Exhibit 1
(ii)	b.	Total costs savings directly attributable to measures	Evans Exhibit 1
(ii)	c.	EM&V activities for the rate period	Evans Exhibit 11
(ii)	d.	Expected peak demand reductions	Evans Exhibit 1
(ii)	e.	Expected energy reductions	Evans Exhibit 1
(iii)		Filing requirements for DSM/EE EMF rider, including:	
(iii)	a.	Total expenses for the test period in the aggregate and broken down by type of expenditure, unit, and jurisdiction	Evans Exhibit 3
(iii)	b.	Total avoided costs for the test period in the aggregate and broken down by type of expenditure, unit, and jurisdiction	Evans Exhibit 1
(iii)	c.	Description of results from EM&V activities	Testimony of Robert Evans and Evans Exhibits A-J
(iii)	d.	Total peak demand reductions in the aggregate and broken down per program	Evans Exhibit 1
(iii)	e.	Total energy reduction in the aggregate and broken down per program	Evans Exhibit 1
(iii)	f.	Discussion of findings and results of programs	Testimony of Robert Evans and Evans Exhibit 6
(iii)	g.	Evaluations of event-based programs	Evans Exhibit 5
(iii)	h.	Comparison of impact estimates from previous year and explanation of significant differences	Testimony of Robert Evans and Evans Exhibits 6 and 8
(iv)		Determination of utility incentives	Testimony of Robert Evans and Evans Exhibit 10
(v)		Actual revenues from DSM/EE and DSM/EE EMF riders	Miller Exhibit 4
(vi)		Proposed Rider 9	Testimony of Carolyn Miller and Miller Exhibit 1
(vii)		Projected NC sales for customers opting out of measures	Miller Exhibit 6
(viii)		Supporting work papers	Flash drive accompanying filing

IV. PORTFOLIO OVERVIEW

Q. WHAT ARE DEC'S CURRENT DSM AND EE PROGRAMS?

A. The Company has two interruptible programs for non-residential customers, Interruptible Service ("IS") and Standby Generation ("SG"), that are accounted for outside of the Mechanism approved by the Commission in the Sub 1032 Order. Aside from IS and SG, the following DSM/EE programs have been implemented by DEC in its North Carolina service territory:

RESIDENTIAL CUSTOMER PROGRAMS

- Appliance Recycling Program (currently suspended)
- Energy Assessments Program
- EE Education Program
- Energy Efficient Appliances and Devices
- HVAC EE Program
- Multi-Family EE Program
- My Home Energy Report
- Income-Qualified EE and Weatherization Program
- Power Manager

NON-RESIDENTIAL CUSTOMER PROGRAMS

- Non-Residential Smart $aver Energy Efficient Food Service Products Program
- Non-Residential Smart $aver Energy Efficient HVAC Products

Program

- Non-Residential Smart $aver Energy Efficient IT Products Program
- Non-Residential Smart $aver Energy Efficient Lighting Products Program
- Non-Residential Smart $aver Energy Efficient Process Equipment Products Program
- Non-Residential Smart $aver Energy Efficient Pumps and Drives Products Program
- Non-Residential Smart $aver Custom Program
- Non-Residential Smart $aver Custom Energy Assessments Program
- PowerShare
- PowerShare CallOption
- Small Business Energy Saver
- Smart Energy in Offices
- Business Energy Report Pilot
- EnergyWise for Business
- Non-Residential Smart $aver Performance Incentive (approved December 20, 2016 in Docket No. E-7, Sub 1032)

Q. ARE THESE SUBSTANTIVELY THE SAME PROGRAMS DEC RECEIVED APPROVAL FOR IN DOCKET NO. E-7, SUB 1032?

A. Yes. The programs contained in the current portfolio are the same as those approved by the Commission in the Sub 1032 Order, with the exception of the recent addition of the Non-Residential Smart $aver Performance Incentive Program; the prior additions of the Business Energy Report pilot, EnergyWise for Business, Smart Energy in Offices, and Small Business Energy Saver programs; and the discontinuation of the Energy Management Information Services Pilot Program.

Q. PLEASE DESCRIBE ANY UPDATES MADE TO THE UNDERLYING ASSUMPTIONS FOR DEC'S PORTFOLIO OF PROGRAMS THAT HAVE ALTERED PROJECTIONS FOR VINTAGE 2018.

A. EM&V results were updated to reflect the savings impacts for those programs for which DEC received EM&V results after it prepared its application in Docket No. E-7, Sub 1105. Updating programs for EM&V results will change the projected avoided cost benefits associated with the projected participation and hence will impact the calculation of the specific program and overall portfolio cost-effectiveness, as well as impact the calculation of DEC's projected shared savings incentive.

Q. AFTER FACTORING THESE UPDATES INTO THE VINTAGE 2018 PORTFOLIO, DO THE RESULTS OF DEC'S PROSPECTIVE COST-EFFECTIVENESS TESTS INDICATE THAT IT SHOULD DISCONTINUE OR MODIFY ANY OF ITS PROGRAMS?

A. DEC performed a prospective analysis of each of its programs and the aggregate portfolio for the Vintage 2018 period. It is important to note that this analysis does not include any values for DEC's Appliance Recycling

Program, as no costs have been included for this Program during Vintage 2018 due to its current suspension. With the exception of the aforementioned program, the cost-effectiveness results for the entire portfolio for Vintage 2018 are contained in Evans Exhibit 7. This exhibit shows that, with the exception of the Income-Qualified EE Products and Services Program, which was not cost-effective at the time of Commission approval, and the Residential HVAC EE Program, the aggregate portfolio continues to project cost-effectiveness.

Q. DUE TO THE COST-EFFECTIVENESS RESULTS OF THE HVAC EE PROGRAM, SHOULD IT BE DISCONTINUED?

A. No. The only borderline cost-effectiveness statistic for the HVAC EE Program is its 0.99 Total Resource Cost test result. Given how close this value is to the 1.00 threshold, coupled with additional planned program modifications that are intended to enhance the Program's overall cost-effectiveness, the Company does not believe that the HVAC EE Program should be discontinued at this time.

Q. DID DEC MAKE ANY MODIFICATIONS TO ITS PORTFOLIO OF PROGRAMS DURING VINTAGE 2016?

A. Yes. The Company has made several modifications to its portfolio of programs during Vintage 2016. These modifications were made in compliance with the Flexibility Guidelines approved by the Commission in its Sub 1032 Order. DEC's Residential HVAC EE Program was modified as follows: (1) the replacement of the existing single initial/maximum incentive structure for HVAC equipment with a three-tier incentive structure based on the efficiency of the new HVAC system; (2) the addition of a programmable, Wi-Fi-enabled smart thermostat measure; (3) the addition of a "quality installation" provision to encourage the proper installation of HVAC systems; and (4) the addition of a referral channel to guide interested customers to one or more DEC-approved HVAC contractors. Other portfolio changes include: (1) increasing the maximum value of the home EE kit provided in DEC's Residential Energy Assessments Program; (2) the expansion of DEC's My Home Energy Report Program to included multi-family residences; and (3) the expansion of eligibility standards for DEC's Non-Residential Smart $aver Energy Efficient Products and Assessments Program to include transmission customers, and provision of an expedited review process for participants needing quicker approval.

V. DSM/EE PROGRAM RESULTS TO DATE

Q. HOW MUCH ENERGY, CAPACITY AND AVOIDED COST SAVINGS DID DEC DELIVER AS A RESULT OF ITS DSM/EE PROGRAMS DURING VINTAGE 2016?

A. During Vintage 2016, DEC's DSM/EE programs delivered over 831 million kilowatt hours ("kWh") of energy savings and over 985 megawatts ("MW") of capacity savings, which produced net present value of avoided cost savings of over $471 million. The 2016 performance results for individual programs are provided in Evans Exhibits 6 and 8.

Q. DID ANY PROGRAMS SIGNIFICANTLY OUT-PERFORM RELATIVE TO THEIR ORIGINAL ESTIMATES FOR VINTAGE 2015?

A. Yes. During Vintage 2016, DEC's portfolio of programs was able to deliver energy and capacity savings that yielded avoided costs that were 139 percent of the target, and it did so while expending 123 percent of targeted program costs. While the Company's entire portfolio of programs performed well, programs in the portfolio that feature lighting measures continued to contribute the largest portion of the avoided cost impacts. In the residential market, the three highest ranked programs in terms of percentage increases in avoided costs from those forecasted for 2016 were the Energy Efficient Appliances and Devices Program, the HVAC EE Program, and the Multi-Family EE Program. These impacts were achieved largely due to elevated participation of customers adopting measures at much higher rates than originally forecasted. The avoided cost savings impacts for these three programs, compared to those originally filed for Vintage 2016, exceeded the projections by 504 percent, 155 percent, and 121 percent, respectively. The energy savings impacts for the three programs, compared to those originally filed for Vintage 2016, exceeded the projections by 331 percent, 187 percent, and 134 percent, respectively.

The non-residential program with the largest percentage increase in avoided costs from those forecasted for 2016 is the Non-Residential Smart

$aver Prescriptive Program. This program produced 199 percent of expected avoided costs and 173 percent of expected energy savings.

Q. HAVE ANY PROGRAMS SIGNIFICANTLY UNDERPERFORMED RELATIVE TO THEIR ORIGINAL ESTIMATES IN VINTAGE 2016?

A. Yes. In the residential market, the three lowest ranked programs, in terms of percentage variations in avoided costs from those forecasted for 2016, are the Appliance Recycling Program, the Income-Qualified EE and Weatherization Program, and the Residential Energy Assessments Program.

The Appliance Recycling Program produced 3 percent of forecasted avoided costs and 3 percent of both forecasted energy and capacity savings. These shortfalls were largely due to the bankruptcy of the program vendor, which interrupted the program delivery and negatively impacted participation. The Company continues to evaluate the long-term viability of the program and is exploring potential new program vendors should it be deemed appropriate to maintain the program as part of the Company's portfolio.

During 2016, the Income-Qualified EE and Weatherization Program produced 74 percent of forecasted avoided costs, 85 percent of forecasted energy savings, and 67 percent of forecasted capacity savings. The underperformance of this Program is primarily due to less than forecasted Program participation. Program participation was 90 percent of that originally forecasted by the Company

The Residential Energy Assessments Program produced 85 percent of forecasted avoided costs, 98 percent of forecasted energy savings, and 114 percent of forecasted capacity savings. The primary driver for the underperformance of DEC's Residential Energy Assessments Program is related to changes in forecasted energy savings impacts.

VI. PROJECTED RESULTS

Q. PLEASE PROVIDE A PROJECTION OF THE RESULTS THAT DEC EXPECTS TO SEE FROM IMPLEMENTATION OF ITS PORTFOLIO OF PROGRAMS.

A. Consistent with its practices during the save-a-watt pilot, DEC will update the actual and projected EE achievement levels in its annual Rider EE filing to account for any program or measure additions based on the performance of programs, market conditions, economics and consumer demand. The actual results for Vintage 2016 and projection of the results for Vintages 2017 and 2018, as well as the associated projected program expense for DEC's portfolio of programs, are summarized in the following table:

DEC System (NC & SC) DSM/EE Portfolio 2016 Actual Results and 2017-2018 Projected Results			
	2016	2017	2018
Annual System MW	985	1,002	1,059
Annual System Net GWh	831	608	817
Annual Program Costs (Millions)	$152	131	$142

The Vintage 2017 projections are similar to those provided by DEC and reported to the Commission in Docket No. E-7, Sub 1105. The projected impacts and cost for Vintage 2018 are different as a result of updated participation estimates as well as the EM&V results that have been applied to the following programs: Residential Income-Qualified EE and Weatherization Assistance for Residential Neighborhoods; Residential Multi-Family EE; Power Manager Load Control Service; Non-Residential Smart $aver Energy Efficient Products and Assessment – Custom Projects; Non-Residential Smart $aver Energy Efficient Products and Assessment – Prescriptive; PowerShare Non-Residential Load Curtailment; the Save Energy and Water Kit and CFL measures included in the Energy Efficient Appliances and Devices Program; and Small Business Energy Saver.

VII. EM&V ACTIVITIES

Q. CAN YOU PROVIDE INFORMATION ON THE COMPANY'S EM&V ACTIVITIES?

A. Yes. Evans Exhibit 11 provides a summary of the estimated activities and timeframe for completion of EM&V by program. Evans Exhibit 12 provides the actual and expected dates when the EM&V for each program or measure will become effective. Evans Exhibits A through J provide the detailed completed EM&V reports or updates for the following programs:

Evans Exhibit	EM&V Reports	Report Finalization Date	Evaluation Type
A	Residential Income-Qualified EE and Weatherization Assistance for Residential Neighborhoods: 2015	12/5/2016	Process and Impact
B	Residential Multi-Family EE: 2014-2015	10/04/2016	Process and Impact
C	Power Manager Load Control Service: 2015	4/26/2016	Process and Impact
D	Non-Residential Smart $aver Energy Efficient Products and Assessment – Custom Projects – 2013-2015	12/23/2016	Process
E	Non-Residential Smart $aver Energy Efficient Products and Assessment – Prescriptive: 2012-2014	4/15/2016	Process
F	Non-Residential Smart $aver Energy Efficient Products and Assessment – Prescriptive: 2013-2015	7/17/2016	Impact
G	PowerShare Non-Residential Load Curtailment: 2014	1/08/2016	Impact
H	PowerShare Non-Residential Load Curtailment: 2015	4/06/2016	Process and Impact
I	Residential Energy Efficient Appliances and Devices – Save Energy and Water Kit: 2014	4/12/2016	Process and Impact
J	Small Business Energy Saver: 2015	9/27/2016	Process and Impact

Q. HOW WERE EM&V RESULTS UTILIZED IN DEVELOPING THE PROPOSED RIDER 9?

A. The Company has applied EM&V in accordance with the process as agreed upon by DEC, SACE, and the Public Staff and approved by the Commission in its *Order Approving DSM/EE Rider and Requiring Filing of Proposed Customer Notice* issued on November 8, 2011, in Docket No. E-7, Sub 979 ("EM&V Agreement"). In accordance with the Sub 1032

Order, DEC continues to apply EM&V in accordance with the EM&V Agreement.

Actual participation and evaluated load impacts are used prospectively to update net lost revenues estimated for 2016. In addition, the EM&V Agreement provides that initial EM&V results shall be applied retrospectively to program impacts that were based upon estimated impact assumptions derived from industry standards (rather than EM&V results for the program in the Carolinas), in particular the DSM/EE programs initially approved by the Commission in Docket No. E-7, Sub 831 ("Sub 831 Programs"), with the exception of the Non-Residential Smart $aver Custom Rebate Program and the Low Income EE and Weatherization Assistance Program.

For purposes of the vintage true-ups and forecast, initial EM&V results are considered actual results for a program and continue to apply until superseded by new EM&V results, if any. For all new programs and pilots approved after the Sub 831 Programs, DEC will use the initial estimates of impacts until it has EM&V results, which will then be applied retrospectively back to the beginning of the offering and will be considered actual results until a second EM&V is performed.

All program impacts from EM&V apply only to the programs for which the analysis was directly performed, though DEC's new product development may utilize actual impacts and research about EE and conservation behavior directly attributed to existing DEC program offerings.

Since program impacts from EM&V in this Application apply only to the programs for which the analysis was directly performed, there are no costs associated with performing additional EM&V for other measures, other than the original cost for EM&V for these programs. As indicated in previous proceedings, DEC estimates that 5 percent of total portfolio program costs will be required to adequately and efficiently perform EM&V on the portfolio.

The level of EM&V required varies by program and depends on that program's contribution to total portfolio, the duration the program has been in the portfolio without material change, and whether the program and administration is new and different in the energy industry. DEC estimates, however, that no additional costs above 5 percent of total program costs will be associated with performing EM&V for all measures in the portfolio.

Q. WHICH PROGRAMS CONTAIN IMPACT RESULTS BASED ON CAROLINAS-BASED EM&V?

A. The following programs have Carolinas-based EM&V applied and have been provided as Evans Exhibits A through J: Residential Income-Qualified EE and Weatherization Assistance for Residential Neighborhoods Program 2015 (Evans Exhibit A); Residential Multi-Family EE Program 2014-2015 (Evans Exhibit B); Power Manager Load Control Service Program 2015 (Evans Exhibit C); Non-Residential Smart $aver

Energy Efficient Products and Assessment Program - Custom Projects 2013-2015 (Evans Exhibit D); Non-Residential Smart $aver Energy Efficient Products and Assessment Program - Prescriptive 2012-2014 (Evans Exhibit E); Non-Residential Smart $aver Energy Efficient Products and Assessment – Prescriptive 2013-2015 (Evans Exhibit F); PowerShare Non-Residential Load Curtailment 2014 (Evans Exhibit G); PowerShare Non-Residential Load Curtailment 2015 (Evans Exhibit H); Residential Energy Efficient Appliances and Devices – Save Energy and Water Kit 2014-2015 (Evans Exhibit I); and Small Business Energy Saver 2015 (Evans Exhibit J).

VIII. RIDER IMPACTS

Q. HAVE THE PARTICIPATION RESULTS AFFECTED THE VINTAGE 2016 EXPERIENCE MODIFICATION FACTOR?

A. Yes. The EMF in Rider 9 accounts for changes to actual participation relative to the forecasted participation levels utilized in DEC's Vintage 2015 Rider EE. As DEC receives actual participation information, it is then able to update participation-driven actual avoided cost benefits from its DSM/EE programs and the net lost revenues derived from its EE programs. For example, as previously mentioned, the Appliance Recycling Program and Income-Qualified EE and Weatherization Program underperformed relative to their original participation targets. As a result, the EMF will be reduced to reflect the lower costs, net lost revenues, and shared savings incentive associated with these programs. On the other hand, higher-than-expected participation in programs, such as the Energy Assessments, Energy Efficient Appliances and Devices, and My Home Energy Report programs, cause the EMF to reflect higher program costs, net lost revenues, and shared savings incentive. In addition to the above, the EMF is impacted by the application of EM&V results.

Q. HOW WILL EM&V BE INCORPORATED INTO THE VINTAGE 2015 TRUE-UP COMPONENT OF RIDER 9?

A. All of the final EM&V results that have been received by DEC as of December 31, 2016 have been applied prospectively from the first day of the month immediately following the month in which the study participation sample for the EM&V was completed in accordance with the EM&V Agreement. Accordingly, for any program for which DEC has received EM&V results, the per participant impact applied to the projected program participation in Vintage 2016 is based upon the actual EM&V results that have been received.

Q. PLEASE DESCRIBE HOW DEC CALCULATED FOUND REVENUES.

A. Consistent with the Sub 1032 Order and with the "Decision Tree" found in Appendix A of the Commission's February 8, 2011 order in Docket No. E-7, Sub 831, and approved for the new portfolio in the Sub 1032 Order, possible found revenue activities were identified, categorized, and netted against the net lost revenues created by DEC's EE programs. Found revenues may result from activities that directly or indirectly result in an increase in customer demand or energy consumption within DEC's service territory. Load-building activities such as these, however, would not be considered found revenues if they (1) would have occurred regardless of DEC's activity, (2) were a result of a Commission-approved economic development activity not determined to produce found revenues, or (3) were part of an unsolicited request for DEC to engage in an activity that supports efforts to grow the economy. On the other hand, found revenues would occur for load growth that did not fall into the previous categories but was directly or indirectly a result of DEC's activities. Based on the results of this work, all potential found revenue-related activities are identified and categorized in Evans Exhibit 4. Additionally, consistent with the methodology employed and approved in Docket No. E-7, Sub 1073, as discussed in detail in the testimony of Company witness Timothy J. Duff in Docket No. E-7, Sub 1050, DEC also proposes to adjust calculation of found revenues to account for the impacts of activities outside of its EE programs that it undertakes that reduce customer consumption – i.e., "negative found revenues."

Q. PLEASE DISCUSS THE ADJUSTMENT THAT DEC PROPOSES TO MAKE TO ITS FOUND REVENUE CALCULATION TO ACCOUNT FOR NEGATIVE FOUND REVENUES.

A. DEC has begun to aggressively pursue, with its outdoor lighting customers, the replacement of aging Mercury Vapor lights with Light Emitting Diode ("LED") fixtures. By moving customers past the standard High Pressure

Sodium ("HPS") fixture to an LED fixture in this replacement process, DEC is generating significant energy savings. These energy savings, since they come outside of DEC's EE programs, are not captured in DEC's calculation of lost revenues. Since one of the activities that DEC includes in the calculation of found revenues is the increase in consumption from new outdoor lighting fixtures added by DEC, it is logical and symmetrical to count the energy consumption reduction realized in outdoor lighting efficiency upgrades. The Company does not take credit for the entire efficiency gain from replacing Mercury Vapor lights, but rather only the efficiency gain from replacing HPS with LED fixtures. In addition, DEC has not recognized any negative found revenues in excess of the found revenues calculated; in other words, the net found revenues number will never be negative and have the effect of increasing net lost revenue calculations. In Docket No. E-7, Sub 1073, the Commission found inclusion of negative found revenues associated with the Company's initiative to replace Mercury Vapor lighting with LED fixtures in the calculation of net found revenues to be reasonable, and the Company proposes to continue to this practice in Rider 9.

Q. HAS THE OPT-OUT OF NON-RESIDENTIAL CUSTOMERS AFFECTED THE RESULTS FROM THE PORTFOLIO OF APPROVED PROGRAMS?

A. Yes, the opt-out of qualifying non-residential customers has had a negative effect on DEC's overall non-residential impacts. For Vintage 2016, DEC had 3,534 eligible customer accounts opt out of participating in DEC's non-residential portfolio of EE programs. In addition, DEC had 4,284 eligible customer accounts opt out of participating in DEC's non-residential DSM programs. While the total number of opted-out accounts increased from Vintage 2015 to Vintage 2016, it is worth noting that there was a positive increase in the number of accounts that opted into the Vintage 2016 DSM Rider. For comparison, only six eligible customer accounts that were opted-out of the Vintage 2014 DSM Rider then opted into the Vintage 2015 DSM Rider. The number of eligible customer accounts that were opted-out of the Vintage 2015 DSM Rider and then opted into the Vintage 2016 DSM Rider was 72.

Q. PLEASE EXPLAIN THE INCREASE IN THE OPT-OUT IN 2016 COMPARED TO 2015.

A. Because the Company does not take part in the customers' economic benefit analysis or the customers' decision-making process, it is difficult to provide a concrete explanation as to the reason for the increase in opt-outs. As non-residential customers become better equipped at determining the economic benefit of participating in the Company's DSM/EE programs versus the costs associated with opting into the DSM/EE Rider, they are more knowledgeable on the best allocation of their resources. The Company believes this knowledge, coupled with increases to the Rider EE rates, is leading to the increase in eligible customer opt-outs.

Q. IS THE COMPANY CONTINUING ITS EFFORTS TO ATTRACT THE PROGRAM PARTICIPATION OF OPT-OUT ELIGIBLE CUSTOMERS?

A. Yes. Increasing the participation of opt-out eligible customers in EE and DSM programs is very important to the Company. As discussed earlier, DEC continues to evaluate and revise its non-residential portfolio of programs to accommodate new technologies, eliminate product gaps, remove barriers to participation, and make its programs more attractive. It also continues to leverage its Large Account Management Team to make sure customers are informed about product offerings and the March Opt-in Window.

IX. PPI CALCULATION

Q. PLEASE PROVIDE AN OVERVIEW OF THE COST RECOVERY AND INCENTIVE MECHANISM APPROVED IN DOCKET NO. E-7, SUB 1032.

A. Pursuant to the Sub 1032 Order, the Mechanism allows DEC to (1) recover the reasonable and prudent costs incurred for adopting and implementing DSM and EE measures in accordance with N.C. Gen. Stat. § 62-133.9 and Commission Rules R8-68 and R8-69; (2) recover net lost revenues incurred for up to 36 months of a measure's life for EE programs; and (3) earn a PPI based upon the sharing of 11.5% of the net savings achieved through DEC's DSM/EE programs on an annual basis.

Q. PLEASE EXPLAIN HOW DEC DETERMINES THE PPI.

A. First, DEC determines the net savings eligible for incentive by subtracting the present value of the annual lifetime DSM/EE program costs (excluding approved low-income programs as described below) from the net present value of the annual lifetime avoided costs achieved through the Company's programs (again, excluding approved low-income programs). The Company then multiplies the net savings eligible for incentive by the 11.5% shared savings percentage to determine its pretax incentive.

Q. PLEASE EXPLAIN IF DEC EXCLUDES ANY PROGRAMS FROM THE DETERMINATION OF ITS PPI CALCULATION.

A. Consistent with the Sub 1032 Order, DEC has excluded the impacts and costs associated with the Income-Qualified EE and Weatherization Program from its calculation of the PPI. At the time the program was approved, it was not cost-effective, but was approved based on its societal benefit. As such, although DEC is eligible to recover the program costs and 36 months of the net lost revenues associated with the impacts of the program, it does not earn an incentive, and the negative net savings associated with these types of programs is not factored into the calculation of the annual shared savings PPI.

X. <u>REVIEW OF DEC COST RECOVERY MECHANISM</u>

Q. IS DEC'S COST RECOVERY AND INCENTIVE MECHANISM FOR DSM/EE PROGRAMS SUBJECT TO REVIEW AS A PART OF THIS PROCEEDING?

A. Yes. Numbered paragraph 78 of the Mechanism, which was approved in 2013, provides that the "terms and conditions of this Mechanism shall be reviewed by the Commission every four years unless otherwise ordered by the Commission. The Company and other parties shall submit any proposed changes to the Commission for approval at the time of the filing of the Company's annual DSM/EE rider filing. During the time of review, the Mechanism shall remain in effect until further order of the Commission revising the terms of the Mechanism or taking such other action as the Commission may deem appropriate."

Q. IS THE COMPANY PROPOSING ANY CHANGES TO THE MECHANISM AT THIS TIME?

A. While DEC has been attempting to address some ambiguity around the application of changing avoided cost rates through discussions with the Public Staff on a potential refinement to the way avoided costs are applied under the Mechanism, the Company is not proposing any changes to the Mechanism at this time. The Company believes the Mechanism continues to perform as it was designed and provides a meaningful incentive to the Company to aggressively pursue offering its customers cost-effective DSM and EE programs. The Mechanism has resulted in significant energy and capacity savings and has allowed the Company to realize substantial avoided costs savings to the benefit of its customers. In the absence of other proposed changes impacting the Mechanism, the Company requests that the Mechanism, as approved in the Sub 1032 Order, remain in effect until the next time the Commission deems it appropriate to review the Mechanism.

XI. CONCLUSION

Q. DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

Duke Energy Carolinas, LLC
Vintage 2014 True-up for January 1, 2014 to December 31, 2014
Docket Number E-7, Sub 1130
Load Impacts and Estimated Revenue Requirements, excluding Lost Revenue by Program

				A	B	C =(A-B * 11.5%)	D= B+C	E	NC Residential Revenue Requirement
	Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5, pg. 1)	D * E
	EE Programs								
1	Appliance Recycling Program	709	5,100,458	$ 1,763,411	$ 1,515,867	$ 28,468	$ 1,544,335	72.9600473%	$ 1,126,747
2	Energy Efficiency Education	735	6,991,608	5,079,938	1,963,153	358,430	2,321,584	72.9600473%	1,693,829
3	Energy Efficient Appliances and Devices	18,727	168,421,617	52,279,769	14,738,129	4,317,289	19,055,418	72.9600473%	13,902,842
4	HVAC Energy Efficiency	2,509	4,526,177	7,061,500	4,786,807	261,590	5,048,397	72.9600473%	3,683,313
5	Income Qualified Energy Efficiency and Weatherization Assistance	792	3,374,813	1,675,463	1,917,192		1,917,192	72.9600473%	1,398,784
6	Multi-Family Energy Efficiency	965	9,953,578	5,306,321	1,442,533	444,336	1,886,869	72.9600473%	1,376,660
7	Energy Assessments	1,312	10,599,335	12,827,575	3,605,737	1,060,511	4,666,249	72.9600473%	3,404,497
8	Subtotal	25,749	208,967,584	$ 85,993,977	$ 29,969,420	$ 6,470,623	$ 36,440,042		$ 26,586,672
9	My Home Energy Report (1)	39,424	146,011,689	12,166,183	8,285,066	446,328	8,731,394	72.9600473%	6,370,430
10	Total for Residential Energy Efficiency Programs	65,173	354,979,273	$ 98,160,160	$ 38,254,486	$ 6,916,951	$ 45,171,437		**$ 32,957,103**
								NC Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 1)	D11* E11
11	**Total DSM Programs (2)**	781,007	-	113,038,043	$ 31,183,186	$ 9,413,309	$ 40,596,495	34.0209980%	**$ 13,811,333**
12	**Total Residential Revenue Requirement**								**$ 46,768,435**

									NC Non-Residential Revenue Requirement
	Non-Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 1)	D * E
	EE Programs								
13	Non Residential Smart Saver Custom Energy Assessments	1,504	9,128,218	$ 6,858,644	$ 1,458,195	$ 621,052	$ 2,079,247	72.9600473%	$ 1,517,020
14	Non Residential Smart Saver Custom	9,392	78,157,513	49,908,871	8,136,712	4,803,798	12,940,510	72.9600473%	9,441,402
15	Energy Management Information Services	-	-	-	74,855	(8,608)	66,246	72.9600473%	48,333
16	Non Residential Smart Saver Energy Efficient Food Service Products	164	2,340,975	1,489,862	199,350	148,409	347,758	72.9600473%	253,725
17	Non Residential Smart Saver Energy Efficient HVAC Products	1,252	4,669,724	5,224,765	815,339	507,084	1,322,423	72.9600473%	964,841
18	Non Residential Smart Saver Energy Efficient Lighting Products	12,290	70,310,751	40,866,018	6,727,675	3,925,909	10,653,584	72.9600473%	7,772,860
19	Non Residential Smart Saver Energy Efficient Pumps and Drives Products	787	6,487,067	3,629,866	584,874	350,174	935,048	72.9600473%	682,211
20	Non Residential Smart Saver Energy Efficient IT Products	15	124,237	35,580	25,730	1,133	26,863	72.9600473%	19,599
21	Non Residential Smart Saver Energy Efficient Process Equipment Products	159	661,883	660,330	89,809	65,610	155,419	72.9600473%	113,394
22	Small Business Energy Saver	1,021	4,933,143	3,244,797	1,026,607	255,092	1,281,699	72.9600473%	935,128
23	Smart Energy in Offices	4,511	21,673,271	2,363,375	1,156,497	138,791	1,295,288	72.9600473%	945,043
24	Total for Non-Residential Energy Efficiency Programs	31,096	198,486,784	$ 114,282,107	$ 20,295,641	$ 10,808,443	$ 31,104,086		**$ 22,693,556**
								NC Non-Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 1)	D25*E25
25	**Total DSM Programs(2)**	781,007	-	$ 113,038,043	$ 31,183,186	$ 9,413,309	$ 40,596,495	41.2108021%	**$ 16,730,141**
26	**Total Non-Residential Revenue Requirement**								**$ 39,423,697**
								NC Retail Peak Demand Allocation Factor (Miller Exhibit 5 pg. 1)	D30* E30
	Total DSM Program Breakdown								
27	Power Manager (Residential)	398,972	-	$ 57,744,666	$ 15,662,693	$ 4,839,427	$ 20,502,121		
28	Power Share CallOption (Non-Residential)	-	-	$ -	$ -				
29	Power Share (Non-Residential)	382,035	-	$ 55,293,377	$ 15,520,492	$ 4,573,882	$ 20,094,374		
30	Total DSM	781,007	-	$ 113,038,043	$ 31,183,186	$ 9,413,309	$ 40,596,495	75.2318001%	$ 30,541,474

(1) My Home Energy Report impacts reflect cumulative capability as of end of vintage year, including impacts for participants from prior vintage
(2) Total System DSM programs allocated to Residential and Non-Residential based on contribution to retail system peak

Duke Energy Carolinas, LLC
Vintage 2015 True Up for January 1, 2015 to December 31, 2015
Docket Number E-7, Sub 1130
Load Impacts and Estimated Revenue Requirements, excluding Lost Revenue by Program

				A	B	C	D= B+C	E	NC Residential Revenue Requirement
	Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 2)	D * E
	EE Programs								
1	Appliance Recycling Program	748	5,534,546	$ 1,901,321	$ 1,537,241	$ 41,869	$ 1,579,111	72.9564706%	$ 1,152,063
2	Energy Efficiency Education	830	4,417,898	$ 2,498,417	$ 2,054,672	$ 51,031	$ 2,105,702	72.9564706%	$ 1,536,246
3	Energy Efficient Appliances and Devices	14,743	129,350,071	$ 49,525,402	$ 12,050,485	$ 4,309,616	$ 16,360,100	72.9564706%	$ 11,935,752
4	HVAC Energy Efficiency	2,663	4,763,631	$ 6,816,479	$ 5,416,833	$ 160,959	$ 5,577,792	72.9564706%	$ 4,069,360
5	Income Qualified Energy Efficiency and Weatherization Assistance	622	2,864,912	$ 1,586,109	$ 2,238,776	$ -	$ 2,238,776	72.9564706%	$ 1,633,332
6	Multi-Family Energy Efficiency	1,339	13,988,109	$ 7,431,163	$ 2,092,935	$ 613,896	$ 2,706,831	72.9564706%	$ 1,974,808
7	Energy Assessments	1,275	10,293,765	$ 10,115,222	$ 3,086,173	$ 808,341	$ 3,894,514	72.9564706%	$ 2,841,300
8	Subtotal	22,219	171,212,932	$ 79,874,113	$ 28,477,114	$ 5,985,712	$ 34,462,825		$ 25,142,861
9	My Home Energy Report (1)	61,770	228,776,428	$ 16,583,325	$ 9,845,895	$ 774,805	$ 10,620,699	72.9564706%	$ 7,748,487
10	Total for Residential Energy Efficiency Programs	83,989	399,989,360	$ 96,457,439	$ 38,323,008	$ 6,760,516	$ 45,083,525		**$ 32,891,348**
								NC Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 2)	D11* E11
11	**Total DSM Programs (2)**	871,952	41,585	101,127,768	$ 31,958,782	$ 7,954,433	$ 39,913,216	32.5218612%	**$ 12,980,521**
12	**Total Residential Revenue Requirement**								**$ 45,871,869**

									NC Non-Residential Revenue Requirement
	Non-Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 2)	D * E
	EE Programs								
13	Non Residential Smart Saver Custom Energy Assessments	87	765,303	$ 321,686	$ 660,420	$ (38,954)	$ 621,465	72.9564706%	$ 453,399
14	Non Residential Smart Saver Custom	11,108	76,142,627	53,882,448	9,932,877	5,054,201	14,987,078	72.9564706%	10,934,043
15	Non Residential Smart Saver Energy Efficient Food Service Products	1,210	7,532,079	5,414,175	194,425	600,271	794,696	72.9564706%	579,782
16	Non Residential Smart Saver Energy Efficient HVAC Products	1,611	5,405,220	6,221,217	1,142,522	584,050	1,726,572	72.9564706%	1,259,646
17	Non Residential Smart Saver Energy Efficient Lighting Products	11,495	67,523,264	42,387,297	11,335,798	3,570,922	14,906,720	72.9564706%	10,875,417
18	Non Residential Smart Saver Energy Efficient Pumps and Drives Products	423	3,354,574	1,924,058	466,478	167,622	634,100	72.9564706%	462,617
19	Non Residential Smart Saver Energy Efficient IT Products	540	5,196,710	1,130,386	716,542	47,592	764,134	72.9564706%	557,485
20	Non Residential Smart Saver Energy Efficient Process Equipment Products	112	630,354	517,342	88,823	49,280	138,103	72.9564706%	100,755
21	Small Business Energy Saver	14,557	78,030,083	48,339,127	13,968,790	3,952,589	17,921,378	72.9564706%	13,074,805
22	Smart Energy in Offices	7,577	36,403,627	4,060,606	1,463,240	298,697	1,761,937	72.9564706%	1,285,447
23	Business Energy Report				126,404	(14,536)	111,868	72.9564706%	81,615
24	Total for Non-Residential Energy Efficiency Programs	48,721	280,983,841	$ 164,198,342	$ 40,096,318	$ 14,271,733	$ 54,368,051		**39,665,011**
								NC Non-Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 2)	D23*E23
25	**Total DSM Programs(2)**	871,952	41,585	$ 101,127,768	$ 31,958,782	$ 7,954,433	$ 39,913,216	42.4483655%	**$ 16,942,508**
26	**Total Non-Residential Revenue Requirement**								**$ 56,607,519**

	Total DSM Program Breakdown							NC Retail Peak Demand Allocation Factor (Miller Exhibit 5 pg. 2)	D28* E28
27	Power Manager (Residential)	454,663	-	$ 52,718,688	$ 14,634,279	$ 4,379,707	$ 19,013,986		
28	EnergyWise for Business	14	41,585	$ 25,458	$ 1,549,305	$ (175,242)	$ 1,374,062		
29	Power Share CallOption (Non-Residential)	-	-	$ -	$ -	$ -	$ -		
30	Power Share (Non-Residential)	417,276	-	$ 48,383,622	$ 15,779,050	$ 3,749,526	$ 19,528,576		
31	Disallowed Costs from 2015 Program Costs Audit (Order E-7 Sub 1105, dated 8/25/16)				$ (3,851)	$ 443	$ (3,408)		
32	Total DSM	871,952	41,585	101,127,768	31,958,782	7,954,433	39,913,216	74.9702266%	$ 29,923,028

(1) My Home Energy Report impacts reflect cumulative capability as of end of vintage year, including impacts for participants from prior vintage

Duke Energy Carolinas, LLC
Vintage 2016 True Up for January 1, 2016 to December 31, 2016
Docket Number E-7, Sub 1130
Load Impacts and Estimated Revenue Requirements, excluding Lost Revenue by Program

	Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	A System NPV of Avoided Cost	B System Cost	C = (A-B) *11.5% Earned Utility Incentive	D= B+C System Cost Plus Incentive	E NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 3)	NC Residential Revenue Requirement D * E
	EE Programs								
1	Appliance Recycling Program	21	164,720	$ 59,758	$ (97,510)	$ 18,086	$ (79,424)	73.0962827%	$ (58,056)
2	Energy Efficiency Education	1,512	6,441,283	3,695,507	2,128,970	180,152	2,309,121	73.0962827%	1,687,882
3	Energy Efficient Appliances and Devices	14,517	120,218,684	82,253,871	24,097,623	6,687,969	30,785,592	73.0962827%	22,503,123
4	HVAC Energy Efficiency	2,462	6,296,332	7,477,524	7,848,636	(42,678)	7,805,959	73.0962827%	5,705,866
5	Income Qualified Energy Efficiency and Weatherization Assistance	668	4,259,297	2,417,741	4,797,981	-	4,797,981	73.0962827%	3,507,146
6	Multi-Family Energy Efficiency	1,572	16,569,621	9,234,398	2,521,903	771,937	3,293,840	73.0962827%	2,407,674
7	Energy Assessments	1,070	7,389,091	6,822,806	2,681,993	476,194	3,158,186	73.0962827%	2,308,517
8	Subtotal	21,823	161,339,028	$ 111,961,606	$ 43,979,596	$ 8,091,659	$ 52,071,255		$ 38,062,152
9	My Home Energy Report (1)	71,814	283,569,925	20,766,959	10,834,966	1,142,179	11,977,145	73.0962827%	8,754,848
10	Total for Residential Energy Efficiency Programs	93,637	444,908,953	$ 132,728,565	$ 54,814,562	$ 9,233,838	$ 64,048,400		**$ 46,817,000**
								NC Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D11* E11
11	**Total DSM Programs (2)**	826,937	1,626,421	99,361,348	$ 28,439,164	$ 8,156,051	$ 36,595,215	33.7973480%	**$ 12,368,212**
12	**Total Residential Revenue Requirement**								**$ 59,185,212**

	Non-Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 3)	NC Non-Residential Revenue Requirement D * E
	EE Programs								
13	Non Residential Smart Saver Custom Energy Assessments	1,584	16,953,402	$ 9,572,687	$ 2,036,662	$ 866,643	$ 2,903,304	73.0962827%	$ 2,122,208
14	Non Residential Smart Saver Custom	7,362	52,700,579	38,962,406	7,365,020	3,633,699	10,998,720	73.0962827%	8,039,655
15	Non Residential Smart Saver Energy Efficient Food Service Products	356	3,809,316	2,474,312	324,492	247,229	571,722	73.0962827%	417,907
16	Non Residential Smart Saver Energy Efficient HVAC Products	808	3,316,901	3,344,669	1,475,696	214,932	1,690,628	73.0962827%	1,235,786
17	Non Residential Smart Saver Energy Efficient Lighting Products	29,109	170,325,289	121,510,106	39,668,788	9,411,752	49,080,540	73.0962827%	35,876,050
18	Non Residential Smart Saver Energy Efficient Pumps and Drives Products	368	2,494,340	1,574,965	472,476	126,786	599,262	73.0962827%	438,038
19	Non Residential Smart Saver Energy Efficient IT Products	107	2,462,027	777,601	285,760	56,562	342,322	73.0962827%	250,225
20	Non Residential Smart Saver Energy Efficient Process Equipment Products	50	313,131	279,184	126,093	17,606	143,698	73.0962827%	105,038
21	Non Residential Smart Saver Performance Incentive	-	-	-	35,711	(4,107)	31,604	73.0962827%	23,102
22	Small Business Energy Saver	16,266	86,253,784	56,088,677	15,378,625	4,681,656	20,060,281	73.0962827%	14,663,319
23	Smart Energy in Offices	8,453	40,613,364	4,445,551	1,062,957	388,998	1,451,955	73.0962827%	1,061,325
24	Business Energy Report	388	5,561,349	302,497	263,473	4,488	267,961	73.0962827%	195,869
25	Total for Non-Residential Energy Efficiency Programs	64,852	384,803,481	$ 239,332,656	$ 68,495,753	$ 19,646,244	$ 88,141,997		**$ 64,428,523**
								NC Non-Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D24*E24
26	**Total DSM Programs(2)**	826,937	1,626,421	$ 99,361,348	$ 28,439,164	$ 8,156,051	$ 36,595,215	40.8166437%	**$ 14,936,939**
27	**Total Non-Residential Revenue Requirement**								**$ 79,365,462**

	Total DSM Program Breakdown							NC Retail Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D29* E29
28	Power Manager (Residential)	455,393	-	$ 54,179,776	$ 13,660,757	$ 4,659,687	$ 18,320,445	`	
27	EnergyWise for Business (Non-Residential)	2,644	1,626,421	$ 1,292,178	$ 470,848	$ 94,453	$ 565,301		
29	Power Share CallOption (Non-Residential)	-	-	$ -	$ -	$ -	$ -		
30	Power Share (Non-Residential)	368,900	-	$ 43,889,394	$ 14,307,559	$ 3,401,911	$ 17,709,470		
31	Total DSM	826,937	1,626,421	$ 99,361,348	$ 28,439,164	$ 8,156,051	$ 36,595,215	74.6139917%	$ 27,305,151

(1) My Home Energy Report impacts reflect cumulative capability as of end of vintage year, including impacts for participants from prior vintage
(2) Total System DSM programs allocated to Residential and Non-Residential based on contribution to retail system peak

Duke Energy Carolinas, LLC
Vintage 2018 Estimate for January 1, 2018 to December 31, 2018
Docket Number E-7, Sub 1130
Load Impacts and Estimated Revenue Requirements, excluding Lost Revenue by Program

	Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	A System NPV of Avoided Cost	B System Cost	C = (A-B) *11.5% Earned Utility Incentive	D= B+C System Cost Plus Incentive	E NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 3)	NC Residential Revenue Requirement D * E
	EE Programs								
1	Appliance Recycling Program	-	-	$ -	$ -	$ -	$ -	73.0962827%	$ -
2	Energy Efficiency Education	1,316	5,604,364	3,623,116	2,103,036	174,809	2,277,845	73.0962827%	1,665,020
3	Energy Efficient Appliances and Devices	11,726	97,729,231	75,680,728	23,729,947	5,974,340	29,704,287	73.0962827%	21,712,730
4	HVAC Energy Efficiency	1,577	5,359,616	7,022,327	4,379,521	303,923	4,683,444	73.0962827%	3,423,423
5	Income Qualified Energy Efficiency and Weatherization Assistance	820	5,287,477	3,678,480	7,483,328	-	7,483,328	73.0962827%	5,470,035
6	Multi-Family Energy Efficiency	2,197	22,582,141	16,642,851	4,161,326	1,435,375	5,596,701	73.0962827%	4,090,980
7	Energy Assessments	1,145	7,435,992	6,928,380	2,613,893	496,166	3,110,059	73.0962827%	2,273,337
8	Subtotal	18,781	143,998,821	$ 113,575,881	$ 44,471,051	$ 8,384,613	$ 52,855,664		$ 38,635,525
9	My Home Energy Report (1)	77,277	304,386,954	24,656,402	12,472,487	1,401,150	13,873,637	73.0962827%	10,141,113
10	Total for Residential Energy Efficiency Programs	96,058	448,385,775	$ 138,232,283	$ 56,943,538	$ 9,785,763	$ 66,729,301		**$ 48,776,639**
								NC Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D11* E11
11	**Total DSM Programs (2)**	908,363	3,530,072	114,602,691	$ 29,301,500	$ 9,809,637	$ 39,111,137	33.7973480%	**$ 13,218,527**
12	**Total Residential Revenue Requirement**								**$ 61,995,166**

	Non-Residential Programs	System kW Reduction - Summer Peak	System Energy Reduction (kWh)	System NPV of Avoided Cost	System Cost	Earned Utility Incentive	System Cost Plus Incentive	NC Retail kWh Sales Allocation Factor (Miller Exhibit 5 pg. 3)	NC Non-Residential Revenue Requirement D * E
	EE Programs								
13	Non Residential Smart Saver Custom Energy Assessments	2,320	20,322,216	$ 12,569,495	$ 2,141,618	$ 1,199,206	$ 3,340,824	73.0962827%	$ 2,442,018
14	Non Residential Smart Saver Custom	10,881	95,315,609	58,953,664	12,072,548	5,391,328	17,463,876	73.0962827%	12,765,445
15	Non Residential Smart Saver Energy Efficient Food Service Products	120	817,239	696,058	156,944	61,998	218,942	73.0962827%	160,039
16	Non Residential Smart Saver Energy Efficient HVAC Products	2,007	4,345,576	6,216,533	1,822,719	505,289	2,328,008	73.0962827%	1,701,687
17	Non Residential Smart Saver Energy Efficient Lighting Products	12,435	92,350,939	76,143,190	18,461,820	6,633,358	25,095,178	73.0962827%	18,343,642
18	Non Residential Smart Saver Energy Efficient Pumps and Drives Products	305	2,067,770	1,442,220	388,316	121,199	509,515	73.0962827%	372,437
19	Non Residential Smart Saver Energy Efficient IT Products	0	3,823,152	1,572,581	379,927	137,155	517,082	73.0962827%	377,968
20	Non Residential Smart Saver Energy Efficient Process Equipment Products	31	316,290	161,902	67,742	10,828	78,571	73.0962827%	57,432
21	Non Residential Smart Saver Performance Incentive	651	5,706,017	3,529,229	998,804	290,999	1,289,803	73.0962827%	942,798
22	Small Business Energy Saver	17,124	93,135,919	68,772,482	17,602,867	5,884,506	23,487,373	73.0962827%	17,168,397
23	Smart Energy in Offices	8,604	41,339,434	4,666,226	1,244,723	393,473	1,638,196	73.0962827%	1,197,460
24	Business Energy Report	353	5,051,658	271,460	195,505	8,735	204,240	73.0962827%	149,292
25	Total for Non-Residential Energy Efficiency Programs	54,831	364,591,820	$ 234,995,040	$ 55,533,534	$ 20,638,073	$ 76,171,607		**$ 55,678,613**
								NC Non-Residential Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D24*E24
26	**Total DSM Programs(2)**	908,363	3,530,072	$ 114,602,691	$ 29,301,500	$ 9,809,637	$ 39,111,137	40.8166437%	**$ 15,963,853**
27	**Total Non-Residential Revenue Requirement**								**$ 71,642,466**

	Total DSM Program Breakdown							NC Retail Peak Demand Allocation Factor (Miller Exhibit 5 pg. 3)	D29* E29
28	Power Manager (Residential)	503,304	-	$ 63,087,336	$ 12,175,733	$ 5,854,834	$ 18,030,568		
27	EnergyWise for Business (Non-Residential)	17,034	3,530,072	$ 3,130,792	$ 2,170,686	$ 110,412	$ 2,281,098		
29	Power Share CallOption (Non-Residential)	-	-	$ -	$ -	$ -	$ -		
30	Power Share (Non-Residential)	388,025	-	$ 48,384,563	$ 14,955,081	$ 3,844,390	$ 18,799,471		
31	Total DSM	908,363	3,530,072	$ 114,602,691	$ 29,301,500	$ 9,809,637	$ 39,111,137	74.6139917%	$ 29,182,380

(1) My Home Energy Report impacts reflect cumulative capability as of end of vintage year, including impacts for participants from prior vintage
(2) Total System DSM programs allocated to Residential and Non-Residential based on contribution to retail system peak

Duke Energy Carolinas, LLC
For the Period January 1, 2016 - December 31, 2016
Docket Number E-7, Sub 1130
North Carolina Net Lost Revenue Estimates for Vintages 2014 - 2018

Vintage 2014

Line	Residential	2014	2015	2016	2017[a]	2018	Total
1	Energy Assessments	$ 310,196	$ 500,880	$ 501,062	$ 190,675		$ 1,502,813
2	My Home Energy Report	6,638,564	-	-	-		6,638,564
3	Energy Efficient Appliances and Devices	3,921,239	8,151,532	8,153,160	3,968,600		24,194,531
4	HVAC Energy Efficiency	117,000	219,684	219,716	122,471		678,870
5	Appliance Recycle Program	107,895	256,674	256,774	133,279		754,622
6	Income Qualified Energy Efficiency and Weatherization Assistance	85,575	159,286	159,365	75,709		479,936
7	Multi-Family Energy Efficiency	179,326	500,657	500,420	337,939		1,518,341
8	Energy Efficiency Education	130,480	321,732	321,839	176,708		950,758
9	Total Lost Revenues	11,490,275	10,110,444	10,112,335	5,005,380	-	36,718,433
10	Found Residential Revenues *						-
11	Net Lost Residential Revenues	**$ 11,490,275**	**$ 10,110,444**	**$ 10,112,335**	**$ 5,005,380**	**$ -**	**$ 36,718,433**

Line	Non-Residential	2014	2015	2016	2017[a]	2018	Total
12	Nonresidential Smart Saver Custom Energy Assessments	$ 166,013	$ 225,057	$ 224,335	$ 51,043		$ 666,448
13	Non Residential Smart Saver Custom	1,188,092	1,945,285	1,939,985	743,821		5,817,183
14	Energy Management Information Systems	-	-	-	-		-
15	Non Residential Smart Saver Energy Efficient Food Service Products	44,169	74,304	74,379	36,422		229,274
16	Non Residential Smart Saver Energy Efficient HVAC Products	98,437	173,947	173,807	73,619		519,810
17	Non Residential Smart Saver Energy Efficient Lighting Products	1,308,771	2,404,636	2,328,275	1,122,841		7,164,524
18	Non Residential Smart Saver Energy Efficient Pumps and Drives Products	94,422	169,075	169,026	103,506		536,029
19	Non Residential Smart Saver Energy Efficient IT Products	419	3,025	3,013	2,327		8,784
20	Non Residential Smart Saver Energy Efficient Process Equipment Products	19,578	29,107	28,991	18,041		95,717
21	Smart Business Energy Saver	20,511	245,550	246,497	172,896		685,454
22	Smart Energy in Offices	139,995	798,049	-	825,755		1,763,799
23	Total Lost Revenues	3,080,408	6,068,035	5,188,307	3,150,271	-	17,487,021
24	Found Non-Residential Revenues *	1,473					1,473
25	Net Lost Non-Residential Revenues	**$ 3,078,935**	**$ 6,068,035**	**$ 5,188,307**	**$ 3,150,271**	**$ -**	**$ 17,485,548**

Vintage 2015

Line	Residential	2014	2015	2016	2017[a]	2018	Total
26	Residential Energy Assessments		$ 283,810	$ 477,755	$ 479,509	$ 192,780	$ 1,433,854
27	My Home Energy Report		10,047,270	-	-	-	10,047,270
28	Energy Efficient Appliances and Devices		3,690,801	6,169,189	6,059,875	2,465,287	18,385,152
29	HVAC Energy Efficiency		132,091	234,971	235,585	102,323	704,971
30	Appliance Recycle Program		150,790	279,847	281,052	128,296	839,985
31	Income Qualified Energy Efficiency and Weatherization Assistance		65,602	135,872	132,791	69,865	404,130
32	Multi-Family Energy Efficiency		336,658	681,177	680,181	343,112	2,041,127
33	Energy Efficiency Education		89,806	220,573	221,372	129,974	661,725
34	Total Lost Revenues		14,796,828	8,199,384	8,090,365	3,431,636	34,518,212
35	Found Residential Revenues *						-
36	Net Lost Residential Revenues		**$ 14,796,828**	**$ 8,199,384**	**$ 8,090,365**	**$ 3,431,636**	**$ 34,518,212**

Line	Non-Residential	2014	2015	2016	2017[a]	2018	Total
37	Nonresidential Smart Saver Custom Energy Assessments		$ 5,659	$ 22,194	$ 22,737	$ 16,388	$ 66,978
38	Non Residential Smart Saver Custom		1,430,029	2,470,784	2,511,341	1,029,605	7,441,759
39	Energy Management Information Services		-	-	-	-	-
40	Non Residential Smart Saver Energy Efficient Food Service Products		52,180	284,070	288,740	229,533	854,523
41	Non Residential Smart Saver Energy Efficient HVAC Products		110,198	197,505	200,180	86,454	594,337
42	Non Residential Smart Saver Energy Efficient Lighting Products		1,437,746	2,405,896	2,371,512	904,353	7,119,506
43	Non Residential Smart Saver Energy Efficient Pumps and Drives Products		51,265	82,153	118,968	30,654	283,040
44	Non Residential Smart Saver Energy Efficient IT Products		58,585	173,258	177,273	113,631	522,747
45	Non Residential Smart Saver Energy Efficient Process Equipment Products		14,723	25,414	35,411	10,545	86,093
46	Smart Business Energy Saver		1,845,652	3,623,187	2,802,670	1,762,026	10,033,534
47	Smart Energy in Offices		438,392	963,050	954,597	-	2,356,039
48	EnergyWise for Business		-	-	-	-	
49	Total Lost Revenues		5,444,429	10,247,511	9,483,428	4,183,188	29,358,556
50	Found Non-Residential Revenues *						-
51	Net Lost Non-Residential Revenues		**$ 5,444,429**	**$ 10,247,511**	**$ 9,483,428**	**$ 4,183,188**	**$ 29,358,556**

Line	Residential	2014	Vintage 2016 2015	2016	2017(a)	2018	Total
52	Residential Energy Assessments			$ 193,362	$ 365,002	$ 337,681	$ 896,046
53	My Home Energy Report			13,052,806	-	-	13,052,806
54	Energy Efficient Appliances and Devices			2,665,196	3,970,834	5,806,762	12,442,793
55	HVAC Energy Efficiency			132,583	-	335,533	468,116
56	Appliance Recycle Program			5,096	327,591	8,172	340,859
57	Income Qualified Energy Efficiency and Weatherization Assistance			99,159	268,624	209,692	577,475
58	Multi-Family Energy Efficiency			378,234	527,652	765,524	1,671,410
59	Energy Efficiency Education			142,691	264,212	301,958	708,861
60	Total Lost Revenues		-	16,669,126	5,723,916	7,765,323	30,158,365
61	Found Residential Revenues *						-
62	Net Lost Residential Revenues		**$ -**	**$ 16,669,126**	**$ 5,723,916**	**$ 7,765,323**	**$ 30,158,365**

	Non-Residential	2014	2015	2016	2017(a)	2018	Total
63	Nonresidential Smart Saver Custom Energy Assessments			$ 199,079	$ 347,624	$ 391,534	$ 938,237
64	Non Residential Smart Saver Custom			905,212	2,558,214	1,688,954	5,152,380
65	Energy Management Information Services			-	-	-	-
66	Non Residential Smart Saver Energy Efficient Food Service Products			25,112	109,628	67,001	201,741
67	Non Residential Smart Saver Energy Efficient HVAC Products			46,789	193,142	103,312	343,242
68	Non Residential Smart Saver Energy Efficient Lighting Products			2,934,384	2,070,736	6,576,250	11,581,370
69	Non Residential Smart Saver Energy Efficient Pumps and Drives Products			37,771	124,718	65,494	227,983
70	Non Residential Smart Saver Energy Efficient IT Products			59,904	92,546	75,765	228,216
71	Non Residential Smart Saver Energy Efficient Process Equipment Products			4,731	25,844	10,677	41,252
72	Small Business Energy Saver			2,142,080	2,542,422	4,313,008	8,997,510
73	Smart Energy in Offices			546,646	202,104	-	748,749
74	Business Energy Report			331,618	-	-	331,618
75	EnergyWise for Business			36,035	42,467	83,192	161,694
76	Total Lost Revenues			7,269,361	8,309,444	13,375,187	28,953,993
77	Found Non-Residential Revenues *						-
78	Net Lost Non-Residential Revenues			$ 7,269,361	$ 8,309,444	$ 13,375,187	$ 28,953,993

Line	Residential	2014	Vintage 2017 2015	2016	2017(a)	2018	Total
78	Residential Energy Assessments				$ 191,626	$ -	$ 191,626
79	My Home Energy Report				10,414,784	-	10,414,784
80	Energy Efficient Appliances and Devices				1,518,576	3,085,375	4,603,951
81	HVAC Energy Efficiency						-
82	Appliance Recycle Program				-	-	-
83	Income Qualified Energy Efficiency and Weatherization Assistance				122,111	249,170	371,280
84	Multi-Family Energy Efficiency				319,916	605,213	925,129
85	Energy Efficiency Education				132,106	262,244	394,350
86	Total Lost Revenues		-	-	12,699,119	4,202,002	16,901,121
87	Found Residential Revenues *						-
88	Net Lost Residential Revenues		**$ -**	**$ -**	**$ 12,699,119**	**$ 4,202,002**	**$ 16,901,121**

	Non-Residential	2014	2015	2016	2017(a)	2018	Total
89	Nonresidential Smart Saver Custom Energy Assessments				$ 182,503	$ 383,160	$ 565,663
90	Non Residential Smart Saver Custom				1,349,462	2,833,159	4,182,621
91	Energy Management Information Services				-	-	-
92	Non Residential Smart Saver Energy Efficient Food Service Products				57,555	117,567	175,122
93	Non Residential Smart Saver Energy Efficient HVAC Products				99,640	188,797	288,437
94	Non Residential Smart Saver Energy Efficient Lighting Products				1,087,136	1,870,239	2,957,375
95	Non Residential Smart Saver Energy Efficient Pumps and Drives Products				65,477	98,438	163,915
96	Non Residential Smart Saver Energy Efficient IT Products				48,587	102,038	150,624
97	Non Residential Smart Saver Energy Efficient Process Equipment Products				13,568	13,834	27,402
98	Small Business Energy Saver				1,102,111	2,937,757	4,039,868
99	Smart Energy in Offices				1,812,965	854,649	2,667,614
100	Business Energy Report				188,577	-	188,577
101	EnergyWise for Business				32,311	67,231	99,542
102	Total Lost Revenues			-	6,039,892	9,466,867	15,506,759
103	Found Non-Residential Revenues *						-
104	Net Lost Non-Residential Revenues			$ -	$ 6,039,892	$ 9,466,867	$ 15,506,759

* Found Revenues - See Evans Exhibit 4

(a) Lost revenues were estimated by applying forecasted lost revenue rates for residential and non-residential customers to state specific forecasted program participation.

Vintage 2018

Line	**Residential**	**2014**	**2015**	**2016**	**2017**[(a)]	**2018**	**Total**
105	Residential Energy Assessments					$ 189,591	$ 189,591
106	My Home Energy Report					15,916,706	15,916,706
107	Energy Efficient Appliances and Devices					2,465,108	2,465,108
108	HVAC Energy Efficiency					145,909	145,909
109	Appliance Recycle Program					-	-
110	Income Qualified Energy Efficiency and Weatherization Assistance					131,969	131,969
111	Multi-Family Energy Efficiency					624,158	624,158
112	Energy Efficiency Education					139,276	139,276
113	Total Lost Revenues		-	-	-	19,612,717	19,612,717
114	Found Residential Revenues *						-
115	Net Lost Residential Revenues		**$ -**	**$ -**	**$ -**	**$ 19,612,717**	**$ 19,612,717**

	Non-Residential	**2014**	**2015**	**2016**	**2017**[(a)]	**2018**	**Total**
116	Nonresidential Smart Saver Custom Energy Assessments					$ 263,062	$ 263,062
117	Non Residential Smart Saver Custom					1,286,383	1,286,383
118	Energy Management Information Services					-	-
119	Non Residential Smart Saver Energy Efficient Food Service Products					10,829	10,829
120	Non Residential Smart Saver Energy Efficient HVAC Products					59,787	59,787
121	Non Residential Smart Saver Energy Efficient Lighting Products					1,215,496	1,215,496
122	Non Residential Smart Saver Energy Efficient Pumps and Drives Products					25,728	25,728
123	Non Residential Smart Saver Energy Efficient IT Products					48,416	48,416
124	Non Residential Smart Saver Energy Efficient Process Equipment Products					4,509	4,509
125	Non Residential Smart Saver Performance Incentive					77,007	77,007
125	Small Business Energy Saver					1,280,808	1,280,808
126	Smart Energy in Offices					707,291	707,291
127	Business Energy Report					140,256	140,256
128	EnergyWise for Business					47,682	47,682
129	Total Lost Revenues			-	-	5,167,253	5,167,253
130	Found Non-Residential Revenues *						-
131	Net Lost Non-Residential Revenues			$ -	$ -	$ 5,167,253	$ 5,167,253

* Found Revenues - See Evans Exhibit 4

(a) Lost revenues were estimated by applying forecasted lost revenue rates for residential and non-residential customers to state specific forecasted program participation.

Duke Energy Carolinas, LLC
For the Period January 1, 2016 - December 31, 2016
Docket Number E-7 Sub 1130
Actual Program Costs for Vintage Years 2016

		Carolinas System - 12 Months Ended 12/31/2014	Revised Carolinas System - 12 months Ended 12/31/2015	Revised Carolinas System - 12 months Ended 12/31/2016
1	Residential Energy Assessments	$ 3,605,737	$ 3,086,173	2,681,993
2	My Home Energy Report	8,285,066	9,845,895	10,834,966
3	Energy Efficient Appliances and Devices	14,738,129	12,050,485	24,097,623
4	HVAC Energy Efficiency	4,786,807	5,416,833	7,848,636
5	Appliance Recycle Program	1,515,867	1,537,241	(97,510)
6	Income Qualified Energy Efficiency and Weatherization Assistance	1,917,192	2,238,776	4,797,981
7	Multi family Energy Efficiency	1,442,533	2,092,935	2,521,903
8	Energy Efficiency Education	1,963,153	2,054,672	2,128,970
9	Nonresidential Smart Saver Custom Energy Assessments	1,458,195	660,420	2,036,662
10	Energy Management Information Systems	74,855	-	
11	Non-Residential Smart Saver Custom	8,136,712	9,932,877	7,365,020
12	Non-Residential Smart Saver Performance Incentive			35,711
13	Non-Residential Energy Efficient Food Service Products	199,350	194,425	324,492
14	Non-Residential Smart Saver Energy Efficient HVAC Products	815,339	1,142,522	1,475,696
15	Non-Residential Smart Saver Energy Efficient Lighting Products	6,727,675	11,335,798	39,668,788
16	Nonresidential Energy Efficient Pumps and Drives Products	584,874	466,478	472,476
17	Nonresidential Energy Efficient ITEE	25,730	716,542	285,760
18	Nonresidential Energy Efficient Process Equipment Products	89,809	88,823	126,093
19	Smart Energy In Offices	1,156,497	1,463,240	1,062,957
20	Small Business Energy Saver	1,026,607	13,968,790	15,378,625
21	Business Energy Report	-	126,404	263,473
22	Power Manager	15,662,693	14,634,279	13,660,757
23	EnergyWise for Business	-	1,549,305	470,848
24	Power Share	15,520,492	15,779,050	14,307,559
25	**Total Energy Efficiency & Demand Side Program Costs**	**$ 89,733,313**	**$ 110,381,960**	**$ 151,749,480**

26	NC Allocation Factor for EE programs	72.9600473%	72.9564706%	73.0962827%
27	NC Allocation Factor for DSM programs-Residential	34.0209980%	32.5218612%	33.7973480%
28	NC Allocation Factor for DSM programs-Non-Residential	41.2108021%	42.4483655%	40.8166437%

		NC Allocated - 12 Months Ended 12/31/2014	NC Allocated - 12 Months Ended 12/31/2015	NC Allocated - 12 Months Ended 12/31/2016
29	Residential Energy Assessments	$ 2,630,748	$ 2,251,563	$ 1,960,437
30	My Home Energy Report	6,044,788	7,183,217	7,919,957
31	Energy Efficient Appliances and Devices	10,752,946	8,791,608	17,614,467
32	HVAC Energy Efficiency	3,492,457	3,951,930	5,737,061
33	Appliance Recycle Program	1,105,977	1,121,517	(71,276)
34	Income Qualified Energy Efficiency and Weatherization Assistance	1,398,784	1,633,332	3,507,146
35	Multi family Energy Efficiency	1,052,473	1,526,931	1,843,417
36	Energy Efficiency Education	1,432,317	1,499,016	1,556,198
37	Nonresidential Smart Saver Custom Energy Assessments	1,063,900	481,819	1,488,724
38	Energy Management Information Systems	54,614	-	-
39	Non-Residential Smart Saver Custom	5,936,549	7,246,677	5,383,556
40	Non-Residential Smart Saver Performance Incentive			26,103
41	Non-Residential Energy Efficient Food Service Products	145,446	141,845	237,192
42	Non-Residential Smart Saver Energy Efficient HVAC Products	594,872	833,543	1,078,679
43	Non-Residential Smart Saver Energy Efficient Lighting Products	4,908,515	8,270,198	28,996,409
44	Nonresidential Energy Efficient Pumps and Drives Products	426,724	340,326	345,362
45	Nonresidential Energy Efficient ITEE	18,773	522,764	208,880
46	Nonresidential Energy Efficient Process Equipment Products	65,525	64,802	92,169
47	Smart Energy In Offices	843,781	1,067,528	776,982
48	Small Business Energy Saver	749,013	10,191,136	11,241,203
49	Business Energy Report	-	92,220	192,589
50	Power Manager	10,608,831	10,394,843	9,611,683
51	EnergyWise for Business		1,213,062	369,834
52	Power Share	12,850,841	12,354,553	11,238,078
51	**Total Energy Efficiency & Demand Side Program Costs**	**$ 66,177,873**	**$ 81,174,431**	**$ 111,354,852**

Evans Exhibit 4, page 1

Duke Energy Carolinas, LLC
January 2014 - December 2016 Actuals
January 2017 - December 2018 Estimates
Docket Number E-7, Sub 1130
North Carolina Found Revenues

	Actual/ Reported KWH			Estimated KWH			
	2014	2015	2016	2017	2018	Total	Decision Tree Node
Economic Development	166,234,550	464,610,000	271,322,290	-	-	902,166,840	Box 5 - exclude
Plug-in Electric Charging Station Pilot	238,696	-	-	-	-	238,696	Box 3 - exclude
Lighting							
Residential	105,354	90,653	90,608	90,608	90,608	467,831	Box 6 - include
Non Residential (Regulated)	95,391	76,081	96,691	96,691	96,691	461,545	Box 6 - include
MV to LED Credit - Residential (Regulated)	(156,381)	(171,375)	(189,823)	(546,182)	(546,182)	(1,609,943)	Box 6 - include
MV to LED Credit - Non-Residential (Regulated)	(104,331)	(160,589)	(173,799)	(500,076)	(500,076)	(1,438,871)	Box 6 - include
Total KWH	166,413,279	464,444,770	271,145,967	(858,959)	(858,959)	900,286,098	
Total KWH Included	(59,967)	(165,230)	(176,323)	(858,959)	(858,959)	(2,119,438)	
Total KWH Included (net of Free Riders 15%)	(50,972)	(140,446)	(149,875)	(730,115)	(730,115)	(1,801,522)	
Annualized Found Revenue - Non Residential	$ (3,701)	$ (37,913)	$ (40,823)	$ (213,562)	$ (213,562)	$ (509,561)	
Annualized Found Revenue - Residential	$ (34,952)	$ (55,340)	$ (67,983)	$ (314,947)	$ (314,947)	$ (788,170)	

	2014	2015	2016	2017	2018	Total
Vintage 2014 - Non Res	1,473	(3,701)	(3,701)	(5,173)		(11,102)
Vintage 2015 - Non Res		(21,596)	(37,913)	(37,913)	(16,317)	(113,738)
Vintage 2016 - Non Res			(21,749)	(40,823)	(40,823)	(103,395)
Vintage 2017 - Non Res				(115,680)	(213,562)	(329,242)
Vintage 2018 - Non Res					(115,680)	(115,680)
Net Negative Found Revenues to Zero*	-	25,296	63,362	199,589	386,382	674,629
Subtotal - Non Res	$ 1,473	$ -	$ -	$ -	$ -	$ 1,473
Vintage 2014 - Res	(12,947)	(34,952)	(34,952)	(22,005)		(104,857)
Vintage 2015 - Res		(32,355)	(55,340)	(55,340)	(22,985)	(166,020)
Vintage 2016 - Res			(38,231)	(67,983)	(67,983)	(174,197)
Vintage 2017 - Res				(170,596)	(314,947)	(485,543)
Vintage 2018 - Res					(170,596)	
Net Negative Found Revenues to Zero*	12,947	67,307	128,523	315,925	576,512	1,101,214
Subtotal - Residential	$ -	$ -	$ -	$ -	$ -	$ -
Total Found Revenues	$ 1,473	$ -	$ -	$ -	$ -	$ 1,473

* Eliminates the inclusion of total negative found revenues at the Residential and Non-Residential level

Duke Energy Carolinas
System Event Based Demand Response January 1, 2016 - December 31, 2016
Docket Number E-7, Sub 1130

Date	State	Program Name	Event Trigger	High / Low System Temp (F)	Customers Notified /Switches Dispatched	MW Reduction
6/23/2016	NC and SC	Power Manager	Economic, Low Reserves	94 / 76	185,744 / 222,898	219.9
7/13/2016	NC and SC	PowerShare Mandatory	Emergency, Low Reserves	93 / 71	168	302.2
7/13/2016	NC and SC	PowerShare Generator	Emergency, Low Reserves	93 / 71	13	11.9
7/13/2016	NC	Interruptible Service (IS)	Emergency, Low Reserves	93 / 71	50	115.1
7/13/2016	NC	Standby Generator (SG)	Emergency, Low Reserves	93 / 71	24	10.7
7/14/2016	NC and SC	Power Manager	Emergency, Low Reserves	96 / 72	186,504 / 223,788	220.8
7/14/2016	NC and SC	PowerShare Mandatory	Emergency, Low Reserves	96 / 72	168	315.8
7/14/2016	NC and SC	PowerShare Generator	Emergency, Low Reserves	96 / 72	13	11.8
7/14/2016	NC	Interruptible Service (IS)	Emergency, Low Reserves	96 / 72	50	122.8
7/14/2016	NC	Standby Generator (SG)	Emergency, Low Reserves	96 / 72	24	8.6
7/25/2016	NC and SC	PowerShare Mandatory	Emergency, Low Reserves	97 / 76	168	326.5
7/25/2016	NC and SC	PowerShare Generator	Emergency, Low Reserves	97 / 76	13	10.2
7/25/2016	NC	Interruptible Service (IS)	Emergency, Low Reserves	97 / 76	50	121.4
7/25/2016	NC	Standby Generator (SG)	Emergency, Low Reserves	97 / 76	24	8.5
7/26/2016	NC and SC	PowerShare Mandatory	Emergency, Low Reserves	94 / 76	168	328.8
7/26/2016	NC and SC	PowerShare Generator	Emergency, Low Reserves	94 / 76	13	10.1
7/26/2016	NC	Interruptible Service (IS)	Emergency, Low Reserves	94 / 76	50	121.6
7/26/2016	NC	Standby Generator (SG)	Emergency, Low Reserves	94 / 76	24	8.1
9/8/2016	NC and SC	Power Manager	Economic, Low Reserves	93 / 68	189,396 / 227,222	179.9
9/19/2016	NC and SC	Power Manager	Economic, Low Reserves	87 / 73	190,306 / 228,381	150.2

Notes:
- The 'High Temperature' is the average of the daily high temperatures from 3 weather stations (Charlotte, Greensboro, Greenville/Spartanburg)
- 'Customers Notified' is the number of participants notified to participate in the event
- 'Switches Dispatched' values represent the monthly active switch counts
- 'MW Reduction' values are based on the average across all hours of the event
- A loss adjustment of 1.0622 has been included in the 'MW Reduction' values.

A. Description

During the first quarter 2017 Duke Energy Carolinas Collaborative meeting, Duke Energy Carolinas, LLC (the "Company") will provide an update on the performance of its energy efficiency and demand side management programs/pilots for the timeframe of January 2016 thru December 2016. The Company's product managers prepared reports on each program/pilot describing the offerings and detailing each program's performance. This Executive Summary describes how the Company performed in regards to the energy efficiency and demand side management program/pilot performance at an aggregate level during the full year of Vintage 2016 in comparison to as filed information. Program-specific details are provided in the individual reports.

Program reports include:

Program	Category	Customer
Appliance Recycling Program	EE	Residential
Energy Assessments	EE	Residential
Energy Efficient Appliances and Devices	EE	Residential
Energy Efficiency Education Programs	EE	Residential
HVAC Energy Efficiency Program	EE	Residential
Income Qualified Energy Efficiency and Weatherization Assistance	EE	Residential
My Home Energy Report	EE	Residential
Multi-Family Energy Efficiency	EE	Residential
Business Energy Reports	EE	Non-residential
Non-Residential Smart $aver Prescriptive	EE	Non-residential
Non-Residential Smart $aver Custom	EE	Non-residential
Non-Residential Smart $aver Custom Assessment	EE	Non-residential
Non-Residential Smart $aver Performance Incentive	EE	Non-residential
Small Business Energy Saver	EE	Non-residential
Smart Energy in Offices	EE	Non-residential
EnergyWise for Business	EE/DSM	Non-residential
Power Manager	DSM	Residential
PowerShare	DSM	Non-residential

Audience

All retail Duke Energy Carolinas customers who have not opted out.

B &C. Impacts, Participants and Expenses

The tables below include actual results for the full year of Vintage 2016 in comparison to as filed data for Vintage 2016.

The Company includes the number of units achieved and a percentage comparison to the as filed values. The unit of measure varies by measure as a participant, for example, may be a single CFL bulb, a kW, a kWh, a household or a square foot. Due to the multiple measures in a given program or programs, units may appear skewed and are not easily comparable.

Carolinas System Summary[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$339.2	$471.4	139%
Program Cost	$123.8	$151.7	123%
MW[2]	1,048.0	985.4	94%
MWH	591,014.9	831,338.9	141%
Units	122,678,112	128,265,465	105%

1) Numbers rounded.

2) As filed MW are annual maximum peak. Coincident peak is tracked for impacts.

Carolinas Energy Efficiency Summary[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$234.2	$372.1	159%
Program Cost	$92.6	$123.3	133%
MW[2]	119.0	158.5	133%
MWH	591,014.9	829,712.4	140%
Units	121,803,507	127,486,396	105%

1) Numbers rounded.

2) As filed MW are annual maximum peak. Coincident peak is tracked for impacts.

Carolinas Demand Response Summary[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$105.0	$99.4	95%
Program Cost	$31.2	$28.4	91%
MW[2]	929.0	826.9	89%
MWH	N/A	1,626.4	-
Units[3]	874,605	779,069	89%

1) Numbers rounded.

2) MW capability derived by taking the average over the PowerShare and PowerManager contract periods.

3) Units included in filing represented kW at meter, rather than number of participants. YTD value reflects average participation for 2016.

4) Numbers rounded.

D. Qualitative Analysis

The Company includes the number of units achieved and a percentage comparison to the as filed values. The unit of measure varies by measure as a participant, for example, may be a single CFL bulb, a kW, a kWh, a household or a square foot. Due to the multiple measures in a given program or programs, units may appear skewed and are not easily comparable.

Energy efficiency impacts have primarily been driven by lighting measures for both residential and non-residential customers. This is a result of a higher take-rate for lighting offerings than originally projected.

Highlights

Energy Efficiency

Customer participation continues to be largely driven by lighting and assessments programs. These measures provide customers with a relatively low cost efficiency upgrade, with minimal hassle, creating a positive initial energy efficiency experience.

Demand Side Management (DSM)

The DSM portfolio is comprised of PowerShare (non-residential), Power Manager (residential), and EnergyWise for Business (non-residential) programs. The impacts and participation were very close to the 2016 As-Filed targets.

Issues

There have been a number of program specific issues that have negatively impacted the following programs: Appliance Recycling Program, Income Qualified Energy Efficiency and Weatherization Assistance and Non-Residential Smart $aver Custom Assessment. The Residential HVAC Energy Efficiency Program had previously struggled to achieve participation and impact targets. Modifications to this program were implemented in the first half of 2016 and the program has seen improvement in its cost-effectiveness scores.

Potential Changes

Several programs are reviewing their current processes and are considering potential changes to increase customer adoption. Potential changes are discussed in individual program reports.

E. Marketing Strategy

Located in individual reports.

F. Evaluation, Measurement and Verification

Located in individual program reports.

A. Description

The Appliance Recycling Program ("Program") promotes the removal and responsible disposal of operating refrigerators and freezers from Duke Energy Carolinas, LLC's (the "Company's") residential customers. The refrigerator or freezer must have a capacity of at least 10 cubic feet but not more than 30 cubic feet. The Program recycles approximately 95% of the material from the harvested appliances.

Audience

Eligible Program participants include the Company's residential customers who own operating refrigerators and freezers used in individually metered residences.

B &C. Impacts, Participants and Expenses

Appliance Recycling[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$2.2**	**$0.1**	**3%**
Program Cost	**$1.8**	**($0.1)**	**-6%**
MW	**0.8**	**0.0**	**3%**
MWH	**5,655.1**	**164.7**	**3%**
Units	**10,710**	**263**	**2%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

Continued support to service customers who were impacted with the abrupt closure of the Program in late, 2015. Participation received in 2016 was due to pickup of appliances from canceled appointments for DEC customers (total appliances; Refrigerators and Freezers) and any uploads not previously recorded for the program by the vendor. At this time, we believe all impacted customers have been addressed.

Issues

During 2016, the Program was primarily focused on servicing customers with canceled appointments and reissuing incentive payments to customers who were not paid or who received bounced incentive check from JACO. Additionally, the Company is reviewing all data submitted by JACO and will submit any participation records that were not processed by JACO prior to the receivership.

Potential Changes

No Changes at this time.

E. Marketing Strategy

No Marketing efforts were performed.

F. Evaluation, Measurement and Verification

No evaluation activities were conducted in 2016.

A. Description

The Energy Efficient Appliances and Devices program ("Program") offers a variety of measures that allow eligible Duke Energy Carolinas, LLC (the "Company") customers to take action and reduce energy consumption. The Program includes offers for lighting measures, pool pumps, heat pumps water heaters and water measures.

Free LED Program

The Free LED (Light Emitting Diode) program launched in January 2016, replacing the Free CFL program. It is designed to increase the energy efficiency of residential customers by offering customers LEDs to install in high-use fixtures within their homes.

The LEDs are offered through multiple channels to eligible customers. The on-demand ordering platform, which launched on June 18th, enables eligible customers to request LEDs and have them shipped directly to their homes. Eligibility is based on past campaign participation (i.e., coupons, Business Reply Cards ("BRCs") and other Company programs offering lighting). Bulbs are available in 3, 6, 8, 12 and 15 pack kits that contain 9 watt A19 LED bulbs. The maximum number of bulbs available for each household is 15, but customers may choose to order less.

Customers have the flexibility to order and track their shipment through three separate channels:

1) Telephone: Customers may call a toll-free number to access the Interactive Voice Response ("IVR") system, which provides prompts to facilitate the ordering process. The IVR is designed to handle request for both English and Spanish-speaking customers. Customers may easily validate their account, determine their eligibility and order their LEDs over the phone.

2) The Company's Web Site: Customers can go online to order LEDs. Eligibility requirements and frequently asked questions are also available.

3) Online Services ("OLS"): Customers enrolled in the Company's Online Services may order LEDs through the Company's web site, if they are eligible.

Specialty Lighting

The Duke Energy Savings Store ("Store") is an extension of the on-demand ordering platform enabling eligible customers to purchase specialty bulbs and have them shipped directly to their homes. The Store launched on April 26, 2013 and offers a variety of CFLs and Light Emitting Diodes lamps ("LEDs") including; Reflectors, Globes, Candelabra, 3-Way, Dimmable and A-Line type bulbs. The incentive levels vary by bulb type and the customer pays the difference, including shipping. The maximum number of incented bulbs eligible by the Company is 36 per account. However, customers may choose to order additional bulbs but will not receive the Company offered incentive.

Customers can check eligibility and shop for specialty bulbs through four separate channels:

1) The Company Web Site: Customers can go online to visit the Store and purchase specialty bulbs. Frequently asked questions are available to help customers learn more about the program and how sustainable they can be by purchasing and using CFL and LED lighting.
2) Online Services: Customers enrolled in the Company's Online Services may visit the Store and purchase specialty bulbs. Upon login, eligible customers are intercepted with the Store offer. Customers can select "Shop Now" or "No Thanks". Additional links and promos within OLS are also available for customers to access the Store.

3) Phone Ordering: Customers are provided with the opportunity to order by phone. A toll free phone number is now provided on all promotional pieces for the program and customers can place their orders over the phone directly with the programs third party vendor.
4) On occasion, Duke Energy provides customers with a mail-in option for placing an order. Customers who receive a direct mail campaign that offer specially priced bulb bundles the option to order these bundles online, by phone or with a postage paid return mailer included in the piece.

The Store is managed by a third party vendor, Energy Federation Inc. ("EFI"). EFI is responsible for maintaining the Store website and fulfilling all customer purchases. The Store's landing page provides information about the store, lighting products, account information and order history. Support features include a toll free number, package tracking and frequently asked questions.

An educational tool is available to help customers with their purchase decisions. The interactive tool provides information on bulb types, application types, savings calculator, lighting benefits, understanding watts versus lumens (includes a video) and recycling/safety tips. Each wireframe within the educational tool provides insight on the types of bulbs customers can purchase and/or provides answers to questions they have about the products or savings.

Product pages for each bulb category include application photos, product images, product specifications, purchase limits and program pricing. Customers may place items in their shopping carts to purchase at a later time. Customers can pay for their purchase with a credit card or by check.

Benefits of the four distinct channels for the Savings Store include:

- Improved customer experience
- Advanced inventory management
- Simplified program coordination
- Enhanced reporting
- Increased program participation
- Reduced program costs
- Quick and convenient
- Discounted pricing

Retail Lighting

The Energy Efficient Lighting Program launched in March of 2016. Work began earlier in 2016 to ensure that program launch at the retail outlets was successful. This program works through lighting manufacturers and retailers to offer discounts to DEC customers at the register on, LEDs, and energy-efficient fixtures.

The DEC Energy Efficient Lighting Program will encourage customers to adopt energy efficient lighting through incentives on a wide range of products, including, LEDs and fixtures. Customer education is imperative to ensure customers are purchasing the right bulb for the application in order to obtain high satisfaction with lighting products and subsequent purchases.

Water Measures

The Save Energy and Water Kit Program ("SEWK") is designed to increase the energy efficiency of residential customers by offering customers low flow water fixtures and insulated pipe tape for use within their homes.

The SEWK program is offered through a selective ordering process, enabling eligible customers to request a kit and have it shipped directly to their homes. Customers residing in a single-family home with an electric water heater who has not received similar measures through another Company-offered energy efficiency program are eligible for the program. Kits are available in two sizes for homes with one or more full bathrooms and contain varying quantities of shower heads, bathroom aerators, kitchen aerator and insulated pipe tape. Program participants with at least one electric water heater are eligible for one kit shipped free of charge to their home.

Customers are pre-screened based on the eligibility requirements and mailed a business reply card (BRC). Upon receiving the BRC from the customer, the Company will ship the eligible kit to the customer. Due to the unique eligibility requirements of this program, the BRC is the only channel the Company is currently employing to offer the kits to customers.

High Efficiency Pool Pumps

The High Efficiency Pool Pumps measure ("Pool Energy Efficiency Program") is designed to encourage the purchase and installation of energy efficient variable speed pool pumps for residential in-ground swimming pools. Eligible customers receive an incentive of $300 for the replacement of an eligible single-speed pool pump with a new Energy Star certified variable speed pump. New swimming pool construction is also eligible for the rebate. The program is marketed through a network of participating contractors ("Trade Allies") that interface directly with the customer, as well as through various marketing channels such as direct mail, email, company website, bill inserts and other customer communications. Eligible customers include single-family, owner-occupied residential customers with an in-ground pool in the Duke Energy Carolinas service territory. Builders of single-family residences are eligible for new residence construction that includes an in-ground swimming pool.

High Efficiency Heat Pump Water Heater

The High Efficiency Heat Pump Water Heater measure is designed to encourage the installation and adoption of heat pump water heaters. Eligible customers receive an incentive of $350 for the replacement of an existing electric water heater with an Energy Star certified heat pump water heater having an Energy Factor ("EF") rating of 2.0 or higher. The program is marketed through a network of participating contractors ("Trade Allies") that interface directly with the customer, as well as through various marketing channels such as direct mail, email, company website, bill inserts and other customer communications. Eligible customers include single-family, owner-occupied residential customers with electric water heating in the Duke Energy Carolinas service territory. Builders of single-family residences that include an eligible heat pump water heater are also eligible for the rebate.

Audience

Customers who meet the Program eligibility requirements.

B &C. Impacts, Participants and Expenses

Energy Efficient Appliances and Devices[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$16.3**	**$82.3**	**504%**
Program Cost	**$5.5**	**$24.1**	**436%**
MW	**4.1**	**14.5**	**357%**
MWH	**36,348.3**	**120,218.7**	**331%**
Units	**955,750**	**3,868,812**	**405%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Free LED Program

Highlights

The Free LED offer was made available to eligible customers beginning in January 2016. At that time, while the ordering platform was being built for the transition from CFLs to LEDs, the offer was presented to a select number of eligible customers via Business Reply Card (BRC) for a 6 pack of LEDs. Over the course of 4 monthly direct mail campaigns over 250K BRCs were mailed to customers in Duke Energy Carolinas. Of those, over 55K customers mailed back the BRC and placed an order; accountings for 24.8% take rate.

On June 18th, the Free LED ordering platform launched as described in section A. From that point through the end of the year, an additional 117K orders were placed accounting for over 1.9M bulbs. During this time, 73% of the orders were placed through OLS (Online Services). The IVR accounted for 11% of orders and public website had 16%.

Issues

Analyzing customer data and finding ways to effectively market to non-participating customers.

Potential Changes

The program will expand its reach by opening up the offer to customers who previously ordered CFLs through various Duke Energy EE offerings. These customers will have to have placed their orders at least 5 years ago to become re-eligible to order LEDs. This is expected to become available in March 2017.

Specialty Lighting

Highlights

Customers are responding well to the discounted specialty lamps offered via the Energy Efficiency Store. The Energy Efficiency Store provides functionality allowing customers to purchase CFLs and LEDs at any time. Over 36,000 orders were placed in 2016 resulting in over 449,000 bulbs being delivered. Over 83 percent of customers accessed the Energy Efficiency Store via the public website, while 17 percent accessed the Energy Efficiency Store by logging into their on-line services account.

Issues

Educating and bringing awareness of the Store to eligible customers. Educating customers about LED lighting, how to choose the right bulb and why they should make sure the LED bulbs they use are Energy Star certified.

Potential Changes

Introduction of more LED's and non-lighting products to provide variety to the product mix and improved the overall shopping experience.

Retail Lighting

Highlights

The program has moved a total of 1,082,612 measures, including 928,284 LEDs and 154,328 Fixtures.

The DEC Energy Efficiency Program had 8 lighting retail channels actively participating in 2016. While the top three retail channels account for 60% of the program sales, all retail channels are considered important in that they allow access to the program for a widely diverse and geographically spread population of DEC customers. This assures that the Program reaches 90% of customers within 30 miles of a participating retail location.

The Program is operating efficiently with 64% of overall Program costs going directly to customers in the form of incentives. 99% of the remaining Program costs are spent on implementation and administration of the Program, including incentives and management fees. Only 1% of these costs are spent on marketing, labor and other costs.

Issues

No issues at this time.

Potential Changes

No changes at this time.

Save Energy and Water Kit Program

Highlights

The Save Energy and Water Kit (“Program”) was launched in April 2014. In 2016, over 347,000 business reply cards “BRCs” were mailed resulting in the distribution of over 38,000 kits to customers and over 420,000 measures.

Issues

The Company continues to analyze data from non-respondents of the BRC offer to identify opportunities to increase the adoption rate. Customers lack the ability to order the different products offered in the kit in the quantities and finishes they desire, this has proved to be a challenge in getting the products installed.

Potential Changes

Innovative marketing campaigns will be utilized to improve awareness for hard to reach and late adopter customers. In 2017, the program will launch an online ordering option that will allow customers to choose the finish for the products offered in the kits. Additionally, the program will add other energy efficient water saving products to the online ordering platform that will allow customers to upgrade the products offered through the program and pay the difference during check out.

High Efficiency Pool Pumps

Highlights

The Company partnered with several wholesale distributers across North Carolina and South Carolina to serve as distribution channels for program awareness and developing the Trade Ally Network. Trade Allies are important to the program’s success and continue to be targeted through these channels because they interface with the customer during the decision-making process. Several training classes were conducted throughout the jurisdiction to continue educating the trade allies on the advanced technology variable speed offers for reducing energy consumption as well as how to sell the technology to the end user.

Issues

Customer buy-in and participation of the Trade Ally network is vital to the success of the program. Educating contractors on new emerging technologies and the value the technologies provide customers is critical in growing the trade ally network and their willingness to adopt the program. Additionally many distributers are requesting POS rebates as they do not want to deal with submitting rebates or handling the additional paper work requirements for the Program. The Company is currently working to determine if a technology build can be put in place to accommodate distributor needs and boost participation.

High Efficiency Heat Pump Water Heater

Highlights

The Company has partnered with manufactures and national retailer such as General Electric and Lowes to increased program awareness and maximized in store purchases. The program continued recruiting plumbing contractors and currently registered HVAC companies to increase coverage across the jurisdictions and maximize participation. Training classes were conducted throughout the jurisdiction to continue educating the trade allies on the advanced technology offers for reducing energy consumption as well as how to sell the technology to the end user vs. traditional electric hot water heaters.

Issues

Educating and bringing awareness of the program to both customers and potential contractors has been challenging. Educating contractors has been addressed through additional Trade Ally marketing, recruitment and training but remained slow do to the re-emerging technology of heat pump water heaters and willingness to adopt more technical services. Customer awareness is being addressed through program design and marketing tactics but will be primarily targeted as a joint effort with manufactures and national retailers. Their willingness to continue co-branding and the frequency of those campaigns will be critical in reaching our customer base. In addition, GE announced in Q4 2016 that they would stop production of the GEO-Spring HPWH by the end of 2016 which carried a significant percentage of the market share. The Program is now working with AO Smith to continue maximizing in-store retail purchases.

E. Marketing Strategy

Free LED Program

The overall strategy of the program is to reach residential customers who have not adopted LED lighting. The Company will continue to educate customers on the benefits of LEDs while addressing barriers for customers who have not participated in the program. Additionally, the ease of Program participation will also be highlighted to encourage use of the on-demand ordering platform. The Free LED and Specialty Lighting offers utilize the same ordering platform which allows the Company to promote both lighting offers efficiently and bring awareness to non-adopters. Until the Free LED portion of the ordering platform launched in June, the program utilized a Business Reply Card (BRC) to generate interest in the program since officially transitioning the program away from CFLs in January.

A sample of program collateral, such as the Business Reply Card and New Customer Letter (which cross promotes Specialty Lighting) is available in the Appendix.

Specialty Lighting

Since the launch of the Store, the marketing efforts include bill messages, bill inserts, email campaigns and direct mail. Examples of the marketing pieces can be found in the Appendix. Awareness and education will be the main focus in collateral messages to eligible customers.

Retail Lighting

The program's marketing efforts for 2016 included:

- Point of Purchase materials at the participating retailer locations
- Duke Energy and Program website
- General Awareness Campaigns
  - Bill Inserts
  - Email
  - Online Advertising
  - Paid advertising/mass media
  - Out of Home advertising
- Advertised events at key retailers including:
  - Direct mail
  - Email
  - Paid advertising/mass media (radio, newspaper, etc.)
  - Social media
  - In Store materials (fliers, bag stuffers, posters, banners, etc.)
- Community outreach events (home shows, sporting events, cultural events, etc.)

These marketing efforts are designed to create customer awareness of the Program, to educate customers on energy saving opportunities and to emphasize the convenience of Program participation. Additionally, marketing efforts related to advertised in-store events are designed to motivate customer participation.

Save Energy and Water Kit Program

The overall strategy of the program is to reach residential customers who have not adopted low flow water devices. The Company will continue to educate customers on the benefits of low flow water devices while addressing barriers for consumers who have not participated in the program.

Direct mail marketing in the form of BRCs is the only marketing channel being utilized by this program in the Carolinas. The Company will pursue the option to add a web-based ordering platform in 2017.

High Efficiency Pool Pumps

The Company implemented several customer marketing campaigns in 2016 which leveraged channels such as email, paid search, display ads, direct mail and social media to build awareness of the program. Other channels such as co-branded retail displays with selected distributers were utilized to create awareness for the program. The programs' messaging was built around the benefits of the product including payback, annual savings and cleaner pools.

High Energy Efficiency Heat Pump Water Heater

The Company implemented several customer marketing campaigns in 2016 which leveraged channels such as bill inserts, paid search, and display ads to build awareness of the program. Other channels such as co-branded retail displays with selected manufactures and national retailers were utilized to create awareness for the program.

F. Evaluation, Measurement and Verification

On-site data collection for the Residential Free LED and Retail Lighting program was conducted in 2016.

Free LED and Specialty Bulbs evaluation work is planned to be combined with a final process and impact report scheduled for third quarter of 2017.

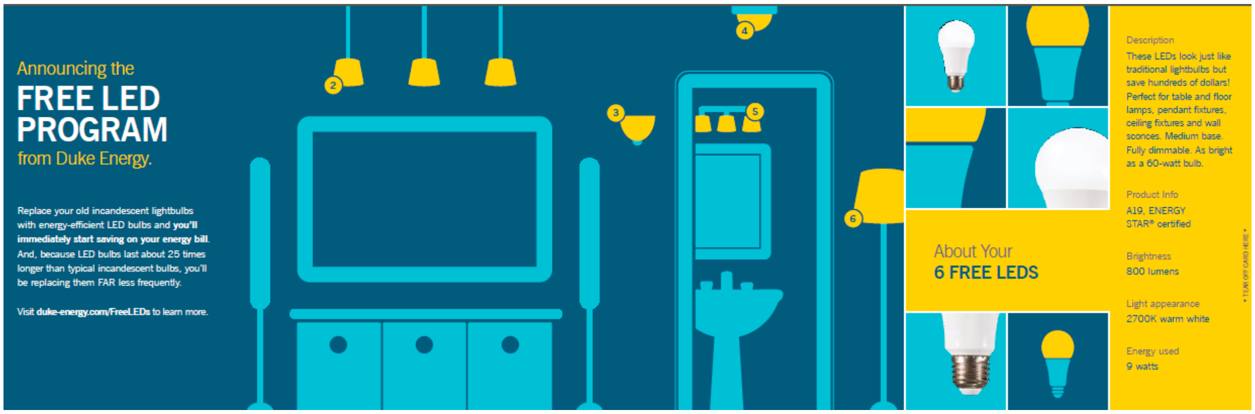
For the Retail Lighting evaluation, the process and impact report is scheduled for third quarter of 2017.

No evaluation work was performed for the Save Energy and Water Kit program in 2016. Evaluation work will begin in 2017 for a combined DEC/DEP process and impact evaluation. The evaluation will consist of engineering estimates of the measures provided in the kits. A final report is expected in third quarter of 2017.

In addition, participation continues to be monitored for heat pump water heaters and pool pump measures.

G. Appendix

Free LED Program – Direct Mail Business Reply Card



Free LED Program – Direct Mail New Customer Letter:

DUKE ENERGY.

<<Mr. Sample A. Sample>>
<<Mailing Address Line 1>>
<<Mailing Address Line 2>>
<<Anytown, USA 12345>>

Welcome to Duke Energy!

As your new energy provider, we're always looking for ways to help you save money and energy. Energy-efficient lighting is a great way to do both.

We'd like to start you on the right foot and, as a welcome, offer you a **FREE BOX OF LED BULBS**. You'll get general purpose ENERGY STAR® certified 9-watt bulbs for your home.

YOUR FREE LEDS:

- **Use up to 90% less energy** and **last 25 times longer** than incandescent bulbs
- Contain **no mercury**
- Have a potential **lifetime savings** of up to $206 per bulb

Order your FREE BULBS now.

Visit **duke-energy.com/FreeLEDBulbs** or call **800.943.7585.**

Here's your account number to make ordering even easier:
<<account number here>>

SHOP MORE. SAVE MORE.

Once your freebies are gone, our online store offers a wide variety of name-brand, energy-saving bulbs at a discount. We offer specialty bulbs for every room in your house, and we'll have them shipped to your door.

Shop now at: **duke-energy.com/OnlineStore**

We offer free shipping on orders of $25 or more. Use code Duke103 at checkout. Free shipping offer ends 12/15/2016.

APPLIANCE RECYCLING PROGRAM

Free removal of your extra fridge. Easy. Convenient. Plus get $50.

- Contact us to schedule your free home pickup
- We'll come get your fridge when it's good for you
- You'll get a **$50** check and save up to **$150 a year** in energy costs

Schedule your free pickup today. Call **855.398.6200** or visit **duke-energy.com/save**.

For more information and eligibility please visit duke-energy.com/save.

4 ONLINE SAVINGS STORE

Stop paying retail prices for your energy-saving light bulbs. Shop online.

- Enjoy up to **92 percent** off retail prices
- Huge selection of energy-saving CFL and LED bulbs delivered to your door
- Free shipping on orders over $25 through May 31, 2016. Use promotion code **Duke315**

Visit **duke-energy.com/BigSavings** and start saving money today.

MIX Paper from responsible sources FSC® C017821

DUKE ENERGY.

It's March **Savings** Madness!

4 ways we can help you score more than $1,000.

Order + Install = **SAVE** up to $120 each year

Would you like to save energy and water at home – and save money on your utility bills? It's simple! **Just sign up to receive one of the FREE Save Energy And Water Kits** we're offering exclusively to our customers.

These kits include the latest low-flow showerheads, kitchen and bathroom faucet aerators, water heater pipe insulation materials and a step-by-step, detailed installation guide.

Did you know that your electric water heater is the second-largest energy expense in your home?

Only heating and cooling uses more energy. Your water heater can account for 18 percent of your monthly energy bill. So, it only makes sense that if you save water, you save the energy it takes to heat that water.

See how easy it is to install these products with our brief installation videos at **duke-energy.com/savewater**.

Inside the Save Energy and Water Kit

Low-flow showerheads
If your showerhead is several years old, you could save as much as two gallons of water each minute, or more, by replacing it with one of our low-flow models.

Faucet aerators
Faucet aerators mix air with water to reduce the amount of water used while maintaining a satisfactory water pressure.

Insulation tape for your water heater pipes
The energy needed to heat water can represent a large portion of your monthly energy bill. Wrapping your water heater pipes is a simple way to help maintain water temperature in your home and save you nearly 17 percent on your monthly bill.

Installation guide and how-to video
Your kit also includes a detailed, step-by-step instructional guide to help you complete the installation of your new fixtures.

To learn more about this new program, or the kit, visit **duke-energy.com/savewater** or call **866.807.1544**.

☐ YES, send me my **FREE** Save Energy and Water Kit!
I confirm that my residence has an electric water heater, and that its location corresponds with my Duke Energy account on record. I will install my new fixtures at this residence only.

The barcode above is embedded with your address and account information.
This system ensures your privacy and allows us to process your order quickly by scanning the barcode.

DUKE ENERGY.

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 55 SOUTHBOROUGH MA
POSTAGE WILL BE PAID BY ADDRESSEE

DUKE ENERGY – SAVE ENERGY AND WATER PROGRAM
ENERGY FEDERATION INC
1 WILLOW ST STE 2
SOUTHBOROUGH MA 01772-9808

DUKE ENERGY.

Stop rinsing money down the drain!
Get a FREE Save Energy and Water Kit delivered to your door.
Simply return the attached reply card.

DUKE ENERGY.

Lower your monthly energy bills, and get new kitchen and bathroom fixtures from Duke Energy.

The items included in this kit combine the best energy efficiency with the best performance. These devices save more energy and water than most of the low-flow devices on the market today.

In your kit, you've received:


Low-flow showerhead(s)


Water heater pipe insulation tape


Faucet caps with aerators for the bathroom


Rubber easy-grip cloth


Adjustable faucet cap with aerator for the kitchen

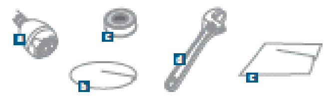

Roll of pipe thread sealing tape

The following instructions will help you install these items in your home. Watch our how-to installation videos online at duke-energy.com/savewater. Then, **let the savings begin!**

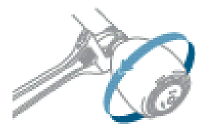
Showerhead Installation

What you'll need:

- Low-flow showerhead(s)
- Rubber easy-grip cloth
- Pipe thread sealing tape
- Wrench (optional)
- Rag

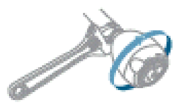


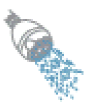
1. Remove your existing showerhead.
- Wrap the rubber easy-grip cloth around the base of your showerhead where it is attached to the shower arm.
- Turn the showerhead counterclockwise (left) to loosen.
- If the showerhead is difficult to loosen, you may need to use a vise-grip or adjustable pliers to help remove it. Before using any tools, wrap the easy-grip cloth around the fixture to protect it from the teeth of the vise-grip or pliers during removal.



2. Apply pipe thread sealing tape.
- Once your existing showerhead is removed, wipe the pipe threads with a clean, dry cloth to remove any excess moisture.
- Stretch two layers of the white pipe thread sealing tape provided across the threads to cover them. Then cut the tape off the roll. This tape is used to seal the pipe connection and lubricate the threads for easy assembly.

3. Install your new low-flow showerhead.
- Hold the base of your new showerhead with the rubber easy-grip cloth and twist it onto the threaded area of the shower arm in a clockwise direction (right).
- You may tighten the shower pipe with the rubber easy-grip cloth too, if necessary, to prevent any leaks.





4. Test your showerhead.
- Turn on the water to test your new showerhead. Look closely at the connection between the shower arm and the base showerhead collar to see if there is any water leaking.
- If the showerhead is leaking, tighten the base collar with a vise-grip or pliers.

5. Adjusting the water flow mode.
- Your new low-flow showerhead is equipped with two different modes: massage and pulsating. You can change the modes by twisting the outer ring in both directions until you create the desired water flow.
- If you turn the outer ring all the way to the right, the water will be in massage mode. If you turn it all the way to the left, it is in full spray mode.

Troubleshooting tips:
If you have followed the installation instructions and you still find water leakage, there are three common sources of water leaks:

a. Your pipe threads are not taped properly. Please be sure to use two layers of the provided tape to ensure the seal is tight.

b. If your tape is applied correctly and the showerhead is still leaking, then your showerhead is crossthreaded. Unscrew and reinstall it, making sure you are lining up the threads.

c. In some cases, your showerhead may not be properly tightened. Please wrap the easy-grip cloth around your new fixture to protect it, and then use a vise-grip or pliers over the cloth to ensure a fully tight connection between your shower arm and your new showerhead.

Try these troubleshooting tips before calling Energy Federation Inc. (EFI) customer service at 866.807.1544.

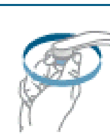
Faucet Aerator Installation
(for both kitchen and bathroom)

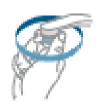
What you'll need:

- Faucet caps with aerators*
- Rubber easy-grip cloth
- Wrench (optional)

* *If you experience trouble installing the kitchen aerator or it does not fit, call 866.807.1544. We will ship you a free adapter.*

1. Remove your existing faucet cap.
- Using the rubber easy-grip cloth, unscrew your faucet cap in a counterclockwise (left) direction.
- Your faucet arm will have threads on the inside (female) or threads on the outside (male). If your faucet arm has female threads, use the male rubber washer to align and install your new faucet cap and aerator. If your faucet arm has male threads, use the female rubber washer provided.





2. Install your new faucet cap with aerator.
- Install the new faucet cap by aligning the threads on the inside of the faucet arm with the exterior threads of the new cap.
- Gently screw in the faucet cap in a clockwise (right) direction until it is firmly connected. Tighten it fully with the rubber easy-grip cloth provided.

Help the planet. Help your wallet.

Water and energy are precious resources. And now we've made it possible for you to save water every time you turn on the faucet or take a shower.

Our FREE **state-of-the-art showerheads** offer consistent water flow and help ensure a great shower experience. And the fixtures help you save on your bill and conserve water.

Make the switch with our Save Energy and Water Kit today.

Save Energy and Water Kits are available to qualifying Duke Energy Carolinas, Duke Energy Progress, Duke Energy Indiana, Duke Energy Kentucky and Duke Energy Ohio customers.

Inside your FREE kit:

State-of-the-art showerheads
Newer, top-of-the-line showerheads can help you save up to 2 gallons per minute while maintaining water pressure and your comfort.

Faucet aerators
Mixing air with water reduces the amount of water needed. The aerator also maintains constant and satisfactory water pressure.

Pipe insulation tape
Wrapping your water heater pipes is a simple way to manage water temperature in your home and saves you nearly 17 percent on your energy bill.

Installation guide and how-to video
Your kit includes a detailed, step-by-step instructional guide to help you complete the installation of your new fixtures.

To learn more about our program, visit **duke-energy.com/SaveWater** or call **866.807.1544**.

☐ YES, send me my **FREE** Save Energy and Water Kit!

DUKE ENERGY.

You'll feel good knowing you've helped the planet too.

Water and energy are precious resources. And now we've made it possible for you to save water and still enjoy your shower experience.

Our **FREE state-of-the-art showerheads** offer consistent water flow and help ensure a great shower experience. And the fixtures help you save on your bill and conserve water.

Make the switch with our Save Energy and Water Kit today.

Save Energy and Water Kits are available to qualifying Duke Energy Carolinas, Duke Energy Progress, Duke Energy Indiana, Duke Energy Kentucky and Duke Energy Ohio customers.

Inside your FREE kit:

State-of-the-art showerheads
Newer, top-of-the-line showerheads can help you save up to 2 gallons per minute.

Faucet aerators
Mixing air with water reduces the amount of water needed. The aerator also maintains constant and satisfactory water pressure.

Pipe insulation tape
Wrapping your water heater pipes is a simple way to manage water temperature in your home and saves you nearly 17 percent on your energy bill.

Installation guide and how-to video
Your kit includes a detailed, step-by-step instructional guide to help you complete the installation of your new fixtures.

To learn more about our program, visit **duke-energy.com/SaveWater** or call **866.807.1544**.

☐ YES, send me my **FREE** Save Energy and Water Kit!

I confirm that my residence has an electric water heater and that its location corresponds with my Duke Energy account on record. I will install my new fixtures at this residence only.

The barcode above is embedded with your address and account information.
This system ensures your privacy and allows us to process your order quickly by scanning the barcode.

DUKE ENERGY.

**Shopping for today's energy-efficient bulbs can be easy.
Here's what that labeling information really means:**

Lighting Facts
Per Bulb

Brightness	800 lumens (C)
(A) Estimated Yearly Energy Cost	$1.65
Life	22.8 years (D)
(B) Light Appearance	Warm — Cool
Energy Used	13.5 watts (E)

A – Energy Cost
An estimate of how much this bulb costs to use per year. (CFLs and LEDs use up to 90% less energy than traditional incandescent bulbs.)

B – Light Appearance
Color temperature is measured in "Kelvins." The lower the Kelvin number, the warmer the tone ... the higher the Kelvin, the cooler and brighter the tone.

C – Brightness
The light output of today's bulbs is measured in lumens. The higher the number, the brighter the bulb.

D – Bulb Life
Brace yourself. ENERGY STAR® certified bulbs last up to 25 times longer than incandescents. So depending on use, you could go as long as five to even 22 years between bulb changes.

E – Energy Used
Watts are the measure of energy used by the bulb – not the bulb's brightness. CFLs and LEDs use significantly less electricity than incandescent bulbs to achieve the same level of brightness.

Three ways to order

Click us
dukeenergy.com/NewBulbs

Call us
866.849.9704

Mail us
your order in the attached envelope

$5 flat-rate shipping
Use promo code Duke318 at checkout

Remember, when you order your energy-efficient LED bulb kits through the Duke Energy Savings Store they are:

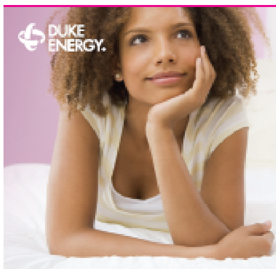
- The latest ENERGY STAR® bulbs available
- Delivered to your door
- At up to 82% off retail prices

Order today to start saving.

These special prices end September 21!

DUKE ENERGY.

**<Name>, pick a pack of savings.
Now through September 21, 2016!**



DUKE ENERGY.

You're not dreaming.
Huge savings on LEDs for your bed and bath.

HURRY NOW for discounts on LEDs. Offer ends on September 21, 2016.

You should have the best lighting in your bed and bath and all of our LED lightbulbs are ENERGY STAR® rated. They provide top color quality and light output. You'll also save on energy and money for years to come. **Why wait?**

Start shopping.

Go online to **duke-energy.com/NewBulbs** and log in with your account number. Or, if you prefer to call, that works too. Call us at **866.849.9704**.

A21 3-WAY 2-PACK

Typically used in bedrooms for nightstands and floor lamps. As bright as a 35w bulb.
Retail value for 2: $26.50
Customer Price: $12.50

SAVE 53% OFF RETAIL

SAVE 82% OFF RETAIL

R30 REFLECTOR 5-PACK

A popular bulb for 4-inch recessed can fixtures. As bright as a 60w bulb.
Retail value for 5: $42.50
Customer Price: $7.50

SAVE 65% OFF RETAIL

DIMMABLE GLOBE 4-PACK

Great for bathroom vanities and fully dimmable. As bright as a 40w bulb.
Retail value for 4: $29.50
Customer Price: $9.50

Order Form

A21 3-WAY LED 2-PACK	$12.50	
R30 REFLECTOR LED 5-PACK	$7.50	
DIMMABLE GLOBE LED 4-PACK	$9.50	

Order up to 3 of the following special LED packs!

$5.00

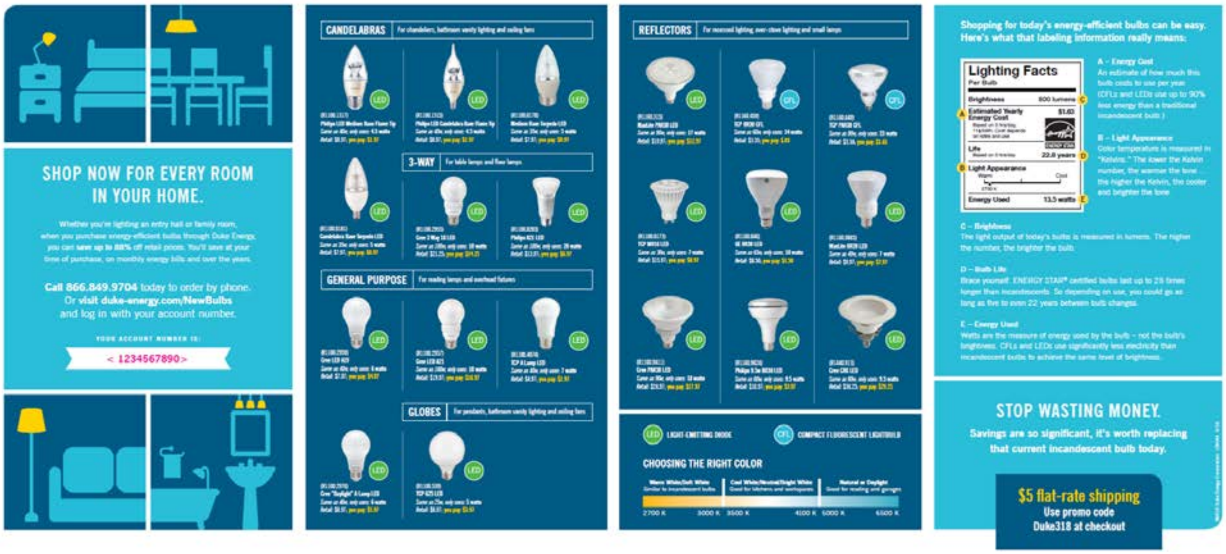
Choose a 3-way pack for nightstand lamps.
Limit 1

Choose a reflector pack for your recessed lighting.
Limit 1

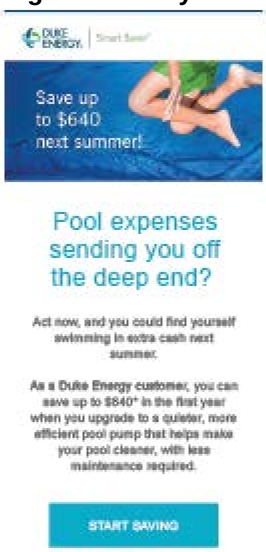
Choose a dimmable globe pack for bathrooms.
Limit 1

Double Check!

Duke Energy only offers Energy Star® certified bulbs.



High Efficiency Pool Pump Digital Ad



High Efficiency Pool Pumps Email

Pool costs sending you off the deep end?

We can help.

As a Duke Energy customer, you can get paid to improve your pool. Save up to $640* in the first year when you upgrade to a quieter, more efficient pool pump.

Install an ENERGY STAR® certified variable-speed pool pump:

- Get a $300 rebate
- Pays for itself in less than two years
- Saves you up to $340 each year in energy costs
- Makes your pool cleaner, with less maintenance

Call 866.785.6209 or visit **duke-energy.com/Splash** for eligibility requirements – and let the summertime savings begin.

*$300 rebate + $340 energy savings

DUKE ENERGY. | Smart $aver®

ST24A | 400 South Tryon Street
Charlotte, NC 28202

DUKE ENERGY | Smart $aver®

Pool expenses sending you off the deep end?

Act now, and you could find yourself swimming in extra cash next summer.

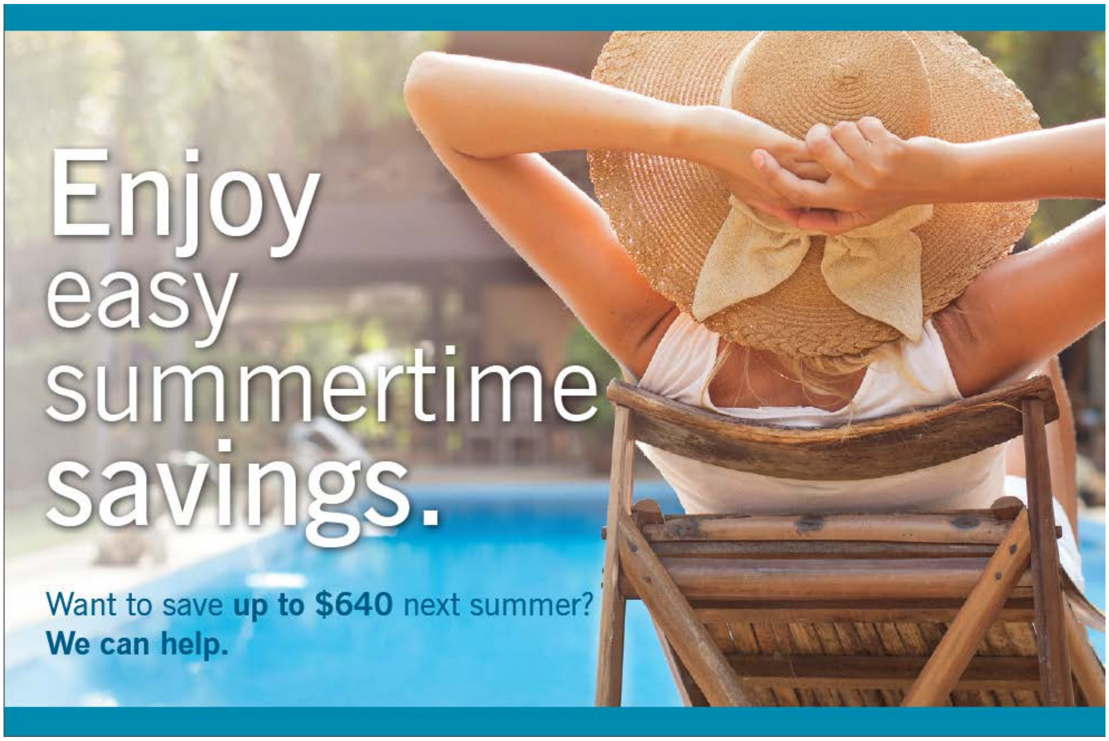
As a Duke Energy customer, you can save up to $640* in the first year when you upgrade to a quieter, more efficient pool pump that helps make your pool cleaner, with less maintenance required.

START SAVING

An ENERGY STAR® certified variable-speed pool pump:

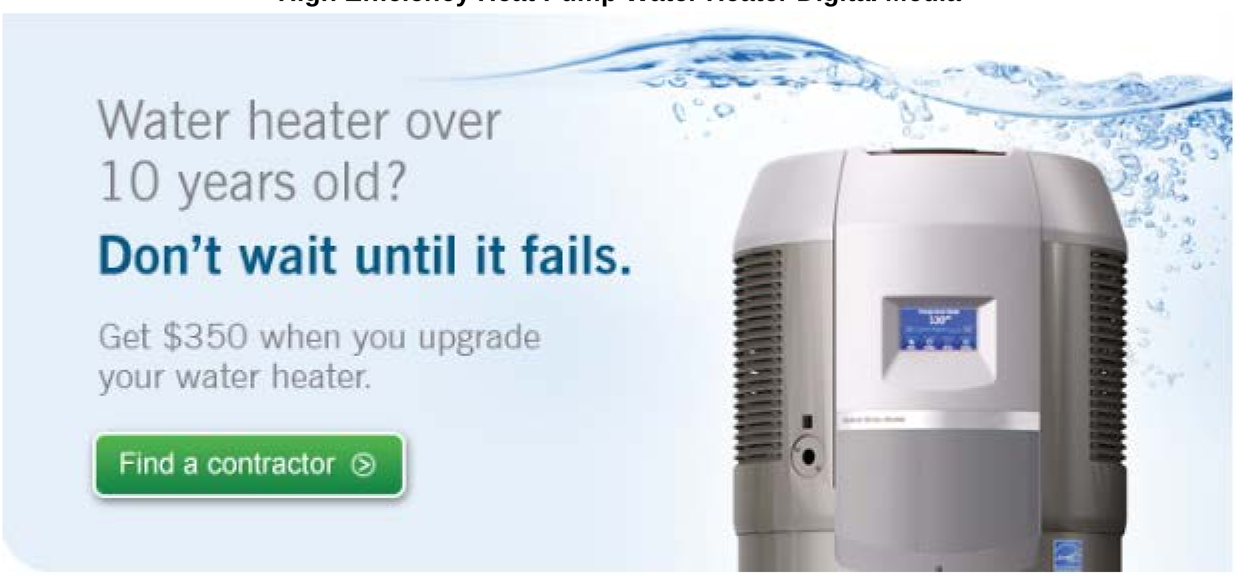
- Gets you a $300 rebate after you install, using a participating contractor.
- Pays for itself in less than two years.
- Saves you up to $340 each year in energy costs.

High Efficiency Heat Pump Water Heater National Retailer Display



High Efficiency Pool Pump Facebook Posting

High Efficiency Heat Pump Water Heater Digital Media



A. Description

The Energy Efficiency Education Program ("Program") is an energy efficiency program offered in the Duke Energy Carolinas (the "Company" or "DEC") service territory. The Program is available to students in grades K-12 enrolled in public and private schools who reside in households served by the Company. The current curriculum administered by The National Theatre for Children ("NTC") targets K-8 grade students.

The Program provides principals and teachers with an innovative curriculum that educates students about energy, resources, how energy and resources are related, ways energy is wasted and how to be more energy efficient. The centerpiece of the curriculum is a live theatrical production focused on concepts such as energy, renewable fuels and energy efficiency performed by two professional actors. Teachers receive supportive educational material for classroom and student take home assignments. The workbooks, assignments and activities meet state curriculum requirements.

School principals are the main point of contact responsible for scheduling their school's performance at their convenience. Once the principal confirms the performance date and time, two weeks prior to the performance, all materials are delivered to the principal's attention for classroom and student distribution. Materials include school posters, teacher guides, and classroom and family activity books.

Students are encouraged to complete a home energy survey with their family (included in their classroom and family activity book) to receive an Energy Efficiency Starter Kit. The kit contains specific energy efficiency measures to reduce home energy consumption. The kit is available at no cost to all student households at participating schools, including customers and non-customers.

Audience

Eligible participants include the Company's residential customers who reside in households served by Duke Energy Carolinas with school-age children enrolled in public and private schools.

B &C. Impacts, Participants and Expenses

Energy Efficiency Education[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$4.2**	**$3.7**	**89%**
Program Cost	**$2.5**	**$2.1**	**86%**
MW	**0.7**	**1.5**	**219%**
MWH	**6,580.2**	**6,441.3**	**98%**
Units	**26,250**	**30,170**	**115%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

For the sixth straight year, the Company is supporting arts and theatre in schools while providing an important message about energy efficiency through an innovative delivery channel for students. Enhancing the message with a live theatrical production truly captivates the students' attention and reinforces the classroom curriculum materials provided.

The 2016-2017 school year offered two new productions in partnership with the Program vendor, The National Theatre for Children (NTC). The elementary school production, *The Conservation Caper,* is a 25 minute performance for elementary students and teaches them how to use resources wisely through a fun superhero adventure featuring Nikki Neutron and a cast of colorful characters. *The Energy Agents*, a 40-minute performance, is designed for middle school students. This production combines sketch comedy with improvisation and audience participation to teach students about natural resources and energy efficiency while complimenting student studies in science and energy.

During 2016, a total of 598 schools were visited in the Company's DEC service territory, a total of 1,082 performances were held and approximately 204,535 students were reached with the Program.

Once the completed energy efficiency survey is processed for an eligible customer, the Energy Efficiency Starter Kit is shipped and received within two to four weeks. To ensure customer satisfaction with the Energy Efficiency Starter Kit and the installation of items, an email reminder is sent monthly after successful kit delivery to encourage families to return their Business Reply Card (BRC). Qualified households that have submitted their energy efficiency survey and returned the BRC are automatically entered into the household contest drawing, sponsored by NTC.

Additionally, school and classroom contests encourage sign ups and NTC awards checks to schools whose students, along with their families completed home energy surveys and received energy efficiency kits as part of the Program. In the fall and spring of each year, a drawing is held selecting one school and one household contest winner. Principals, teachers and students may view their school's progress and compare the number of sign ups to other schools via the website, www.trackmysignups.org.

Updates

The Company continues to enhance the Program by:

- Introducing two new productions each school year to refresh and refocus the materials and scripts to keep participating schools engaged.
- Promoting the program through social media to encourage awareness, recognition and participation.
- Partnering with Duke Energy Account and District Managers to leverage existing relationships in the community to develop positive media stories while encouraging kit sign ups.
- Offering teacher satisfaction survey evaluations after the performances for both the elementary and middle school performances. Average survey data from fall 2016 indicated 92% of the teacher surveys had very high satisfaction ratings.
- Upgrading the Energy Efficiency Starter Kits with LEDs and reviewing alternative kit measures to be considered for student households that have already received the current kit in previous years.

E. Marketing Strategy

The National Theatre for Children is responsible for all marketing campaigns and outreach. NTC utilizes direct mail and email sent directly to principals to market the Program.

F. Evaluation, Measurement and Verification

There is currently no planned difference in the EM&V plans for the Programs in DEC and DEP. However, due to the pre-established schedule of DEC evaluation and the launch schedule for the Program in DEP, the evaluations will initially be performed separately at different times. Subsequent evaluations are expected to be combined for the Programs in DEC and DEP. At that time, the allocation of combined EM&V costs is proposed to be based on the projected number of participants of the Programs for each company.

No DEC evaluation activity took place in 2016. The next evaluation work is planned as a combined Duke Energy Carolinas and Duke Energy Progress process and impact evaluation. Evaluation activities will begin third quarter of 2017, with a final report to be delivered in second quarter of 2018.

The goal of the impact evaluation is to assess the net energy savings attributable to the Program, as well as the persistence of the energy savings over time. The independent, third-party EM&V consultant will determine the detailed analysis methodologies, sample design and data collection activities. The impact evaluation for this Program is expected to consist of engineering estimates and a billing analysis.

Where applicable, a statistically representative sample of participants will be selected for the analysis. The Company intends to follow industry-accepted methodologies for all measurement and verification activities, consistent with International Performance Measurement Verification Protocol (IPMVP) Options A, C or D depending on the measure.

A. Description

The Home Energy House Call Program ("Program") is offered under the Energy Assessment Program. Duke Energy Carolinas, LLC (the "Company") partners with several key vendors to administer the Program.

The Program provides a free in-home assessment performed by a Building Performance Institute ("BPI") certified energy specialist designed to help customers reduce energy usage and save money. The BPI certified energy specialist completes a 60 to 90 minute walk through assessment of a customer's home and analyzes energy usage to identify energy savings opportunities. The energy specialist discusses behavioral and equipment modifications that can save energy and money with the customer. The customer also receives a customized report that identifies actions the customer can take to increase their home's efficiency. Examples of recommendations might include the following:

- Turning off vampire load equipment when not in use.
- Turning off lights when not in the room.
- Using energy efficient lighting.
- Using a programmable thermostat to better manage heating and cooling usage.
- Replacing older equipment.
- Adding insulation and sealing the home.

In addition to a customized report, customers receive an energy efficiency starter kit with a variety of measures that can be directly installed by the energy specialist. The kit includes measures such as energy efficiency lighting, low flow shower head, low flow faucet aerators, outlet/switch gaskets, weather stripping and an energy saving tips booklet.

Audience

Eligible Program participants are Company's residential customers that own a single-family residence with at least four months of billing history and have central air, electric heat or an electric water heater.

B &C. Impacts, Participants and Expenses

Energy Assessments[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$8.0**	**$6.8**	**85%**
Program Cost	**$3.0**	**$2.7**	**89%**
MW	**0.9**	**1.1**	**114%**
MWH	**7,546.6**	**7,389.1**	**98%**
Units	**7,656**	**8,693**	**114%**

1) Values are reflected at the system level.

2) Units represent number of kits, and do not include additional LEDs

3) Numbers rounded.

D. Qualitative Analysis

Highlights

The Company continued with a multi-channel approach which included Duke Energy website pages, website banners, online services banner, paid search campaigns, email, bill inserts, bill messages and direct mail. We utilize Acxiom segmentation to reach customers with a high propensity to participate . Examples of online, bill inserts and direct mail promotions are available in the appendix. We continue to explore other channels for our marketing campaigns to reach our target audience and maximize both program performance as well as customer experience.

Communication channels amongst vendors, partners and the team at Duke Energy continue to be optimized to maximize collaboration regarding marketing initiatives, future scheduling, availability, routing, targeting, backlog, etc. to drive efficient operations as well as customer satisfaction.

Through December 2016 the program has conducted 8,693 assessments and installed 20,160 additional LEDs. As part of the transition to LEDs in April, the program incorporated training to focus on measure installations that resulted in an increase in bulb installs from an average of 14% in first quarter to an average of 50% through the fourth quarter. The increase in install rate is influenced by the technology change along with additional training launched during the transition. We have seen similar increase across all measures so will continues focus on ways to maximize the savings opportunity per participant.

Potential Changes

Some program enhancements to increase the effectiveness of the Program being considered include:

- Upgraded lighting to LED technology in April 2016. The change included replacing the previous CFLs in the kit to a 9W LED. Depending on the number of high use sockets, the advisor can install up to six (6) additional LEDs outside of the kit.
- Upgraded the scheduling form on the website to enable the customer to select, schedule, cancel and or modify their appointment in real time. As the tool just launched in July, we are continuing to optimize the tool to enhance the customer experience.
- We continue to incorporate propensity modeling to allow for more targeting.
- Incorporated an onsite training program May 2016 with field advisors and call center employees on a monthly basis featuring one or more energy efficiency programs to provide clarity around other Duke Energy offers. This effort will help facilitate a better customer experience as well as transition to the next step in their journey of becoming more energy efficient. As part of the training, we conducted a question and answer (Q&A) session and plan a second phase that will include a recording so we can repurpose for new hires and easily reference as often as needed.
- Exploring cost effective approach to include thermal imaging as part of the assessment in response to customer feedback and requests.
- Considering replacing the current showerhead with a chrome version to increase installation based on customer feedback.

E. Marketing Strategy

Program participation continues to be driven through a multichannel approach including targeted mailings to pre-qualified residential customers, bill inserts, online promotions and online video. For those who elect to receive offers electronically, email marketing continues to be used to supplement direct mail. Information about the Program was included in the My Home Energy Report distributed in January 2016 and July 2016. The Program management team continues to explore additional channels to drive awareness including but not limited to community outreach and event marketing as well as other cross promotional opportunities. The creative continues to drive engagement and interest in the program based on online survey results and enrollment. The core messaging continues to be simple and focused on key benefits: (a free energy assessment from Duke Energy can help save energy and money while also increasing comfort) and (three easy steps: you call, we come over, you save).

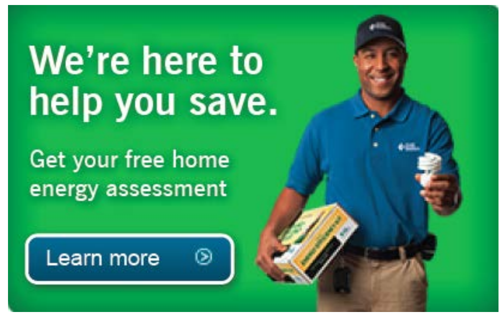
Home Energy House Call program information and an online assessment request form are available at www.duke-energy.com.

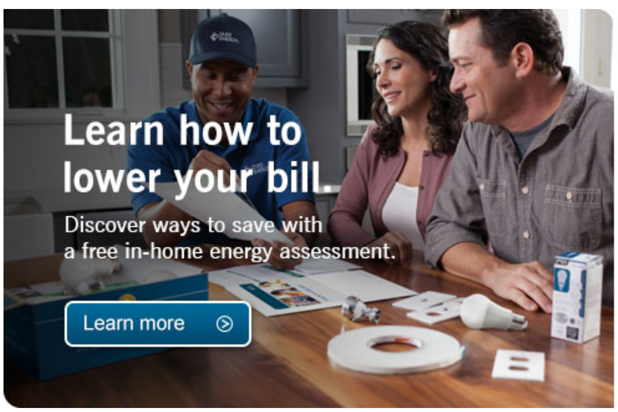
F. Evaluation, Measurement and Verification

There is currently no evaluation activity for this Program. The next process and impact evaluation report is scheduled for completion in third quarter of 2017 with activities beginning late 2016.

G. Appendix: 2016 Marketing Samples

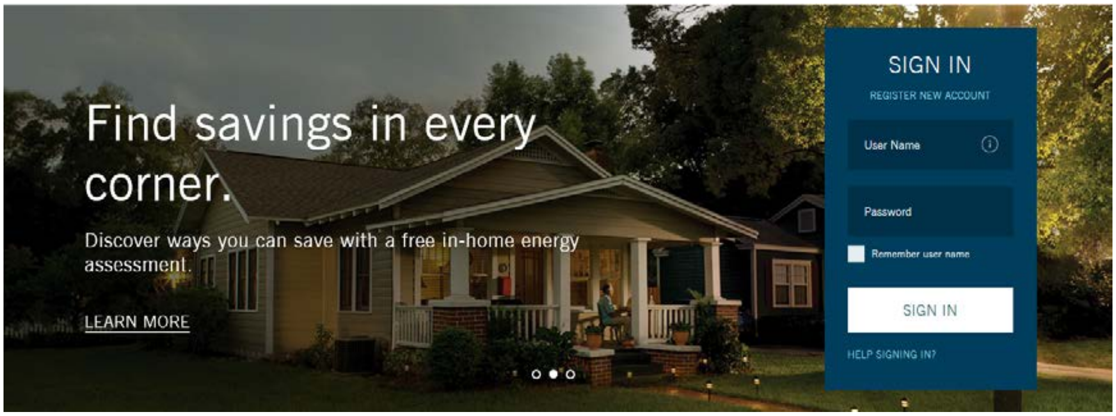
Online Banners:



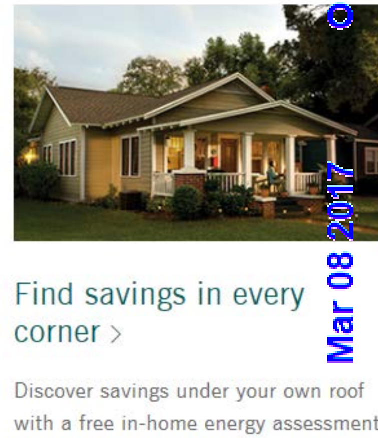


Web Banners Cont'd

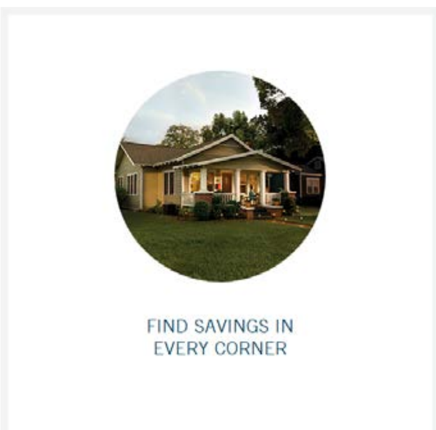
Duke-energy.com CDP Homepage Banner

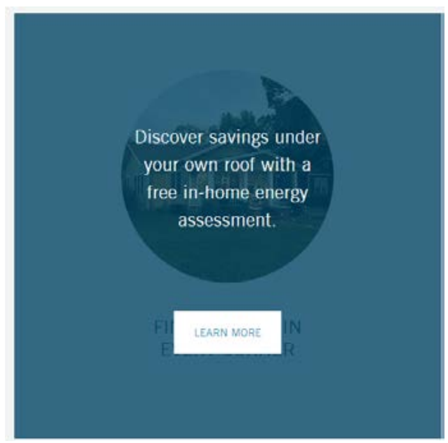


Rectangular Pod

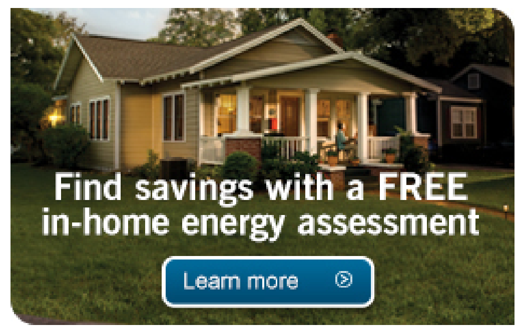


Flipboard



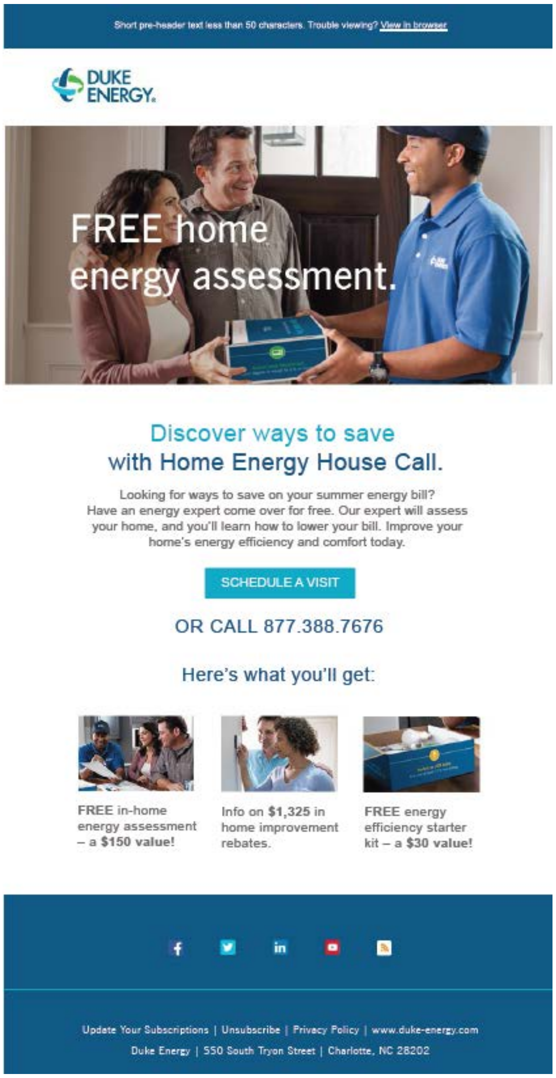


OLS Banner



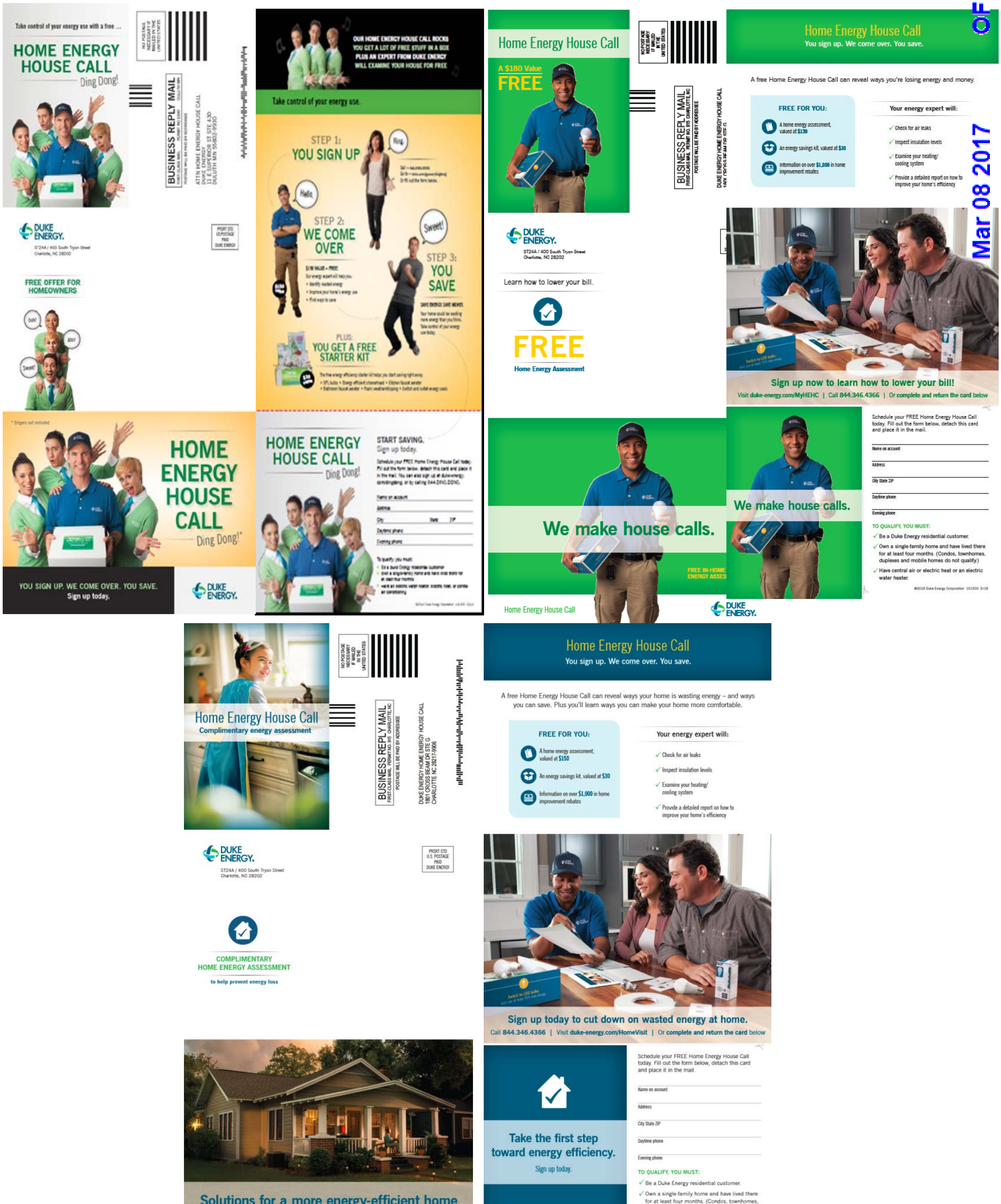
Pandora Ads

Email:


Short pre-header text less than 50 characters. Trouble viewing? View in browser
DUKE ENERGY.
FREE home
energy assessment.
Discover ways to save
with Home Energy House Call.
Looking for ways to save on your summer energy bill?
Have an energy expert come over for free. Our expert will assess
your home, and you'll learn how to lower your bill. Improve your
home's energy efficiency and comfort today.
SCHEDULE A VISIT
OR CALL 877.388.7676
Here's what you'll get:
FREE in-home energy assessment – a $150 value!
Info on $1,325 in home improvement rebates.
FREE energy efficiency starter kit – a $30 value!
Update Your Subscriptions | Unsubscribe | Privacy Policy | www.duke-energy.com
Duke Energy | 550 South Tryon Street | Charlotte, NC 28202


FREE home
energy assessment.
Discover ways to save with Home Energy House Call.
SCHEDULE A VISIT
OR CALL
877.388.7676
Here's what you'll get:
Update Your Subscriptions
Unsubscribe
Privacy Policy
www.duke-energy.com

Direct Mail:


HOME ENERGY HOUSE CALL
Ding Dong!
BUSINESS REPLY MAIL
DUKE ENERGY
FREE OFFER FOR HOMEOWNERS
Take control of your energy use.
STEP 1: YOU SIGN UP
STEP 2: WE COME OVER
STEP 3: YOU SAVE
PLUS: YOU GET A FREE STARTER KIT
Home Energy House Call
A $180 Value
FREE
Learn how to lower your bill.
FREE
Home Energy Assessment
You sign up. We come over. You save.
A free Home Energy House Call can reveal ways you're losing energy and money.
FREE FOR YOU:
Your energy expert will:
Sign up now to learn how to lower your bill!
YOU SIGN UP. WE COME OVER. YOU SAVE.
Sign up today.
START SAVING.
We make house calls.
Complimentary energy assessment
COMPLIMENTARY HOME ENERGY ASSESSMENT
to help prevent energy loss
A free Home Energy House Call can reveal ways your home is wasting energy – and ways you can save. Plus you'll learn ways you can make your home more comfortable.
Sign up today to cut down on wasted energy at home.
Call 844.346.4366 | Visit duke-energy.com/HomeVisit | Or complete and return the card below
Take the first step toward energy efficiency.
Sign up today.
Solutions for a more energy-efficient home

Bill Inserts:

Bill Inserts (Cont'd)

Find savings in every corner.

Discover ways you can save with a ***FREE*** in-home energy assessment.

Home Energy House Call

Free **in-home energy assessment and energy savings kit for eligible homeowners – $180 value!**

Your FREE expert will:

- Check for air leaks
- Inspect insulation levels
- Examine your heating/cooling system

Sign up today! Call **855.739.9114** or visit **duke-energy.com/FreeAudit** to see if you qualify.

DUKE ENERGY.

Facebook ads:

Duke Energy
Sponsored ·

We make house calls. Get a FREE in-home energy assessment to learn how your home is losing energy and money. For eligible homeowners.

Home Energy House Call
Free in-home energy assessment!
Duke-energy.com/HomeEnergyVisit

90 4 Comments 14 Shares

Like Comment Share

Duke Energy
Sponsored ·

Discover ways to save with Home Energy House Call. Get a FREE in-home energy assessment from an energy expert. For eligible homeowners.

Free in-home energy assessment!
Plus FREE LEDs and more!
Duke-energy.com/HomeEnergyVisit

90 4 Comments 14 Shares

Like Comment Share

A. Description

The Residential HVAC Energy Efficiency Program ("Program") offers measures that allow eligible Duke Energy Carolinas, LLC (the "Company") customers to take action and reduce energy consumption in the their home, including direct action against the home's single-largest user. The Program offering provides incentives for the purchase and installation of eligible central air conditioner or heat pump replacements in addition to Quality Installations and Wi-Fi enabled Smart Thermostats when installed and programmed at the time of installation of the HVAC system . Program participants may also receive an incentive for central air conditioner tune up, heat pump tune up, attic insulation, air sealing, duct sealing and duct insulation.

Program staff is responsible for establishing relationships with HVAC and home performance contractors as well as home builders ("Trade Allies") who interface directly with residential customers. These Trade Allies market and leverage the Program to assist with selling these products and services to customers. Once the Trade Ally has sold the service/product, they adhere to Program requirements for completion and submit incentive applications on behalf of the customer. An incentive is disbursed to the customer and/or Trade Ally after the application has been approved and processed.

Duke Energy contracts with a third party vendor who is responsible for application processing, incentive payment disbursement, and Trade Ally and customer call processing.

Audience

The Company's residential customers that meet the eligibility requirements of the Program.

B &C. Impacts, Participants and Expenses

HVAC Energy Efficiency[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$4.8**	**$7.5**	**155%**
Program Cost	**$5.1**	**$7.8**	**154%**
MW	**1.5**	**2.5**	**161%**
MWH	**3,365.2**	**6,296.3**	**187%**
Units	**9,986**	**19,477**	**195%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

The Company launched the new tiered incentive structure in the market for HVAC replacements with the optional add on measures of Quality Installation and Smart Thermostat. The new incentive structure has received a positive reaction from customers as well as Trade Allies. Initial reporting shows that the increased incentive amounts for higher SEER equipment has encouraged customers to install higher efficiency equipment as well as having it properly installed and managed with new technologies.

The Referral Channel successfully launched on June 30, 2016 providing free, trusted referrals to customers who are trying to find reliable qualified contractors for their energy saving home improvement needs. The new channel successfully generated 2,675 customer referrals through the end of 2016.

Customers who's referral generated a sale by the Trade Ally were triggered a star rating survey to rate their experience with using a referred contractor. The Program had a 26% response rate and scored the experience at a 4.8 out of 5 stars.

Issues

The buy-in and participation of the Trade Ally network is vital to the success of the Program. The Program continues to transform the market; shifting market practices away from some of the more commonly utilized practices which rely heavily on decentralized training and varying knowledge levels, as well as imprecise and manual field calculations, towards industry trained and certified trade allies using higher quality diagnostic instruments and processes. The Company has continued to struggle to gain contractor acceptance with the tune and seal measures due to the required diagnostic equipment purchases, obtaining additional industry certifications and altering current business practices. The Program will look to sunset the HVAC tune up measures during 2017 to help improve cost effectiveness of the program and continue to concentrate on providing training for the Quality Installation diagnostic measure which has widely been accepted across the jurisdiction.

- **Marketing Strategy**

Promotion of the HVAC segment of the Program is primarily targeted to HVAC and home performance contractors as well as new home builders. Trade Allies are important to the Program's success because they interface with the customer during the decision-making event, which does not occur often for most customers.

Program information and Trade Ally enrollment links are available on the Program's website to educate customer about the Program and encourage participation. By increasing the overall awareness of the Program and the participation of Trade Allies, it ensures more customers are discussing the benefits of the Program at time of purchase.

The Program implemented several customer marketing campaigns during 2016 which leveraged channels such as bill inserts and email messaging to build awareness of the program. Other channels such as a paid search and co-branded direct mail campaigns with selected Trade Allies were also utilized to create awareness for the program.

The Program also conducted phase II of the thermal imaging prototype which generated awareness to 25,000 customers in the Charlotte, NC market around inefficiencies identified using a full thermal imaging scan of the home. Customers were encouraged to contact Duke Energy to receive a free energy audit by a participating trade ally in an effort to increase participation in program measures. There were 196 customer that participated in the prototype.

- **Evaluation, Measurement and Verification**

There is currently no evaluation activity for this Program. The next process and impact evaluation report is scheduled for completion in fourth quarter of 2017 with activities beginning early 2017.

- **Appendix**

Residential HVAC – Bill Insert

Get up to $600 back. Savings can really add up with our new HVAC rebate options.

DUKE ENERGY. | Smart $aver®

WITH MORE OPTIONS FOR REBATES THAN EVER, **SAVE YOUR WAY.**

There's never been a better time to upgrade your HVAC your way. Duke Energy now offers more rebates on more equipment options than ever – and we even have rebates that include smart thermostats. Choose the option that works best for you and you could get up to $600 back from Duke Energy.

Visit duke-energy.com/YourWay for more details.

Upgrade HVAC with quality installations and **get up to $600 in rebates.**

+

Save up to $300 per year after that.

 30827-I-0058

Residential HVAC – Referral Special Offer Campaigns

Going fast.

Save up to $1,200 on a new AC before XX date.

COOL DEAL

$300 off 16 SEER HVAC

$600 rebate

$300 annual energy savings

$1,200 total savings

DUKE ENERGY. | Smart $aver®

Replace your old AC now and save!

When summer's heat hits, is your AC working harder and cooling less? If your system is more than 10 years old, it's probably time for an upgrade.

Act now and **save up to $1,200** with this special offer:
$300 off new 16 SEER HVAC system
$600 in rebates from Duke Energy
$300 in annual energy savings

Visit **duke-energy.com/coolrebates** and enter the promo code below.

Or call 866.785.6209.

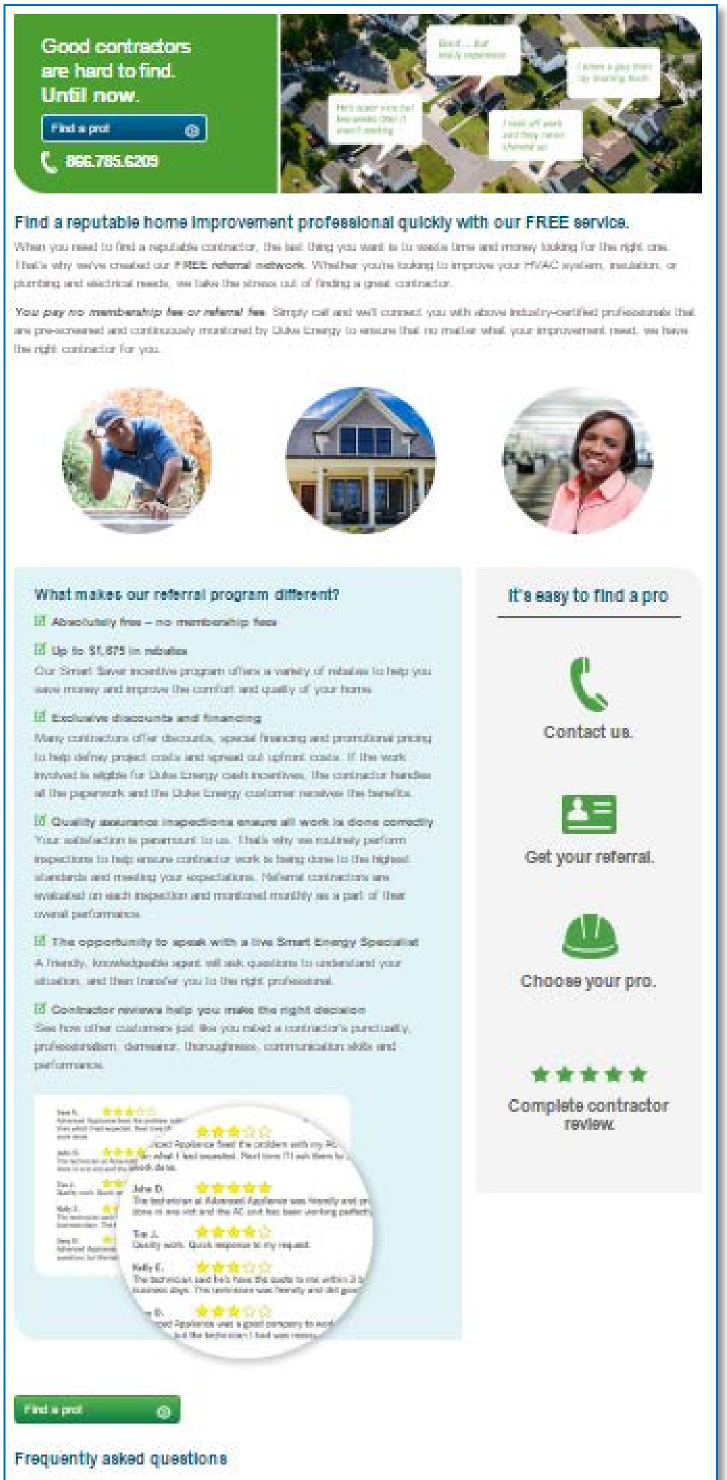
Promo Code: XXX

DUKE ENERGY. | Smart $aver®

ST24A | 400 South Tryon Street
Charlotte, NC 28202

Residential HVAC – Billboard Campaigns

Residential HVAC Referral Web Landing Page



Good contractors are hard to find. Until now.

Find a pro!

866.785.6209

Find a reputable home improvement professional quickly with our FREE service.

When you need to find a reputable contractor, the last thing you want is to waste time and money looking for the right one. That's why we've created our **FREE referral network**. Whether you're looking to improve your HVAC system, insulation, or plumbing and electrical needs, we take the stress out of finding a great contractor.

You pay no membership fee or referral fee. Simply call and we'll connect you with above industry-certified professionals that are pre-screened and continuously monitored by Duke Energy to ensure that no matter what your improvement need, we have the right contractor for you.

What makes our referral program different?

- Absolutely free – no membership fees
- Up to $1,875 in rebates
  Our Smart Saver incentive program offers a variety of rebates to help you save money and improve the comfort and quality of your home.
- Exclusive discounts and financing
  Many contractors offer discounts, special financing and promotional pricing to help defray project costs and spread out upfront costs. If the work involved is eligible for Duke Energy cash incentives, the contractor handles all the paperwork and the Duke Energy customer receives the benefits.
- Quality assurance inspections ensure all work is done correctly
  Your satisfaction is paramount to us. That's why we routinely perform inspections to help ensure contractor work is being done to the highest standards and meeting your expectations. Referral contractors are evaluated on each inspection and monitored monthly as a part of their overall performance.
- The opportunity to speak with a live Smart Energy Specialist
  A friendly, knowledgeable agent will ask questions to understand your situation, and then transfer you to the right professional.
- Contractor reviews help you make the right decision
  See how other customers just like you rated a contractor's punctuality, professionalism, demeanor, thoroughness, communication skills and performance.

It's easy to find a pro

Contact us.

Get your referral.

Choose your pro.

Complete contractor review.

Find a pro!

Frequently asked questions

+ Show All

Residential HVAC Referral Social Ad

A. Description

The purpose of the Low Income Energy Efficiency and Weatherization Assistance Program ("Program") is to assist low income customers with energy efficiency measures in their homes to reduce energy usage. There are three offerings currently in the Program:

- Neighborhood Energy Saver ("NES")
- Weatherization and Equipment Replacement Program ("WERP")
- Refrigerator Replacement Program ("RRP").

WERP and RRP are available for income-qualified customers in Duke Energy Carolinas, LLC's (the "Company's") service territory for existing, individually metered, single-family, condominiums, and mobile homes. Funds are available for (i.) weatherization measures and/or (ii.) heating system replacement with a 14 or greater SEER heat pump, and/or (iii.) refrigerator replacement with an Energy Star appliance. The measures eligible for funding will be determined by a full energy audit of the residence. Based on the results of the audit, customers are placed into a tier based on energy usage (Tier 1, which provides up to $600 for energy efficiency services; and Tier 2, which provides up to $4,000 for energy efficiency services, including insulation), allowing high energy users to receive more extensive weatherization measures. WERP and RRP are delivered in coordination with State agencies that administer the state's weatherization programs.

Customers participating in the NES receive a walk-through energy assessment to identify energy efficiency opportunities in the customer's home and a one-on-one education on energy efficiency techniques and measures. Additionally, the customer receives a comprehensive package of energy efficient measures. RNP participants may have the measures listed below installed in their home based on the opportunity identified from the energy assessment.

1. Compact Fluorescent Bulbs (CFL's) - Up to 15 CFL's to replace incandescent bulbs.
2. Electric Water Heater Wrap and Insulation for Water Pipes.
3. Electric Water Heater Temperature Check and Adjustment.
4. Water Saving Faucet Aerators - Up to three faucet aerators.
5. Water Saving Showerheads - Up to two showerheads.
6. Wall Plate Thermometer.
7. HVAC Winterization Kits – Up to three kits for wall/window air conditioning units will be provided along with education on the proper use, installation and value of the winterization kit as a method of stopping air infiltration.
8. HVAC Filters - A one-year supply of HVAC filters will be provided along with instructions on the proper method for installing a replacement filter.
9. Air Infiltration Reduction Measures - Weather stripping, door sweeps, caulk, foam sealant and clear patch tape will be installed to reduce or stop air infiltration around doors, windows, attic hatches and plumbing penetrations.

Audience

WERP is available to qualified customers in existing individually-metered, owner-occupied single-family residences, condominiums or manufactured homes.

RRP is available to qualified customers in individually-metered residences irrespective of whether the property owner or the tenant owns the refrigerator.

NES is available to individually-metered residential customers in selected neighborhoods where ~50% of the homeowners have income equal to or less than 200% of the Federal Poverty Guidelines, based on third party and census data.

B &C. Impacts, Participants and Expenses

Income Qualified Energy Efficiency and Weatherization Assistance[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$3.3**	**$2.4**	**74%**
Program Cost	**$10.6**	**$4.8**	**45%**
MW	**1.0**	**0.7**	**67%**
MWH	**5,010.0**	**4,259.3**	**85%**
Units	**10,421**	**9,336**	**90%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

In 2016, NES offered free walk-through energy assessments to 13 qualifying neighborhoods; Charlotte, NC, Reidsville, NC, Spindale, NC, Thomasville, NC, Burlington, NC and Greensboro, NC, China Grove, NC, N. Wilkesboro, NC, Spencer, NC, Pickens, SC, Ninety-Six, SC, York, SC and Pendleton, SC, serving a total of 8,502 customers. Neighborhood events have included support from community groups and speakers such as elected officials, community leaders and community action agency representatives. Starting 2016, one vendor now services all jurisdictions. Starting January 2016, the program is called “Neighborhood Energy Saver” (NES) which provides a consistent name across all jurisdictions.

Starting 2017, the program will transition from CLFs to LEDs.

The Company launched WERP and RRP in February 2015 in North Carolina and South Carolina. The Company selected the program administrator, North Carolina Community Action Agency (NCCAA), in December 2014 via a request for proposal. The company is working with the NC and SC Weatherization Agencies to deliver this program. In 2016, 724 families received weatherization assistance in conjunction with the DOE weatherization program, with 133 refrigerators replaced, 80 Tier 1 services provided and 621 Tier 2 services provided.

E. Marketing Strategy

WERP and RRP plan to piggy-back the marketing efforts of the current state Weatherization Assistance Programs administered by the state weatherization service providers. Additionally, agencies may utilize referrals generated from other Company energy efficiency programs as well as from their existing pool of weatherization applicants.

NES continues to target neighborhoods with a significant low-income customer base using a grassroots marketing approach to interact on an individual customer basis to gain trust. Participation is driven through a neighborhood kick-off event that includes trusted community leaders and local and state officials explaining the benefits of the Program. The purpose of the kick-off event is to rally the neighborhood around energy efficiency and to educate customers on methods to lower their energy bills. Customers have the option to make an appointment for an energy assessment at the time of the event.

In addition to the kick-off event, the Company plans to use the following avenues to inform eligible customers about the Program:

- Direct mail (letters and reminder post cards)
- Door hangers
- Press releases and/or neighborhood flyers
- Community presentations and partnerships
- Inclusion in community publications such as newsletters, etc.

F. Evaluation, Measurement and Verification

The process and impact evaluation report for the Neighborhood Energy Saver portion of the Program was completed in fourth quarter of 2016.

The process evaluation included interviews with program management, implementation contractors, and customer participants. Customer interviews were included as part of the data collection to better understand sources of program awareness, measure verification, use and satisfaction, effectiveness of one-on-one education and leave-behind materials, behavioral changes, and participant spillover.

The impact evaluation determined the net program savings by conducting a billing analysis. The evaluation will verified the key inputs to the engineering algorithms for the kit items provided to Residential Neighborhood Program participants.

Low Income Weatherization Program participation began in August 2015. Impact evaluation plans include a billing analysis; however there is not sufficient billing data available at this time to conduct the evaluation in 2016. The evaluation report is now tentatively planned for the fourth quarter of 2017.

A. Description

The Multi-Family Energy Efficiency program (“Program”) provides energy efficient lighting and water measures to reduce energy usage in eligible multi-family properties. The Program allows Duke Energy Carolinas, LLC (the “Company”) to utilize an alternative delivery channel which targets multi-family apartment complexes. The measures are installed in permanent fixtures by Franklin Energy the program administrator or the property management staff. Franklin Energy is in charge of all aspects of the Program which include outreach, direct installations and customer care.

The Program helps property managers save energy by offering energy efficient lighting and water products. The program offered 13 watt CFLs through November 2016 and transitioned to LEDs beginning in December. The new LEDs include A-Line, Globes and Candelabra bulbs. Property managers also receive energy efficient water measures such as bath and kitchen faucet aerators, water saving showerheads and pipe wrap. The quantity of lighting measures installed is based on apartment size. Franklin Energy may install up to 12 bulbs in a one bedroom apartment, up to 15 bulbs in a two bedroom apartment and up to 18 bulbs in a three bedroom apartment. Water measures are available to eligible customers with electric water heating. These measures assist with reducing maintenance costs while improving tenant satisfaction by lowering energy bills.

The Program offers a direct install (“DI”) option service by Franklin Energy. However, property managers still have the option for their property maintenance crews to complete the installations, upon request. The lighting measures and water measures are installed during scheduled direct install visits by Franklin Energy crews or routine maintenance visits by property personnel. In the case of direct installs, crews carry tablets to keep track of what is installed in each apartment. In the case of DIY installations, the property maintenance crew tracks the number of measures installed and reports them back to Franklin Energy. Franklin Energy then validates this information and submits the results to the Company.

After installations are completed, Quality Assurance (“QA”) inspections are conducted on 20 percent of properties that completed installations in a given month. The QA inspections are conducted by an independent third party.

Audience

The target audience is property managers who have properties that consist of four or more units and are served on an individually metered residential rate schedule. In order to receive water measures, apartments must have electric water heating.

Properties that have already been served by the Property Manager CFL program are only eligible for water measures.

B &C. Impacts, Participants and Expenses

Multi-Family Energy Efficiency[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$7.6**	**$9.2**	**121%**
Program Cost	**$1.9**	**$2.5**	**134%**
MW	**1.0**	**1.6**	**154%**
MWH	**12,320.0**	**16,569.6**	**134%**
Units	**151,004**	**269,651**	**179%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

The Program completed installations at 255 properties in 2016 accounting for close to 24,159 units. The Program installed over 269K measures with lighting measures representing 45 percent of the participation and water measures representing 55 percent of the participation.

Potential Change

The Company is considering upgrading the Program's lighting technology from CFLs to LEDs. Internal work to evaluate cost effectiveness for LED A-line, Globes and Candelabra bulbs for specialty applications in on-going.
These above changes were implemented in December of 2016. The program now offers LED A-line, Globes, and candelabra bulbs.

Issues

During the course of 2016, the Program Manager for the Multi-family Program became aware that a small number of multi-family facilities with less than four units were being allowed to participate in the program. Upon further investigation, it was determined that a contract employee for the third-party program administrator, was solely responsible for facilitating this violation of program eligibility rules. The third-party program administrator has since worked to incorporate controls in the process to prevent future errors and terminated the responsible employee, since it was determined the inappropriate processing tracked back to the 2015 program year. While the participation of multi-family facilities with less than four units violated the approved tariffed eligibility guideline, there were no inaccuracies in the reported costs or the energy saving impacts associated with the participation, so no adjustments were required in this filing and the program continues to operate as approved.

E. Marketing Strategy

As program implementer, Franklin Energy is responsible for marketing and outreach to property managers. This is primarily done through outbound calls and on-site visits to understand initial interest in the program from property managers in the Company's service territory. The Program also utilizes local apartment association memberships to obtain access to contact information for local properties and attend any association trade shows or events to promote the program.

In addition to proactively marketing the Program using these tactics, a Multi-Family Energy Efficiency promo and public website landing were developed for property managers to learn more about the Program. Once enrolled, Franklin Energy provides property managers with a variety of marketing tools to create awareness of the Program to their tenants.. At the conclusion of the installation, window clings will be placed in strategic area throughout the property. Placement of the window clings at a minimum will be at the common areas entry and each residential building on site (to the extent applicable). Using the window cling ensures that the program and Duke Energy are recognized long after the installation has taken place. In addition, tenants are provided an educational leave-behind brochure when the installation is complete. This provides additional details on the installed measures as well as tear-off customer satisfaction survey to fill out and mail back to the Company to provide valuable Program feedback.

Another way a property manager may learn more about this Program is through the MyDuke Portal, an online tool, when they login to pay the bills of vacant units at their property. The MyDuke Portal presents a promo link that directs the user to the Program website for more information.

F. Evaluation, Measurement and Verification

For 2016, the impact and process evaluation was a combined evaluation between Duke Energy Progress and Duke Energy Carolinas, with a final report completed in the fourth quarter of 2016. Duke Energy Carolinas evaluated lighting measures only.

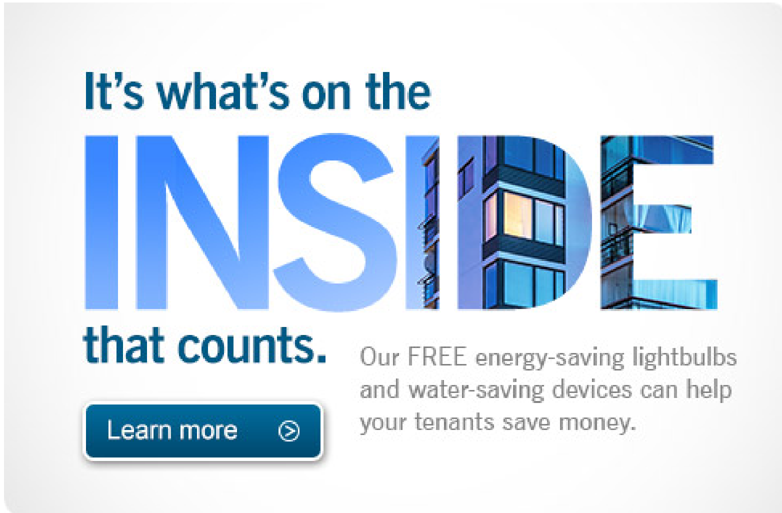
The impact evaluation consisted of estimating annual energy and demand impacts associated with program participation. The primary activity involved an engineering-based analysis to estimate the impacts of the various program measures. The analysis was supplemented by on-site field verification of sampled participants.

Samples of tenants and property managers will be selected for the process evaluation, which will collect information needed to estimate net impacts, assess program satisfaction, and identify program improvement opportunities.

Appendix

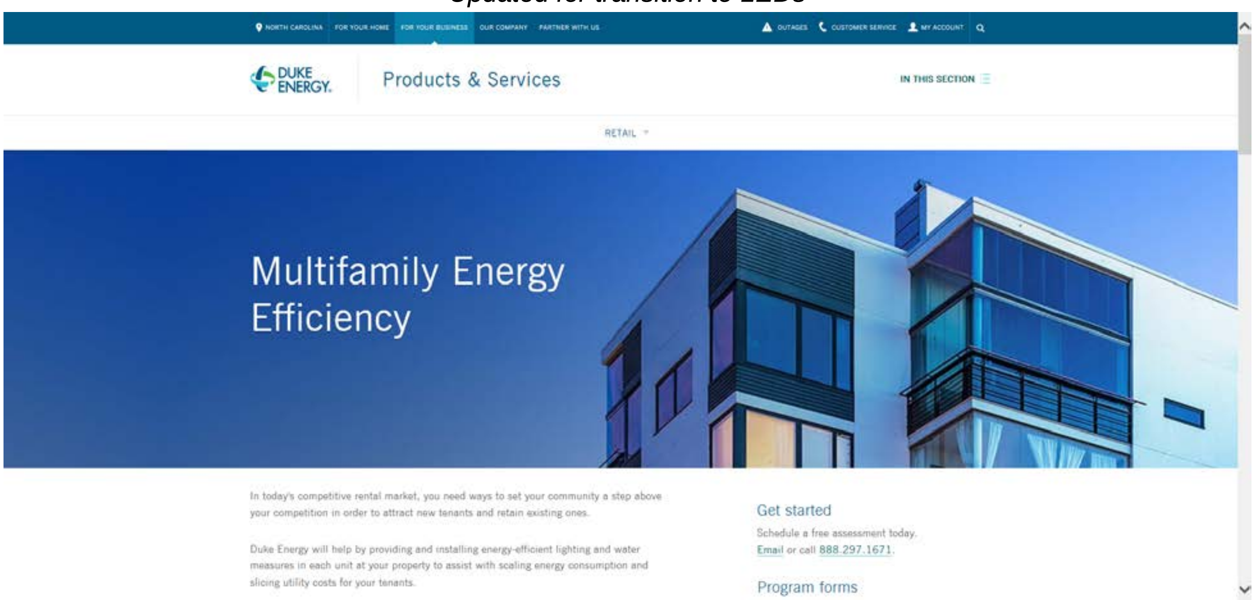
State Landing Page Promotion (Hero Banner)-

Updated for transition to LEDs



Program Web Page

Updated for transition to LEDs



Program Brochure-
Updated for transition to LEDs

Window Cling-
New for 2016

Tenat Leave Behind-

Updated for transition to LEDs

Multifamily Energy Efficiency Program

DUKE ENERGY.

Based on an assessment of your unit, these products were selected to offset your monthly energy usage:

Electric

Straight Line, Globe and Candelabra LED Lightbulbs

LEDs last longer and use up to 90 percent less energy than incandescent bulbs.

Water

(Water-saving products are only installed in properties that use electricity to heat water.)

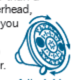
Faucet aerators*

Faucet aerators installed in the kitchen and bathroom use up to 55 percent less water than standard faucet aerators.

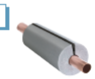
Black handle allows for adjustable flow

Showerhead*

An energy-efficient 1.5-gpm showerhead will use less water than a regular showerhead, which means you can also use less energy to heat the water.



Adjustable flow



Pipe wrap*

Hot water pipe wrap reduces water and energy use by preventing heat loss while hot water travels through the pipes.

*Provided only to properties that use electricity to heat water.

For more information, contact the Multifamily Energy Efficiency Program at 888.297.1671 or dukeenergymultifamilyeep@franklinenergy.com. Or, visit duke-energy.com/multifamily.

Note that this program is administered by Franklin Energy, a contractor of Duke Energy with experience in the installation of home energy-saving products.

Customer Survey

Thank you for participating in this program. We'd like to know how we did installing your new energy-saving products. Please complete the below survey and mail it to us. The survey is also available online at duke-energy.com/multifamilysurvey.

Property name:

Address: Unit No.: City: State: ZIP:

Email:

I was notified in advance of this work. ❑ Yes ❑ No

I was at home while the technicians installed the products. ❑ Yes ❑ No

The technicians' ID badges were visible. ❑ Yes ❑ No ❑ N/A

I am interested in receiving additional information on energy efficiency. ❑ Yes ❑ No

What effect has your participation in the Multifamily Energy Efficiency Program had on your overall satisfaction with Duke Energy? ❑ Positive effect ❑ Negative effect ❑ No effect ❑ Don't know

Using a scale of 1 to 10, please rate your level of agreement with the following statements (circle your response):

	not at all satisfied									completely satisfied
Overall, I was satisfied with the Duke Energy Multifamily Energy Efficiency Program.	1	2	3	4	5	6	7	8	9	10
The technicians respected my property and left it in good condition.	1	2	3	4	5	6	7	8	9	10
The technicians treated me with courtesy.	1	2	3	4	5	6	7	8	9	10
The technicians were knowledgeable about the products and answered my questions.	1	2	3	4	5	6	7	8	9	10
The leave-behind materials are informative.	1	2	3	4	5	6	7	8	9	10

Comments:

DE_LeaveBehindLW_091316

Multifamily Energy Efficiency Program FAQs

Questions? We have your answers.
Here's what you need to know before you get started with this program.

PROGRAM BENEFIT QUESTIONS

Do I have to pay to participate in the program?
Qualified property managers do not pay for these energy-saving products. When you take advantage of the Duke Energy Multifamily Energy Efficiency Program, not only will you receive free upgrades, but you will also help to increase retention rates and attract new tenants.

What's the value of letting us install these energy-saving products?

Straight Line, Globe and Candelabra LED Lightbulbs

Use **up to 90 percent less energy** and **can save an average of $80** over their lifetime in energy costs compared to traditional incandescent bulbs. A popular residential option, ENERGY STAR® light-emitting diodes, or LEDs, can be installed in bathrooms, permanent fixtures, ceiling fans, chandeliers and other high-usage areas.

Bathroom and Kitchen Faucet Aerators

Use **up to 55 percent less water** than traditional 2.2-gallons-per-minute (gpm) faucets, which can reduce water and sewer costs, as well as the amount of energy used to heat the water.*

Black handle allows for adjustable flow

Water-saving Showerheads

Use **up to 40 percent less water** than traditional 2.5-gpm showerheads, which can reduce water and sewer costs, as well as the amount of energy used to heat the water.*

Adjustable flow

Hot Water Pipe Wrap

Reduces water and energy use by preventing heat loss while hot water travels through your building's pipes.*

*Savings are not guaranteed.

A. Description

The My Home Energy Report ("MyHER" or the "Program"), is a periodic comparative usage report that compares a customer's energy use to similar residences in the same geographical area based upon the age, size and heating source of the home. Energy saving recommendations are included in the report to encourage energy saving behavior.

The reports are distributed up to 12 times per year (delivery may be interrupted during the off-peak energy usage months in the fall and spring). The report delivers energy savings by encouraging customers to alter their energy use. Customer's usage is compared to the average home (top 50 percent) in their area as well as the efficient home (top 25 percent). Suggested energy efficiency improvements, given the usage profile for that home, are also provided. In addition, measure-specific offers, rebates or audit follow-ups from other Company offered programs are offered to customers, based on the customer's energy profile.

Audience

Target customers reside in individually-metered, single-family and multifamily residences with an active account and concurrent service from Duke Energy Carolinas, LLC (the "Company"). Multifamily residences must have a registered email address with the Company to be eligible.

B & C. Impacts, Participants and Expenses

My Home Energy Report[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$17.4**	**$20.8**	**120%**
Program Cost	**$12.2**	**$10.8**	**89%**
MW	**55.3**	**71.8**	**130%**
MWH[2]	**204,879.9**	**283,569.9**	**138%**
Units	**1,050,000**	**1,202,664**	**115%**

1) Values are reflected at the system level.
2) Units represents the average monthly participation.
3) Numbers rounded.

D. Qualitative Analysis

As customers receive subsequent reports, their engagement increases as they learn more about their specific energy use and how they compare to their peer group. The report then provides customers tools to reduce their usage in the form of targeted energy efficiency tips that provide customers with actionable ideas to help them become more efficient. Program participants are encouraged to contact the Company with their questions, comments and report corrections. Report corrections continue to generate the largest number of inquiries. Customers wishing to be removed from the Program represent less than one tenth of one percent of Program participants.

Highlights

The Company developed an interactive online portal which allows customers to further engage and learn more about their energy use and opportunities to reduce their usage. Customers are able to set goals, track their progress to goal, and receive more targeted tips. As of December 31, 2016, there were 21,103 customers enrolled on the portal. In June 2016, the company also began sending out electronic versions of the MyHER to these customers enrolled on the portal.

In the cooling season of 2016, within a subgroup of participants DEC-NC, the company tested a behavioral notification mechanism to drive an increase in the coincidental peak demand savings of MyHER. Electronic communications were issued to this subgroup in advance of a peak event, to request a voluntary curtailment of demand, and this same group received a comparative report of their response to the request within 1-2 days after the peak event. The intention of the test was to ascertain the incremental peak demand savings driven by this notification, and to identify any related impact on customer satisfaction. While this test was informative, the Company has decided at this time not to pursue additional testing or implementation due to the lack of measurable impacts with the specific test run.

As of November 1, 2016, the company rolled out a MyHER program targeted to customers living in multifamily dwellings with a registered email address with the Company.

E. Marketing Strategy

Marketing for the Program consists of proactive communication through distribution of reports supported by a program website featuring additional information on the reports, Frequently Asked Questions ("FAQs") and contact resources. The MyHER Interactive portal is marketed by email campaigns as well as in the printed report.

F. Evaluation, Measurement and Verification

The next process and impact evaluation report is scheduled for completion in first quarter of 2017.

For the process evaluation, a sample of participants were surveyed to inform the Program about attitudes, awareness, and MyHER effects on customer engagement and interest in reducing household energy use. The impact analysis estimated the total net energy change in treated homes during the evaluation period compared to a control group consisting of non-treated homes. In addition, the evaluation assessed incremental net impacts from the Program encouraging MyHER customers to visit the Interactive Portal.

A. Description

Power Manager® ("Program") is a demand response program that cycles residential central air conditioning during high summer peak demand periods. Duke Energy Carolinas, LLC (the "Company") installs a load cycling device near the outdoor unit of a qualifying air conditioner. This enables the customer's air conditioner to be cycled off and on when the Company initiates a control event. During these events, the Company can perform cycling or full shed interruptions of participating customers' air conditioning systems at any time to mitigate capacity constraints in the generation, transmission or distribution systems.

Program participants receive a financial incentive as a bill credit in the amount of $8 per month from July through October ($32 annually).

There is no adverse impact on the customer's air-conditioning system. The load control device has built-in safeguards to prevent the "short cycling" of the air-conditioning system. Cycling simply reduces the amount of time the air-conditioning system runs in a given period. Additionally, the indoor fan will continue to run and circulate air during the cycling event.

Audience

The Program is available to the Company's residential customers residing in owner-occupied, single-family residences with a qualifying central air-conditioning unit.

B & C. Impacts, Participants and Expenses

PowerManager[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$60.0**	**$54.2**	**90%**
Program Cost	**$12.9**	**$13.7**	**106%**
MW[2]	**504.2**	**455.4**	**90%**
MWH	**0.0**	**N/A**	**-**
Units[3]	**474,675**	**428,731**	**90%**

Notes on Tables:

1) Values are reflected at the system level.

2) MW capability at the generator derived from the average reduction during the June - September control season achieved by a full shed of participating air conditioners. Vintage 2016 achievements are based on an average of 225,951 Power Manager devices during the June-September control season.

3) Units included in filing represented average kW at the meter during the June - September control season.

4) Numbers rounded.

D. Qualitative Analysis

Power Manager Events

The Company initiated four Power Manager cycling events for customers in North Carolina and South Carolina in the summer of 2016. One each in June and July, and two in September. Prior to these events, Power Manager tests were conducted on two successive days in early June in coordination with Duke Energy Carolinas' System Operations Center to ensure system readiness. In addition, 14 Evaluation, Measurement and Verification events were conducted in 2016 with 119 customers in the company's research sample.

Power Manager Device Replacement

By year end 2016, only 51 older Power Manager devices remained of the nearly 170,000 in place when the Company began a multi-year replacement project in 2011. Final efforts in the replacement work was continuing at year-end. This included the first of two letters mailed to customers requesting they contact us to make arrangements for accessing their property and the Power Manager device in order to remain on the program. If no response, a second and final letter will be mailed in January, 2017.

E. Marketing Strategy

The Company continued its successful marketing of the Power Manager program throughout 2016. Utilizing outbound telephone marketing and a successful spring email offer, Power Manager had a net growth of 16,863 customers (9.5% increase); resulting in a total of 233,007 air conditioners on the program by year-end.

Duke Energy Carolinas mailed the annual notification to participating Power Manager customers at the beginning of June. This serves several purposes:

- It gives the Company a chance to say thank you for being on the program and making a difference.
- It reminds customers of their participation in the program.
- It provides customers with insight about Power Manager: how it works, its benefits, summer time tips, and other information.

Program information and an enrollment form are available to customers on the Power Manager website located at http://www.duke-energy.com/north-carolina/savings/power-manager.asp.

F. Evaluation, Measurement and Verification

Power Manager process and impact evaluations are being conducted by Nexant in 2016. The process evaluation will focus on providing insight for the continuous improvement of the Power Manager program. The impact evaluation results are used to determine the MW impacts of Power Manager events. Both evaluations are scheduled to be completed in the first quarter of 2017.

G. Appendix

Spring Email

This message contains graphics. If you do not see the graphics, click here to view.

DUKE ENERGY®

Earn money for taking a load off.

Get up to $32 off your summer bills – just by helping our region use less energy at peak demand times.

If last summer's energy bills were a bit heavy on the wallet, our Power Manager program can help make this year's bills a little lighter. Enroll now to save up to $32 this summer.

How does the program work?

On a handful of weekday afternoons during the summer, when energy demand is at its highest, Power Manager helps reduce the amount of time your AC runs for a few hours. That helps us keep costs lower and helps keep everyone's rates down. Most people tell us they don't even notice.

Learn more and watch our short video

Enroll now

You'll enjoy:

- $32 in bill credits ($8 each from July-October)
- Knowing you're helping the community by taking a load off the power grid
- Helping the environment and making a positive impact

Update your subscriptions | Privacy Policy | Unsubscribe | www.duke-energy.com

Duke Energy | 550 South Tryon Street | Charlotte, NC 28202

Thank You/Reminder Postcard

Device Replacement Postcard

DUKE ENERGY®

Important Information about Duke Energy's Power Manager® Program

Thank you for participating in **Power Manager®** – a voluntary program that pays you for allowing Duke Energy to reduce your air conditioning runtime when electricity demand is especially high. Reducing electricity use during peak periods lessens our dependence on less efficient and more expensive power sources, resulting in savings to you and benefits to the environment.

In the coming weeks, a technician from our partner GoodCents, will replace the Power Manager device near your air conditioning unit outside your home at

<**789 Main St.**>

By upgrading older devices, we are increasing the program's effectiveness. And like your old device, the new one is completely safe and does not harm your air conditioning unit. All work will be done outside your home and completed at no cost to you.

In most cases, you do not need to be present. If your property has a locked fence or outdoor pets we need to know about, or you have questions, please contact us:

Phone: **800-777-9898** select option 4

To learn more about Power Manager, visit **www.duke-energy.com/PowerManager**.

Thank you for making a difference.

SE

Non-Residential Smart $aver Prescriptive

A. Description

The Non-Residential Smart $aver® Prescriptive Program ("Program") provides incentives to Duke Energy Carolinas, LLC's (the "Company's") commercial and industrial customers to install high efficiency equipment in applications involving new construction and retrofits and to replace failed equipment. The program also uses incentives to encourage maintenance of existing equipment in order to reduce energy usage. Incentives are provided based on the Company's cost effectiveness modeling to assure cost effectiveness over the life of the measure.

Commercial and industrial customers can have significant energy consumption but may lack knowledge and understanding of the benefits of high efficiency alternatives. The Program provides financial incentives to help reduce the cost differential between standard and high efficiency equipment, offer a quicker return on investment, save money on customers' utility bills that can be reinvested in their business, and foster a cleaner environment. In addition, the Program encourages dealers and distributors (or market providers) to stock and provide these high efficiency alternatives to meet increased demand for the products.

The Program promotes prescriptive incentives for the following technologies – lighting, HVAC, pumps, variable frequency drives, food services, process and information technology equipment.

Audience

All of the Company's non-residential opt-in customers billed on an eligible Duke Energy Carolinas rate schedule

B & C. Impacts, Participants and Expenses[1]

Non Residential Smart Saver Prescriptive

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$65.3**	**$130.0**	**199%**
Program Cost	**$11.6**	**$42.4**	**367%**
MW	**18.0**	**30.8**	**171%**
MWH	**105,656.6**	**182,721.0**	**173%**
Units	**2,165,635**	**5,159,807**	**238%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

The Program has developed multiple approaches to reaching the very broad and diverse audience of business customers. In 2016 this consisted of incentive payment applications, with paper and online options, and instant incentives offered through the midstream marketing channel and the Online Energy Savings Store. The 2016 results far exceeded previous expectations due to several key factors:

- LED fixture and lamp measures that were added in late 2015 saw a huge response in 2016
- New online application provided a new, easier way to apply
- Midstream marketing channel added a new tool to submit reimbursement claims, which attracted more distributors to the program
- Outreach expanded the number of Trade Allies working with the program
- Targeted marketing reached out to customers and Trade Allies
- Customer service improved with a dedicated team of representatives answering customer questions via phone and email
- Business energy advisors provided medium businesses with personalized relationships to identify and support new EE projects

[1] The information reflects results for the Non-Residential Smart $aver Prescriptive program in aggregate. Reference the Appendix for results by technology.

PAPER AND ONLINE APPLICATIONS
During 2016, 6,240 applications, consisting of 13,445 measures, were paid for Duke Energy Carolinas prescriptive incentives. Application activity last year was more than double 2015. During 2016, 40% of applications were submitted via the new online application portal. Similar application increases have been seen in Duke Energy's other jurisdictions. Much of this increase has been attributed to the new high efficiency LED lighting measures that were added to the program at the end of 2015. The average payment per paid application was $4,871.

Many Trade Allies participating in the application process reduce the customer's invoice by the amount of the Smart $aver® Prescriptive incentive and then receive reimbursement from Duke Energy. Customers often prefer this rather than paying the full equipment cost upfront and receiving an incentive check from Duke Energy. More information is provided on the next page, as to how the Program engages with Trade Allies.

As of 1/1/2016, the Program applications are no longer administered by a third party. Duke Energy has developed an internal database that allows the Program to self-administer and analyze program data more efficiently for better performance.

MIDSTREAM MARKETING CHANNEL
The midstream marketing channel provides instant incentives to eligible customers at a participating distributor's point of purchase. Approved midstream distributors validate eligible customers and selected lighting, HVAC, food service and IT products through an online portal, and use that information to show customers the incentive-reduced price of high efficiency equipment. Upon purchase, the distributor reduces the customer's invoice for eligible equipment by the amount of the Smart $aver® Prescriptive incentive. Distributors then provide the sales information to Duke Energy electronically for reimbursement. The incentives offered through the midstream channel are consistent with current program incentive levels.

In 2016, Duke Energy launched major improvements to this marketing channel by partnering with the third-party Energy Solutions. Energy Solutions provides the online portal for distributors to manage the paperless validation and incentive application, which is expected to help this channel grow significantly. In 2016, approximately 16% of the Smart $aver impacts were from participation through the midstream marketing channel. Duke Energy currently has 85 distributors signed up for the midstream channel, and an additional 6 that are in the process of joining. Duke Energy continues to work to add more well-known distributors to this channel. Duke Energy expects this channel to continue increasing participation in the Smart $aver Prescriptive program.

ONLINE ENERGY SAVINGS STORE
Duke Energy also offers the Business Savings Store on the Duke Energy website, with orders fulfilled by the third-party EFI. The site provides customers the opportunity to take advantage of a limited number of incentive measures by purchasing qualified products from an on-line store and receiving an instant incentive that reduces the purchase price of the product. In 2016, the Savings Store had 863 unique customers; 80% of which were repeat customers. The incentives offered in the store are consistent with current program incentive levels.

TRADE ALLY MANAGEMENT
Over the years, the Program has worked closely with Trade Allies (TA) to promote the program to our business customers at the critical point in time when customers are considering standard or high efficiency equipment options. Currently, there are 2,138 energy-efficiency equipment vendors, contractors, engineers, architects and energy services providers who are based in the Carolinas and registered as a TA with the Smart $aver® Non-residential programs (prescriptive and custom). The Smart $aver® outreach team builds and maintains relationships with TAs associated with the technologies in and around Duke Energy's service territory. Existing relationships continue to be cultivated while recruitment of new TAs also remains a focus. Duke Energy's efforts to engage TAs include the following activities:

- Trade Ally Search tool located on the Smart $aver® website
- Trade Ally co-marketing including information about the Smart $aver program in the TA's marketing efforts
- Online application portal training and support
- Midstream channel support
- Trade Ally year-end awards

- Trade Ally newsletter and monthly emails
- Technology- and segment-specific marketing collateral
- Trade Ally discussion group (20 trade allies that give input on program)
- Trade Ally training
- Sponsorship of trade ally events
- Online collateral toolkit for access to marketing materials

In 2016, a number of Trade Allies joined the Program that specifically target traditionally hard to reach small business customers. There were challenges with a subset of the new TAs, those that had previous experience with other utilities that have different program rules and expectations of conduct. The TA outreach team continues to diligently educate these TAs on the expectations of the Smart $aver program.

The Company continues to look for ways to engage the TAs in promotion of the Program as well as more effective targeting of TAs based on market opportunities.

Issues

Feedback from participating customers and Trade Allies is positive overall, and also provides some insight into the barriers to participating in the program. A small portion of customers report that the application process is too complex or cumbersome, and that the waiting time for payment can be too long. In response, the program continues to work to improve the application form and processing, as well as expand channels that do not require complex paperwork and offer faster incentive payment. Duke Energy also continues to reach out to those customers who have not yet participated in the Smart $aver® program.

As the program has matured, much of the low-hanging fruit is already gathered. In order to offer customers additional options for energy savings , Duke Energy periodically adds and updates measures to the Prescriptive portfolio. The additions made in late 2015 included LED measures that have been extremely popular, however it is infrequent that such a popular new category of equipment becomes available in the market. The Company continues to work with outside consultants and internal resources to develop strategies to understand equipment supply/value chains and increase awareness of these measures going forward.

Potential Changes

Standards continue to change and new more efficient technologies continue to emerge in the market. Duke Energy periodically reviews major changes to baselines, standards, and the market for equipment that qualify for existing measures, and explores opportunities to add measures to the approved Program that provide incentives for a broader suite of energy efficient products. As a result of this work in 2016, a limited number of new measures and measure updates are being launched in mid-January. These changes will be provided in the quarterly update under the flexibility guidelines. For existing measures that are changing, such as reductions to the incentive amount, a 90-day grace period is offered for applications on the past measure and incentive amount to allow customers to apply for incentives on equipment installations that occurred prior to the incentive change.

New measures in 2017:

- Agricultural Lighting
- Agricultural Non Lighting: Creep Heat Pad, Dairy Heat Reclaimer, Dairy Plate Cooler, Dairy Scroll Compressor, Engine Block Heater Timer, High Efficiency Fans, Low Energy Livestock Waterer, Low Pressure Sprinkler, Milk Vacuum Pump VFD
- Lighting - delamping of fluorescent 2', 3', 4', and 8' T8 (with and without reflector), as part of a lighting retrofit
- Interior induction lighting, indoor sport LED lighting
- Lighting Power Density for New Construction
- Updates to the 2' and 4' LED linear tube, and LED lamps reclassified into three categories: A-lamp, Decorative/Globe/3-way, and PAR/BR/MR
- Indoor and outdoor LED channel signs
- Controls: Lighting occupancy sensors (with and without daylighting control), photocells, time clocks, daylight sensors; occupancy sensors for plug load; and, escalator motor efficiency controller

- Process equipment: Air Receiver Tanks for Load/No Load Compressors, Compressed air audit and leak repair, cycling compressed air dryer, low pressure drop filter, no-loss condensate drain
- Demand Control Ventilation for Kitchen Exhaust Hood
- HVAC: Water source heat pump, and VSD on chiller

Measure removals in 2017:
- LED lamp measure (replaced with 3 updated measures)
- LED linear tube measures (replaced with 2 updated measures to change unit of measure)
- Occupancy sensors, remote-mounted daylight sensor, and switch/fixture-mounted daylight sensor (replaced with 3 updated measures to change unit of measure)
- Compact fluorescent screw-in bulb (complete removal due to market changes)

Incentive reductions in 2017:
- LED downlight ($15 reduced to $11)
- LED canopy fixtures ($137/$154/$175 reduced to $56/$105/$150)
- LED flood lights ($39/$98 reduced to $11/$29)
- LED refrigerated case lights ($39/$50 reduced to $14/$18)
- LED panel fixtures ($40/$40/$100 reduced to $25/$25/$50)

A similar review is being planned for 2017, with special emphasis on identifying new and updated lighting and HVAC measures, along with general program enhancements.

Duke Energy is considering new and innovative ways to reach out to customer segments that have had a lower rate of prescriptive incentive applications, and considering options to partner with other Duke Energy EE programs to cover gaps in the market. In 2017, a new retail marketing channel is being tested with the third-party Leidos. Similar to the midstream marketing channel, eligible customers that shop at selected Sam's Club stores located in Duke Energy Carolinas service area may purchase eligible LED lamps at an incentive-reduced price. Leidos provides the sales information to Duke Energy electronically for reimbursement. The test is being conducted for the first half of 2017, and based on the results will be considered for continuation and/or wider expansion.

In 2017, the Program plans to start offering new low-cost measures at no out-of-pocket cost to certain segments of customers. Analysis to finalize the measures is planned for the first half of 2017. Commission notification will be provided prior to the offering of these future measures. Similar initiatives are also under consideration.

The Program is also exploring an optional new process for customers to pre-verify equipment eligibility, which is designed to give customers certainty that their selected equipment qualifies for an incentive prior to purchase and will overcome another barrier that can delay investment in EE projects.

E. Marketing Strategy

Nonresidential customers are informed of programs via targeted marketing material and communications. The 2016 marketing plan includes direct marketing such as email and direct mail, online marketing (Hero banner), print marketing and supporting partnerships. The marketing team has selected a highlighted topic for each month, and promotes coordinated communication around that topic.

The following chart summarizes the campaigns during 2016. Example images are found on the following pages.

Month	Channel	Audience	Incentives Highlighted
Feb*	Email, Hero Banner	CRE, Retail, manufacturing, government	HVAC Baseline Changes

Mar*	Email, Direct Mail, Bill Insert, Hero Banner	All	LED Tubes
Apr*	Email, Hero Banner	CRE, Retail, manufacturing, government	Rooftop Tune-up and Advanced Rooftop Controls
May	Email, Direct Mail, Hero Banner	Warehouses, Retail, CRE, Manufacturing, Education, Hospitals	Cool Roof
Jun*	Email, Hero Banner	Lodging, Restaurants, Education, Hospitals, Gyms and Fitness Facilities	Water Conservation Measures
Jul*	Email, Direct Mail, Bill Insert, Hero Banner	All	Lighting Controls
Aug*	Email, Direct Mail, Hero Banner	Lodging, Colleges & Universities	Energy Management Controls
Sep*	Email, Hero Banner, Social Media	BSS and SBES customers	Window film, faucet aerators, water heater pipe insulation
Oct	Social Media	All	General Program
Nov*	Email, Direct Mail, Social Media	Restaurants, Lodging, Hospitals, Convenience Stores	Food Service

* Email also sent to the participating Trade Allies.

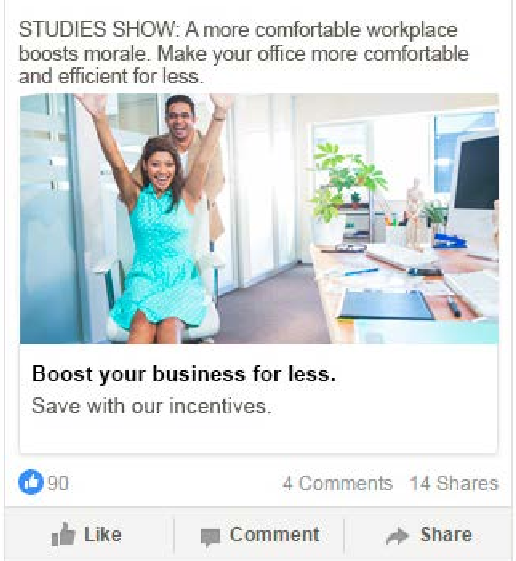
The internal marketing channel is comprised of assigned Large Business Account Managers, small and medium Business Energy Advisors, and Local Government and Community Relations, who all identify potential opportunities as well as distribute program collateral and informational material to customers and Trade Allies. Duke Energy has two business energy advisors in the Carolinas area to perform outreach to unassigned small and medium business customers. The business energy advisors follow up on customer leads to assist with program questions and steer customers to the trade ally search tool who are not already working with a trade ally. In addition, the business energy advisors are contacting customers with revenue between $60,000 and $250,000 to promote the Smart $aver® programs.

In addition, the Economic and Business Development groups also provide a channel to customers who are new to the service territory.

Bill Insert

Non-Residential Smart $aver Prescriptive

Link Ad



OLS Banner

Display Ad

F. Evaluation, Measurement and Verification

A process and impact evaluation report that encompassed participation between January 2013 and July 2015 for all Smart $aver prescriptive technologies was completed in July 2016.

Evaluation work for a process and impact evaluation is beginning the 3rd quarter of 2016, with a combined DEC and DEP final report in the fourth quarter of 2017.

The process evaluation will include interviews with program management, Trade Allies and customer participants. Customer and Trade Ally interviews will include data collection to gauge customer satisfaction, free-ridership and spillover.

The impact evaluation will consist of estimating annual energy and demand impacts associated with program participation. The primary activity will involve an engineering-based analysis to estimate the impacts of the various program measures. The analysis will be supplemented by on-site field verification of sampled participants, as well as database and deemed savings reviews.

G. Appendix

Non Residential Smart Saver Energy Efficient Food Service Products[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$0.8	$2.5	322%
Program Cost	$0.2	$0.3	133%
MW	0.1	0.4	297%
MWH	1,656.9	3,809.3	230%
Units	1,280	3,574	279%

1) Values are reflected at the system level.
2) Numbers rounded.

Non Residential Smart Saver Energy Efficient HVAC Products[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$10.4	$3.3	32%
Program Cost	$1.9	$1.5	77%
MW	2.9	0.8	28%
MWH	7,233.8	3,316.9	46%
Units	1,873,678	4,198,078	224%

1) Values are reflected at the system level.
2) Numbers rounded.

Non Residential Smart Saver Energy Efficient Lighting Products[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$49.2	$121.5	247%
Program Cost	$7.8	$39.7	508%
MW	13.9	29.1	209%
MWH	83,856.7	170,325.3	203%
Units	272,565	952,684	350%

1) Values are reflected at the system level.
2) Numbers rounded.

Non-Residential Smart $aver Prescriptive

Non Residential Energy Efficient Pumps and Drives Products[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$3.1	$1.6	51%
Program Cost	$1.0	$0.5	49%
MW	0.9	0.4	42%
MWH	7,239.3	2,494.3	34%
Units	6,773	3,361	50%

1) Values are reflected at the system level.

2) Numbers rounded.

Non Residential Energy Efficient ITEE[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$1.8	$0.8	44%
Program Cost	$0.6	$0.3	49%
MW	0.1	0.1	78%
MWH	5,572.9	2,462.0	44%
Units	10,861	759	7%

1) Values are reflected at the system level.

2) Numbers rounded.

Non Residential Energy Efficient Process Equipment Products[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$0.1	$0.3	377%
Program Cost	$0.0	$0.1	379%
MW	0.0	0.1	259%
MWH	97.0	313.1	323%
Units	478	1,351	283%

1) Values are reflected at the system level.

2) Numbers rounded.

A. Description

Duke Energy Carolinas, LLC's (the "Company's") Non-Residential Smart $aver® Custom Assessment (the "Program") offers financial assistance to qualifying commercial, industrial, and institutional customers to help fund an energy assessment or design assistance in order to identify energy efficiency conservation measures of an existing or new building(s) or system. The detailed study and subsequent list of suggested energy efficiency measures will reduce energy costs with the intent of also helping customers to utilize the Non-Residential Smart $aver® Custom and/or Prescriptive Programs. The deliverable of the Program is a detailed energy report that includes the above as well as the technical data needed for the Non-Residential Smart $aver® Custom and/or Prescriptive Program and to provide assistance with the Non-Residential Smart $aver® Application. All kWh and kW savings identified from measures implemented as a result of the pre-qualified assessments are solely counted to the Program.

The program was expanded in 2015 to include new construction design assistance. Design assistance assists customers with new construction, major renovations, and additions by providing design assistance to help enable construction beyond the applicable state energy code. Design assistance includes a number of benefits: 1) professional engineering and design resources, 2) computer simulated energy modeling to develop multiple energy efficiency design options providing each customer design choices 3) final computer simulated energy model with selected design, 4) support for application of Non-Residential Smart $aver® Custom and/or Prescriptive Incentives.
The intent of the Program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the Company's technical and financial assistance. The Program's application requires pre-qualification for eligibility. Currently, all assessments and design assistance are performed by professional engineering firms that have been pre-selected and contracted by the Company. The current engineering firms include: CB&I, Inc., ThermalTech Engineering, Inc., and CLEAResult.. Each offers a diversified set of skills that allow all qualifying commercial, industrial, and institutional customers to be supported.

In 2017, there are plans to modify the Program. The above contracted professional engineering companies will still be utilized for assessments if the customer chooses to select this resource option. Additionally, the Program will allow customers to seek third party engineering assistance of their own selection and receive the same financial assistance. Pre-established criteria will need to be met for the funds to be released in order that the Program maintains its high engineering standards and quality of work. By allowing flexibility and choice, the expectation is for the Program's participation to increase.

Audience

Pre-qualified non-residential electric customers, except those that choose to opt-out of the Program, are eligible.

B & C. Impacts, Participants and Expenses

Non Residential Smart Saver Custom Technical Assessments[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$9.0**	**$9.6**	**107%**
Program Cost	**$2.8**	**$2.1**	**76%**
MW	**2.0**	**1.6**	**79%**
MWH	**17,528.7**	**16,953.4**	**97%**
Units	**14,202**	**199**	**1%**

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

Customers continue to show interest in the Program. In 2016, 65 new customers expressed interest in the Program of which 11 customers have received assessments or are in progress. Approximately, 18 customers are evaluating the information and considering whether to proceed with a project. Additionally, 19 customers were handed off to the Small Business Energy Saver Program which was better suited to meet their needs. Over 50 percent of the customers that receive assessments implement the energy efficiency projects. Lack of capital is the primary reason for not moving forward with projects. In addition, if the energy efficiency measures identified do not meet the internal financial criteria needed for a capital project.

The Company delivered over 15,000 MWh in 2016.

E. Marketing Strategy

The marketing strategy for the Program is to work with those customers that need technical and financial assistance as a companion to their internal resources. Given the facility-wide approach, many of the energy savings opportunities are complex and interactive in nature which fits well with the end-to-end involvement utilized in the Program. Typical customer marketing activity involves direct marketing from assigned Account Managers, electronic postcards, e-mails, and information attained through the Company's website, and direct customer inquiries. Marketing will be expanded in 2017 to include professional engineering trade allies as their services to customers may be able to be funded through the Program.

F. Evaluation Measurement and Verification

A process and impact evaluation report for Smart $aver custom assessment measures is scheduled to be completed in second quarter of 2017.

Samples of participants are selected for the process and impact studies. For the impact evaluation, some blend of selective monitoring and site visits are being performed at a sample of facilities, with engineering-based estimation and participant billing analysis to be determined by the evaluator. Evaluation analysis may include identification of spillover impacts from the process of engaging customers in the energy assessment. Participant surveys are planned to collect information needed to estimate net impacts and for the process evaluation.

A. Description

Duke Energy Carolinas, LLC's (the "Company's") Non-Residential Smart $aver® Custom Incentives (the "Program") offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted-out) to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The Program is designed to meet the needs of the Company's customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by the Non-Residential Smart $aver Prescriptive Program. The intent of the Program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the Company's technical or financial assistance.

Unlike the Non-Residential Smart $aver Prescriptive Program, the Program requires pre-approval prior to the project initiation. Proposed energy efficiency measures may be eligible for customer incentives if they clearly reduce electrical consumption and/or demand.

The two approaches for applying for incentives for this Program are Classic Custom and Custom-to-Go. The difference between the two approaches focuses on the method by which energy savings are calculated. The documents required as part of the application process vary slightly.

Currently the applications forms listed below are located on the Company's website under the Smart $aver® Incentives (Business and Large Business tabs).

- Custom Application, offered in word and pdf format.
- Energy savings calculation support:
    - Classic Custom excel spreadsheet approach (> 700,000 kWh or no applicable Custom-to-Go calculator)
        - Lighting worksheet (excel)
        - Variable Speed Drive (VFD) worksheet (excel)
        - Compressed Air worksheet (excel)
        - Energy Management System (EMS) worksheet (excel)
        - General worksheet (excel), to be used for projects not addressed by or not easily submitted using one of the other worksheets
    - Custom-to-Go Calculator approach (< 700,000 kWh and applicable Custom-to-Go calculator)
        - HVAC & Energy Management Systems
        - Lighting
        - Process VFDs
        - Compressed Air

The Company contracts with AESC to perform technical review of applications. Starting in 2016 all other program implementation and analysis is performed by Duke Energy employees or direct contractors.

Audience

All of the Company's non-residential electric accounts billed on eligible rate schedules, except those that choose to opt-out of the Program, are eligible.

B & C. Impacts, Participants and Expenses

Non Residential Smart Saver Custom[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	$42.4	$39.0	92%
Program Cost	$9.8	$7.3	74%
MW	9.0	7.4	82%
MWH	78,437.2	52,700.6	67%
Units	63,551	34,166	54%

1) Values are reflected at the system level.

2) Numbers rounded.

D. Qualitative Analysis

Highlights

Customers continue to identify energy efficiency offers eligible under this Program. An average of 25 new pre-approval applications per month were received in 2016 which is a decrease from 27 for the beginning of the year. The custom program continues to see a large number of small projects and a very small number of large projects from our customers resulting in an overall decrease kWh savings despite an apparent increase in participation.

Smart $aver Custom Incentives program launched the use of a flat rate incentive in 2015. The flat rate incentive allows for greater transparency to customers and the Trade Ally network. Smart Saver Custom has been able to continue to utilize the same flat rate incentive since launch. The current flat rate incentives allows the customer to receive an incentive for both energy and demand savings.

Smart $aver Custom Incentives program also launched the use of an online application in Q1 2016. 25% of applications were received through the online application portal since launch.

Efforts to educate trade allies and vendors who sell energy efficient equipment have been very successful. In many cases, vendors will submit the paperwork for the customer which eliminates a barrier for customers that do not have the resources to devote to completing the application.

The Program launched a fast track option for 2017 which gives customers the ability pay a fee to speed up their application processing time to seven business days. This fee is passed through to the vendor for their cost in expediting the application.

The Program also helped launch a complementary program, Smart $aver Performance Incentives, which will allow customers to apply for projects which are not suitable for Smart $aver Custom. Smart $aver Performance Incentives is filed as a unique program but will initially be implemented in conjunction with Smart $aver Custom to reduce confusion for customers and Trade Allies.

Issues

The Program application process is considered burdensome by some customers due to the individual and technically intensive review required for all projects applying for a custom incentive. In 2016 the program spent a significant amount of time working on the reduction of the application length. Over the past year the program has reduce average processing time to under 30 days for all states/jurisdictions by streamlining processes.

The technical review often requires customers (or their vendor) to quantify the projected energy savings from the proposed project. This can be a lengthy process that may require some level of engineering expertise. Where necessary, this requirement will continue, thus ensuring that incentives are being paid for cost-effective verifiable efficiency gains. Indications are that the Custom-to-Go suite and online application portal have relieved some of this burden.

The custom program is subject to large fluctuations in performance due to the importance of a small number of large projects. There are a significant amount of small projects compared to the small number of large projects which can drive the majority of annual impacts.

The custom program is still limited by customers who are opted-out of the EE Rider. Those customers who are opted-out are not eligible to participate and any projects completed for those customers would be considered lost opportunities. The custom program is actively working with internal resources (large account managers and business energy advisors) to see if opting-in to the EE Rider for a potential project is the best option for those customers currently opted-out.

Finally, the custom program continues to see changes in available technologies as specific measures become eligible for Smart $aver Prescriptive. In 2016, LED tube measures were moved to Smart $aver Prescriptive, causing a significant shift in kWh savings from the Custom program.

Potential Changes

The Custom program continues to evaluate additional improvements to enhance participation, processing speed and program efficiency.

E. Marketing Strategy

The 2016 marketing strategy for the Smart $aver Custom Program was closely aligned with the Non-Residential Smart $aver Prescriptive Program . Looking forward, 2017 will remain the same with the addition of a new marketing channel. The goal is to educate our non-residential customers about the technologies incentivized through both programs, as well as the benefits of installing energy-efficient equipment. These efforts will encompass a multi-channel approach, which will include:

- Email
- Direct Mail
- Print Media
- Online Media
- Industry Associations
- Large Account Managers
- Business Energy Advisors
- Trade Ally Outreach

The Program launched a new marketing channel in 2017 called New Construction Energy Efficiency Design Assistance (NCEEDA) to help identify energy efficiency projects for customers currently underserved in the SMB market. This channel will utilize the vendor Weidt Group to help identify those opportunities, complete savings calculations as well as submit applications for the customer.

F. Evaluation, Measurement and Verification

Currently, evaluation work is getting wrapped up on the Smart $aver custom measures. An impact report is scheduled to be completed in the first quarter of 2017, while the process report was completed in the fourth quarter of 2016.

For the impact evaluation, some blend of selective monitoring and site visits were performed at a sample of facilities, with engineering-based estimates and participant billing analysis conducted by the evaluator. Participant surveys were conducted to collect information needed to estimate net impacts for the process evaluation and to assess satisfaction with the program.

A. Description

Duke Energy Carolinas, LLC's (the "Company's") Non-Residential Smart $aver® Performance Incentives (the "Program") offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted-out) to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The Program is designed to encourage the installation of new high efficiency equipment in new and existing nonresidential establishments as well as efficiency-related repair activities designed to maintain or enhance efficiency levels in currently installed equipment. The Program provides incentive payments to offset a portion of the higher cost of energy efficient installations that are not eligible under either the Smart $aver® Prescriptive or Custom programs. The types of measures covered by the Program include projects with some combination of unknown building conditions or system constraints, or uncertain operating, occupancy, or production schedules The specific type of measures will be included in the agreement with the Customer. The Program is being delivered in close coordination with the existing Custom program team, and share resources for administrative review and payment processing. The Program requires pre-approval prior to project initiation.

The intent of the Program is to broaden participation in the Company's non-residential efficiency programs by being able to provide incentives for projects that previously were deemed too unpredictable to predictively calculate an acceptably accurate savings amount, and therefore no incentives were offered. It is expected that the program will provide a platform to better understand new technologies.

The key difference between the Performance Incentive Program and the Custom Program is that the Performance Incentive customers will be paid incentives based on actual measure performance. For each project, a plan will be developed to verify actual performance of the project upon completion and will be the basis for the performance portion of the incentive.

The Program incentives will typically be paid out in the following manner:

- Incentive #1: For the portion of savings that are expected to be achieved with a high degree of confidence, an initial incentive will be paid. This incentive is paid once installation is complete.
- Incentive #2: After performance is measured and verified, the performance-based part of the incentive will be paid out as follows:
    - If performance measures are met, the remaining percentage of the originally projected total incentive will be paid.
    - If performance exceeds expectations, the incentive payout may be larger.
    - If performance does not meet expectations, the incentive payout may be smaller.

Application forms for applying for incentives are located on the Company's website.

The Company contracts with Alternative Energy Systems Consulting, Inc. (AESC) to perform technical review of applications. All other program implementation is performed by Duke Energy employees or direct contractors.

Audience

All of the Company's non-residential electric accounts billed on eligible rate schedules, except those that choose to opt-out of the Program, are eligible.

B & C. Impacts, Participants and Expenses

Non Residential Smart Saver Performance Incentive[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**N/A**	**$0.0**	**-**
Program Cost	**N/A**	**$0.0**	**-**
MW	**N/A**	**0.0**	**-**
MWH	**N/A**	**0.0**	**-**
Units[3]	**N/A**	**0**	**-**

1) Values are reflected at the system level.

2) Numbers rounded.

3) As filed values not included as program was not included in filing.

D. Qualitative Analysis

Highlights

The Smart $aver Performance Incentives program was launched on January 1, 2017. Efforts have begun to educate internal resources, trade allies and vendors who sell energy efficient equipment, to promote and assist customers to participate in the Program. In addition, the program will be marketed closely with the Smart $aver Custom Program.

In many cases, vendors will submit the paperwork on behalf of the customer which eliminates a barrier for customers that do not have the resources to devote to completing the application.

Issues

Given the infancy of the program, no actual issues have been observed at this time. However, program management will be monitoring a few areas of interest.

For example, the preferred method for measurement and verification of performance is through gathering, monitoring and analyzing customer billing history. However, there may be times when the energy savings are not significant enough to effectively evaluate through the review of billing information. If this is the case, sub-metering will be required at the customer's expense, which may be a hurdle to participate due to the time and expense of monitoring and verifying savings.

The Program may be subject to large fluctuations in performance due to long project lead times and the timeliness and size of the projects.

Potential Changes

The Company continuously will consider functional enhancements to enhance participation, processing speed and program efficiency.

E. Marketing Strategy

The 2017 marketing strategy for the Smart $aver Performance Incentive Program is closely aligned with the Custom Program. The goal is to educate the Company's non-residential customers about the technologies incentivized through both programs, as well as the benefits of installing energy-efficient equipment. These efforts will encompass a multi-channel approach, which will include:

- Email
- Direct Mail
- Print Media
- Online Media
- Industry Associations
- Large Account Managers
- Business Energy Advisors
- Trade Ally Outreach

F. Evaluation, Measurement and Verification

Due to program launch in January 2017, no evaluation activities were conducted in 2016. Future evaluation timing will depend upon sufficient participation.

A. Description

PowerShare® ("Program") is a demand response program offered to commercial and industrial customers. The Program is comprised of Mandatory ("PS-M"), Generator ("PS-G"), Voluntary ("PS-V") and CallOption options, and customers can choose from a variety of offers. Under PS-M, PS-G and CallOption, customers receive capacity credits for their willingness to shed load during times of peak system usage. Energy credits are also available for participation (shedding load) during curtailment events. The notice to curtail under these offers can be rather short (15-30 minutes), although every effort is made to provide as much advance notification as possible. Failure to comply during an event will result in penalties.

Audience

The Program is offered to Duke Energy Carolinas, LLC's (the "Company's") non-residential customers who have not opted-out and are able to meet the load shedding requirements.

B & C. Impacts, Participants and Expenses

PowerShare[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$45.0**	**$43.9**	**98%**
Program Cost	**$18.3**	**$14.3**	**78%**
MW[2]	**424.8**	**368.9**	**87%**
MWH	**0.0**	**N/A**	**-**
Units[3]	**399,929**	**347,302**	**87%**

Notes on Tables:

1) Values are reflected at the system level.
2) MW capability derived by taking average over specific PowerShare contract periods.
3) Units included in filing represented KW at meter, rather than number of participants. The average participation for 2016 is 190.
4) Numbers rounded.

PowerShare CallOption[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$0.0**	**$0.0**	**-**
Program Cost	**$0.0**	**$0.0**	**-**
MW[2]	**0.0**	**0**	**-**
MWH	**0.0**	**N/A**	**-**
Units[3]	**0**	**0**	**-**

Notes on Tables:

1) Values are reflected at the system level.
2) MW capability derived by taking average over specific PowerShare contract periods.
3) Units included in filing represented KW at meter, rather than number of participants. There was no participation in 2016.
4) Numbers rounded.

D. Qualitative Analysis

Highlights

PS-M and PS-G have been well received by customers in both North Carolina and South Carolina. Most customers previously enrolled in Interruptible Power Service (“IS”) and Standby Generator (“SG”) programs in South Carolina transitioned to PS-M and PS-G, respectively. Program modifications made in response to 2013 Environmental Protection Agency (“EPA”) regulations also led to the transition of many North Carolina SG participants to PS-G

Issues

On May 1, 2016, the DC Circuit Court of Appeals mandated vacatur of the 100-hour demand response provision in the EPA’s RICE (Reciprocating Internal Combustion Engines) NESHAP (National Emission Standards for Hazardous Air Pollutants) Rule. As a result, thirty PS-G participants representing more than 35 MW in load reduction capability had to terminate their PowerShare agreements in order to remain compliant with EPA regulations.

In July 2016, there were four PowerShare curtailment events in the DEC territory. The increase in frequency, particularly with two instances of being called on back-to-back days, caused tremendous hardships for industrial participants who are running on a just-in-time manufacturing schedule. Accordingly, we are anticipating a loss of approximately 20 MW in load reduction capability as several of these customers’ contract terms expire in 2017.

The EPA ruling and increased curtailment activity noted above is also expected to negatively impact market potential for new participants going forward.

Potential Changes

No changes anticipated.

E. Marketing Strategy

To date, marketing efforts for the Program have focused on the relationship between the Company’s account executives and their assigned customers. As part of their normal contact with customers, the account executives introduce the Program, including any new options/offers, while explaining the value proposition to the customer. Account executives share in-house analytical spreadsheets that show the specific incentives for each offer as applied to the customer’s specific load profile as well as collateral to explain the details of all the Program offers.

In consideration of the number of qualifying customers that do not meet the criteria for being assigned to account executives, the Company continues to explore both internal and external marketing opportunities to enhance our outreach and increase program participation.

F. Evaluation, Measurement and Verification

The impact and process evaluation for the program year 2016 is scheduled to be completed in the first quarter of 2017. The evaluation will validate the existing processes for calculating baseline demands, monthly bill settlements, and seasonal capabilities.

A. Description

The purpose of Duke Energy Carolinas, LLC's (the "Company's" or "DEC") Small Business Energy Saver program (the "Program") is to reduce energy usage through the direct installation of energy efficiency measures within qualifying small non-residential customer facilities. All aspects of the Program are administered by a single Company-authorized vendor. Program measures address major end-uses in lighting, refrigeration, and HVAC applications.

Program participants receive a free, no-obligation energy assessment of their facility followed by a recommendation of energy efficiency measures to be installed in their facility along with the projected energy savings, costs of all materials and installation, and up-front incentive amount from the Company. Upon receiving the results of the energy assessment, if the customer decides to move forward with the proposed energy efficiency project, the customer makes the final determination of which measures will be installed. The energy efficiency measure installation is then scheduled at a convenient time for the customer and the measures are installed by electrical subcontractors of the Company-authorized vendor.

The Program is designed as a pay-for-performance offering, meaning that the Company-authorized vendor administering the Program is only compensated for energy savings produced through the installation of energy efficiency measures.

Audience

The Program is available to existing non-residential customers that are not opted-out of the Company's Energy Efficiency Rider. Program participants must have an average annual demand of 180 kW or less per active account.

B & C. Impacts, Participants and Expenses

Small Business Energy Saver[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$48.6**	**$56.1**	**115%**
Program Cost	**$21.5**	**$15.4**	**72%**
MW	**16.6**	**16.3**	**98%**
MWH	**68,899.0**	**86,253.8**	**125%**
Units[3]	**72,805,295**	**70,239,423**	**96%**

1) Values are reflected at the system level.
2) Numbers rounded.
3) Units reflect gross kWh.

D. Qualitative Analysis

Highlights

Lime Energy is the Company-authorized vendor administering the Program in both DEC and DEP service areas.

With 2016 being the second full year of the Program being in operation in DEC, the Program maintained its popularity and the Company's small business customers continued to show strong interest in the Program, with over 2,050 Small Business Energy Saver projects completed though year-end.

The Company has administered a customer satisfaction survey to Program participants since the Program's launch in DEC. Customers continue to respond very positively to the Program, with 88% of all 2016 survey participants thus far (through November) rating their overall satisfaction with the Program experience at an 8 or above (out of a 10 scale). Also, Program participants have overwhelmingly responded that the Program has served to improve their perception of Duke Energy, with 83% of responders indicating that the Program has had a positive effect on their overall satisfaction with the Company.

In order to expand the Program offering to more small and medium business customers who will benefit from the direct install model and turn-key Program process, the Company filed a Program modification proposal with both the NC Utilities Commission and the Public Service Commission of SC in September to expand Program availability to include all existing non-residential customer accounts with an average annual demand of 180 kW or less, which is an increase from the previous eligibility limit of 100 kW annual average demand per account. This Program expansion modification was approved in October 2016 by both the NCUC and PSC of SC and implemented within the Program shortly thereafter. Although the Program expansion has only been in effect since late October, the change has already made an impact, with 28 customers in the new, larger kWh range taking advantage of the Program through year-end.

As further explained below in the Evaluation, Measurement and Verification section, the combined DEC and DEP process and impact evaluation report, which was the first Program EM&V report to include DEC, was completed in September. The report included very positive results for DEC, with a Program Realization Rate of 1.12 and a Net to Gross Ratio of 1.04.

Issues

While lighting measures are expected to remain the primary driver of kWh savings in the Program for the foreseeable future, in 2016 the Company worked with our vendor Lime Energy to implement an initiative focused on making the refrigeration measure energy assessment process more efficient, as well as improving customer uptake of project proposals which include refrigeration measures. The Company expects that this continued focus on refrigeration will lead to a significant increase in refrigeration-related savings and participation in 2017.

HVAC-related measures, however, continue to struggle due to the kWh savings-based incentive structure, long payback periods and high measure cost to savings ratio. In order to offer customers additional HVAC-related solutions, the Program started collaboration in early 2016 with the EnergyWise Business demand response program, wherein our Company-authorized vendor Lime Energy is also promoting the free Wi-Fi thermostat offer available through EnergyWise Business to customers while on-site for the Small Business Energy Saver assessment.

Potential Changes

In addition to promoting the EneryWise Business offer, the Company has continued to explore and evaluate potential new HVAC measures to add to the Program with the goal of offering customers more comprehensive energy efficiency projects with “deeper” energy retrofits. With this goal in mind, the Company plans to add HVAC-related control and optimization measures to the Program in early 2017.

As the Program matures, the Company will continue to evaluate opportunities to add incentivized measures suitable for the small business market to the approved Program which fit the direct install program model. The Company would ultimately like to ensure that small business customers are given the opportunity to maximize their energy savings by being offered comprehensive energy efficiency project through the Program wherever possible.

E. Marketing Strategy

In 2016, the Program was marketed primarily using the following channels:

- Direct mail (letters and postcards to qualifying customers)
- Duke Energy Carolinas website
- Social media and search engine marketing
- Email & Duke Energy Business E-Newsletters
- Direct marketing & outreach via Program administrator

- Outreach via Duke Energy Business Energy Advisors
- Community events

All marketing efforts are designed to create customer awareness of the Program, to educate customers on energy saving opportunities and to emphasize the convenience of Program participation for the target market.

F. Evaluation, Measurement and Verification

A combined DEC and DEP process and impact evaluation report that encompassed participation from January 2015 through February 2016 for DEP and August 2014 through February 2016 for DEC was completed in September 2016.

The impact evaluation consisted of engineering estimates augmented with sampled field verification and metering to estimate program impacts. In addition, a sampled lighting metering study was conducted to help inform hours-of-operation for program customers.

Participant surveys were also included to estimate free ridership and spillover as well as assess program processes to identify any needed program improvements.

A. Description

The purpose of Duke Energy Carolinas, LLC's (the "Company's) Smart Energy in Offices Program ("Program") is to increase the energy efficiency of program participants. The Program leverages communities to educate and engage building owners, property managers, building operators, tenants and occupants of a building on ways to reduce energy usage in the workplace through simple behavioral changes. This is accomplished by providing participants with detailed information of the account/building's energy usage, support to launch tenant and building operator energy saving campaigns, forums that allow networking and exchange of building operation best management practices, and information showing comparisons between their building's energy performance and others within their community and actionable recommendations to improve their energy performance.

Audience

Non-residential customers with 12 months of usage history with business operations in building with a minimum of 10,000 square feet and 50% of the space dedicated to office space who meet the Program's eligibility requirements.

B & C. Impacts, Participants and Expenses

Smart Energy in Offices[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	**$5.2**	**$4.4**	**85%**
Program Cost	**$4.4**	**$1.1**	**24%**
MW	**8.1**	**8.5**	**105%**
MWH	**38,788.0**	**40,613.4**	**105%**
Units[3]	**44,533,048**	**46,628,788**	**105%**

1) Values are reflected at the system level.

2) Numbers rounded.

3) Units reflect gross kWh.

D. Qualitative Analysis

A key component of the Program is community engagement from the time of enrollment in the Program and on-going throughout the Program. Program participants identify a single point of contact that is responsible for working with the Company selected vendor's Engagement Managers. This person is responsible for interfacing with Company representatives on all aspects of the Program, including providing assistance to the Company as it relates to coordinating live events, meetings and seminars and assisting with the distribution of Program communication. The customer representative, also referred to as the Coach, is also responsible for dedicating time/resources and implementing the recommendations and guidance provided by the Company. The Coach coordinates with the building operator to carry out building operator campaigns and complete a building profile and benchmark. The Coach also provides the names and contact information for additional customer champions (referred to as energy captains). The energy captains provide a "grassroots" deployment of energy campaigns to ensure employees are aware and participate in the energy campaigns. In addition, Program participants maintain a high level of engagement with the Company during regular check-ins. The check-in provides the Company and customer an opportunity to discuss campaigns that have been conducted or planned in the near future.

Highlights

The Company received regulatory approval from the Commission to implement the Program in third quarter of 2014.[1] Since the Smart Energy in Offices launch on September 3, 2014, about 211 buildings have signed on to participate, representing about 38 customer organizations and over 34 Million Square Feet. SEiO now has active participants in Charlotte Center City, the greater Charlotte area, Greenville, SC, Greensboro, Winston-Salem, and Durham.

# Distinct Coordinating Organizations	# Distinct Duke Energy Customer Names	# Distinct Buildings	# Distinct Duke Energy Accounts	Sum SqFt
38	68	211	233	34624955

There has been a significant level of engagement in the building operator campaigns. An Energy Star Portfolio Manager benchmarking score in conjunction with the Smart Energy HQ portal has been generated for 51% of buildings. To date, operator campaigns offered include: Watts With the Weather, Go With the Flow, Clean Sweep, How Low Can You Go, Let It Go, and Wiser Econmizer. 56% of participants have engaged in building operator campaigns. The second Annual Operator forum and awards ceremony was held on May 19, 2016 and was attended by about 38 participants. In the 4th quarter of 2016, 60 minute interval data was made available in the Smart Energy HQ Portal. This new information will be beneficial in creating awareness about spikes in energy usage that are out of the norm, among other things.
Another exciting offering in 2016 was the collaboration with the University of North Carolina-Charlotte (UNCC). Duke has teamed up with Dr. Robert Cox to utilize his fourth year engineering students in his Building Analytics class. These students do a deep dive into program participants building data to look for abnormalities that indicate opportunities for energy efficiency. The students final exam consists of an operational assessment report delivered to the building operator. This has proven to be a highly successful collaboration that has been embraced by many program participants.

Tenant campaigns launched include Add It Up, Butterfly Effect, Occupancy Awareness, and Fall Off. Tenant action campaigns have been completed or initiated in about 66% of buildings. Over 29,623 distinct actions have been recorded in the Smart Energy HQ from campaign participants. The large increase in participation was due in part to the fact that, rather than random campaigns selected by the Coaches, a set schedule of aligned campaigns was initiated in 2016. This made it easier to manage both on the participant and Engagement Manager's sides. It also increased the sense of the community wide competition. In 2016, a mobile device application, the Happen App, was rolled out in order to provide an additional interface for delivering campaign content and energy usage tips. Enhancements to the app, such as Social Sharing, will be introduced in 2017.

Potential Changes

There are no potential changes at this time.

[1] The North Carolina Utilities Commission issued an Order in Docket No. E-7, Sub 961 on August 13, 2014 and Public Service Commission of South Carolina issued an Order in Docket No. 2014-253-E- on July 9, 2014 approving the Smart Energy in Offices program.

E. Marketing Strategy

A number of marketing channels have been used including email, print media, social media, videos and presentations at public events. Examples include print ads, popup displays and tables with "spin the wheel" challenges at building sustainability events, per property management requests.. Marketing materials, including a poster with the campaign schedule had been developed for increased participant engagement in tenant and operator campaigns. Additionally, we continue to provide tips on how to reduce wasted energy in the office by utilizing our social media channel Twitter. Online newsletters were distributed to participants in March, June and September. A Smart Energy in Offices testimonial video to drive new enrollment and additional engagement is in the final stages of editing and will be rolled out in early 2017. Two new case studies, highlighting participants success, were created in 2016.

F. Evaluation, Measurement and Verification

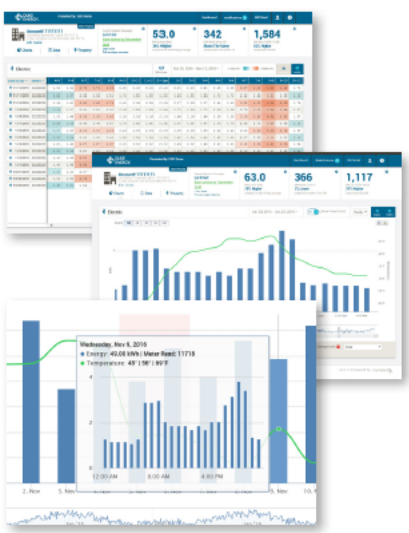
The next process and impact evaluation report is scheduled for completion in third quarter of 2017 with activities beginning in the third quarter of 2016. The impact evaluation will consist of a billing analysis among SEiO customers. As part of the process evaluation, surveys with tenants and interviews with building operators will help assess free ridership, spillover, and awareness, and satisfaction with the program.

A Customer Journey Mapping process by a third party vendor began mid-year, 2016, and results were presented in the fourth quarter of 2016. A plan to increase operational effectiveness and engagement, based on the findings, will be completed in 2017.

G. Appendix

Link to Smart Energy Newsletter Articles

INTERVAL DATA



Energy data packed with information and value.

Smart Energy in Offices (SEiO) now offers participants access to their energy data at a whole new level. Interval data from SEiO gives you the opportunity to analyze your facility's energy usage data by month, by day, and right down to the hour.

- Gain a greater understanding of the consumption patterns and demand events that are driving your electric bill.
- Identify, assess, and diagnose energy usage anomalies and trends at a more granular level.
- Compare hourly/daily/monthly usage to the same time-periods in prior years.
- Assess the impact that building control strategies and schedule changes can make in lowering your building's energy use.

Contact your SEiO Engagement Manager at **info@smartenergyinoffices.com** or at **800-428-4337** to learn how interval data through your Smart Energy HQ can help make your job easier.

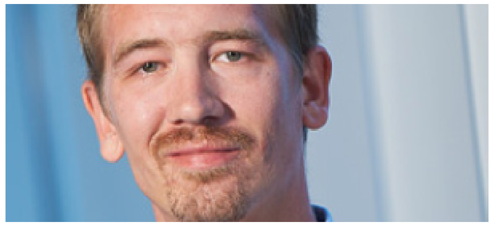
Visit: hq.smartenergyinoffices.com

DUKE ENERGY. | Smart Energy in Offices

DUKE ENERGY | Smart Energy in Offices

SEiO Successes Case Study

Trinity Partners Ally Center Building



Overview

For Shane Woycik, the Ally Center feels somewhat like his own child. From an engineering perspective, having the privilege of being the building operator since its construction is priceless. As he explained, “You really get to see the structure and you literally know what’s behind every wall.” This unique perspective combined with a stellar engineering and property management team, as well as an active partnership with Duke Energy’s Smart Energy in Offices (SEiO) program, has led to some impressive energy-saving success stories from the Ally Center.

Woycik is a senior chief engineer with Trinity Partners, and the Ally Center in uptown Charlotte is where he spends his days. Prior to joining Trinity Partners, Woycik spent about five years with Jones Lang LaSalle as a building engineer at a Delphi plant in Detroit, Mich. Although buildings up north run primarily on boilers versus the south where heat pumps are more typical, he noted that “all of the systems are ultimately trying to do the same thing, which is keeping the occupants comfortable.”

As he focuses on keeping folks comfortable across the Ally Center’s 15 floors, Woycik explained that the building has several unique features and benefits. For example, “All of our fan motors run on variable frequency drives (VFDs), which greatly reduces electrical usage. The fact that the building is only 8 years old and is still considered new gives it that advantage, whereas some older buildings have to budget for updates like VFDs,” Woycik said. He noted a couple of the main benefits of the VFDs: to control speed better and allow fans to run more smoothly.

Another energy-saving feature at the Ally Center is the lighting; it is modern, with low-wattage lamps. “We even have one tenant with an entire floor full of LED lights,” Woycik said, “and we are pushing for all of the can lights to retrofit to LEDs as well.”

“Even though the building is only 8 years old and still considered new, there is still room for improvement. Some of the stuff we have discovered was because of SEiO, and we are really glad we participate!”

Shane Woycik, senior chief engineer

Trinity Partners Ally Center Building

Location: 440 S Church St., Charlotte, NC 28202

Campaigns Completed: 12 Operator campaigns

SEiO Awards for 2015/2016:
Diamond Award Winner for Operator Level
Diamond Award Winner for Building Level

ENERGY STAR Score: 92

Start your SEiO success story.

Contact us at info@smartenergyinoffices.com

DUKE ENERGY | Smart Energy in Offices

SEiO Successes Case Study

Trinity Partners Ally Center Building

Starting with SEiO

At first, Woycik was not sure there would be time for the SEiO program, or if it would be worth the effort. But, he soon realized that "although it's tough to find time to participate in other programs, since day one SEiO has paid off." He has relied upon the program and its campaigns as a type of preventive maintenance tool and "to reinforce the need to check and recheck things in the building that we are and should be doing anyway."

Luckily for Woycik, there was no need to convince Ally Center management – they were immediately on board. The Ally Center even takes the SEiO program a step further by using it to help UNC Charlotte students with real-life work experience in using automation systems to teach and provide on-the-job training for up-and-coming building operators.

SEiO offers both operator- and tenant-focused campaigns and challenges. The former focuses on building systems and controls, and things that operators can do behind the scenes to maximize savings while maintaining optimal system efficiency and occupant comfort. The latter focuses on the building occupants and working with volunteer coaches to encourage and ultimately ask tenants to consider making small changes in their day-to-day life that can add up to a big impact.

The Ally Center's first participation experience was with the completion of a SEiO operator campaign. Most recently they completed Where you at Thermostat?, where they calibrated space temperature sensors and thermostats to verify the accuracy of room sensor readings. Regarding operator campaigns, Woycik noted, "Damper Derby was really great. We were out there making sure outside air dampers were working and no infiltration or leakage was occurring."

Ally Center has also participated in tenant campaigns such as Crab, You're It!, a fun and catchy campaign that encourages office workers to power down energy-using equipment in their workspace, lest they find their desk covered in toy crabs. SEiO also offers community challenges such as Butterfly Effect, which relies on the theory that even the smallest occurrences can change the course of the universe and that simple energy-saving changes can make a big difference in our environment.

Lending Library Success

SEiO has recently launched the Lending Library, an assortment of tools available to borrow to help identify savings opportunities and assist with operator campaigns. While attending the Semi-Annual Operator Forum in May of 2016, Woycik took a look at the Lending Library display table and signed up to borrow a HOBO light sensor. To test a hunch, he placed it in an elevator at the Ally Center and quickly confirmed what he had feared: the elevator lights were not turning off after hours. The elevator company has since been contacted and is addressing the problem.

With regard to the Lending Library, Woycik said, "By borrowing the HOBO light sensor, not only did I prove my assumption on the elevator lights, but I was also able to validate the need for purchasing our own HOBO light sensor for the Ally Center." He added, "The Lending Library is great; we are making discoveries with these tools that SEiO has made available to us!"

Recognizing the Success

Woycik pointed out some additional benefits of participating in the Operator Forums: to network with industry peers, share best practices with building operators in the area, and stay up-to-date with program offerings, campaigns and materials. At the first annual SEiO Awards Ceremony immediately following the Operator Forum in May of 2016, Trinity Partners (and specifically the Ally Center) was recognized as a Diamond Level Operator and Diamond Level Building Award winner – the highest awards achievable!

For additional information regarding Duke Energy Smart Energy in Offices, visit us at smartenergyinoffices.com or follow us on Twitter @DE_SmartEnergy.

DUKE ENERGY | Smart Energy in Offices

SEiO Successes Case Study

Tobin Freid, sustainability manager

Sustainability is not just a buzz word for Tobin Freid, it is a passion. And it takes passion in your field to dedicate time and energy toward it, as Freid has done with sustainability over the past 17 years. Eight of those years have been spent sharing her knowledge and passion with the city and county of Durham. Her recent successful involvement in Duke Energy's Smart Energy in Offices (SEiO) program has been a natural progression to help her meet admirable and lofty sustainability goals.

As a sustainability manager, Freid's main focus is to make sure the city and county of Durham's office buildings are running in a manner that satisfies their day-to-day operational needs, without negatively impacting the environment. Beyond that, she aims to make Durham an energy efficiency role model. She continuously seeks to utilize new and creative ways to help Durham "be green." Freid has studied other cities around the country and watched them transform themselves into prime examples of effective, sustainable cities and is excited to be helping Durham reach its sustainability goals.

Freid's proactive and purposeful approach toward energy efficiency naturally led her toward the SEiO program in 2015, which came as a pleasant surprise. She explains, "We had a meeting with Duke Energy to discuss the migration of our energy data into ENERGY STAR® Portfolio Manager® to help track energy efficiency across all of our properties. SEiO was introduced as a complete solution." Freid's interest was instantly piqued. "Smart Energy, what's that?," she said, "and of course I needed to hear more."

Upon learning just a fraction of what SEiO offers at that initial meeting, Freid understood the potential energy efficiency benefits for the buildings across the city and county. As Freid started communicating with the SEiO team, she learned that SEiO is a no-cost, voluntary behavioral-based program that aims to create a new culture concerning energy savings.

"Lasting behavioral change takes time. SEiO aims to help people understand the value of changing habits for long-term impact."

Tobin Freid, sustainability manager

Success for the city and county of Durham

Number of campaigns
Three communitywide tenant challenges since April, 2016

Participation levels achieved
Add it Up: 217 participants
Butterfly Effect: 207 users taking 6,021 actions

Secrets of success
Personalizing SEiO weekly emails
Creating a buzz among employees
Offering LED bulbs as added incentives to active participants

Start your SEiO success story.

Contact us at info@smartenergyinoffices.com

DUKE ENERGY | Smart Energy in Offices

SEiO offers both operator and tenant focused campaigns and challenges. Operator campaigns focus on building systems and controls to help maximize savings while maintaining optimal system efficiency and occupant comfort. Tenant challenges focus on building occupants and encourages them to make small changes in their work day that can add up to a big impact.

Despite her already busy workload, Freid's interest in the program and action as a SEiO coach was the driving force behind engaging the city and the county. She prioritized SEiO involvement which helped provide the push Freid needed to get through to the majority and the decision makers. She says, "People can be iffy about joining programs if they don't understand the value, or see an instantaneous benefit. But any lasting behavioral change takes time."

Freid's perseverance made her a natural choice for an energy coach, the liaison between the SEiO program and the participating tenants and employees. While the SEiO team organizes the challenges and provides all of the materials and communications necessary to participate, coaches are the ones to implement the challenges among their tenants, encourage participation and create the buzz amongst their co-workers.

Fried oversaw the implementation of the communitywide challenge, "Add It Up" with the city of Durham in April, 2016. The city responded with the highest participation numbers of any community in the program. She followed suit with Durham county and the "Butterfly Effect" challenge in July, 2016. Again, the Durham community had some of the highest participation overall in the SEiO tenant challenge.

While Freid notes appreciation that the SEiO team provides implementation support and awareness building materials, she recognizes that personalization and customization for her teams would help her make the program more successful. She explains that one of the advantages of being a SEiO energy coach is that each will best understand their own audience, making them the ideal communicators and motivators.

Another key to Freid's success was the use of an incentive. She had an extra stash of LED bulbs on-hand from a prior event, which she used to reward active participants. Freid notes, "People were excited about the bulbs. They are useful and a great reminder of what we're trying to do here."

Tobin Freid insists that being a SEiO energy coach doesn't take much time, and is a fun and easy way to help realize sustainability goals. She concludes, "It's about getting what you give."

For additional information regarding Duke Energy Smart Energy in Offices, visit us at smartenergyinoffices.com or follow us on Twitter @DE_SmartEnergy.

A. Description

The Business Energy Report ("BER" or the "Program"), is a periodic comparative usage report that compares a customer's energy use to their peer groups. Comparative groups are identified based on the customer's energy use, type of business, operating hours, square footage, geographic location, weather data and heating/cooling sources. Pilot participants will receive targeted energy efficiency tips in their report informing them of actionable ideas to reduce their energy consumption. The recommendations may include information about other Company offered energy efficiency programs. Participants will receive at least six reports over the course of a year.

Audience

This Pilot is offered to approximately 13,000 customers served on an eligible Duke Energy Carolinas, LLC (the "Company") non-residential rate schedule who are not opted out of the EE portion of the Rider and have at least 12 months of electric usage with the Company. Initial program participants will be automatically enrolled in the Program. Program participants may request their removal from the Program at any time.

B & C. Impacts, Participants and Expenses

Business Energy Report[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	N/A	$0.3	-
Program Cost[4]	N/A	$0.3	-
MW[2]	N/A	0.4	-
MWH	N/A	5,561.3	-
Units[3]	N/A	14,947	-

1) Values are reflected at the system level.
2) Numbers rounded.
3) As filed values not included as program was not included in filing.

D. Qualitative Analysis

As customers receive subsequent reports, their engagement increases as they learn more about their specific energy use and how they compare to their peer group. The report then provides customers tools to reduce their usage in the form of targeted energy efficiency tips that provide customers with actionable ideas to help them become more efficient. Customers are also encouraged to register for BER Interactive, an online portal that offers additional tips and information on their energy usage. Program participants are encouraged to contact the Company with their questions, comments and report corrections.

Highlights

The Company mailed letters to pilot participants on December 30, 2015 welcoming them to the program. Customers were provided a form and a business reply envelope to update information about the business such as business type, operating hours, square footage, own/lease, heating/cooling information, and a contact name. After providing customers an opportunity to respond, the first report was mailed to customers on February 17, 2016. Since February reports were mailed in March, April, May, July, September and November. The next report is scheduled to be mailed mid-February. A customer satisfaction online survey was conducted in October 2016. The survey was sent to 3,448 treatment group

DEC customers and 3,914 control group DEC customers. There was a 4% response rate from both the treatment and control group, with a total of 130 completed surveys received from the treatment group and 167 received from the control group. Key findings indicate that 43% of DEC BER participants recalled receiving the reports. Overall, 73% of BER participants are satisfied with the reports. Customers like the reports because they find them informative and that it helps them manage their usage.

E. Marketing Strategy

The Company will communicate information about the Pilot via the customized proactive reports distributed through, but not limited to, direct mail.

F. Evaluation, Measurement and Verification

There was no evaluation activity for the Program in 2016. The evaluation for the Program is scheduled for completion in first quarter of 2018.

The evaluation is a combined evaluation between DEC and DEP. The impact evaluation consists of a randomized control trial methodology that estimates the total net energy change in a treatment group comprised of BER customers compared to a control group of non-participating business customers.

For the process evaluation, interviews will be conducted among program staff and surveys will be conducted among BER customers who received a BER to assess awareness and satisfaction with recommendations in the BER.

A. Description

The purpose of Duke Energy Carolinas, LLC's (the "Company's" or "DEC") EnergyWise Business (the "Program") is an energy efficiency and demand response program for non-residential customers that will allow the Company to reduce the operation of participants AC units to help manage the power grid. The Program provides customers with options on how they would like to participate in the Program. For participation in the program, Company provides participants with an annual incentive applied directly to their bill.

Program participants can choose between a Wi-Fi thermostat or load control switch that will be professionally installed for free by the program for each air conditioning or heat pump unit that they have. In addition to equipment choice, the participants also can choose at what cycling level they would like to participate. There are three levels of cycling, 30%, 50% or 75%. The levels are the percentage reduction of the normal on/off cycle of the unit. During a conservation period, Company will send a signal to the thermostat or switch to reduce the on time of the unit by the percentage selected by the participant. For participating at the 30% level the customer will receive a $50 annual bill credit for each unit, $85 for 50% cycling or $135 for 75% cycling. Finally, participants that have a heat pump unit with electric resistance emergency/back up heat and choose the thermostat can also participate in a winter option that will allow the Company to control the emergency/back up heat. For the 100% control of the emergency/back up heat, Company will provide an additional $25 annual bill credit.

Participants choosing the thermostat will be given access to a portal that will allow them to control their units from anywhere they have internet access. They can set schedules, adjust the temperature set points and receive energy conservation tips and communications from the Company. In addition to the portal access, participants will also receive conservation period notifications. This will allow participants to make adjustments to their schedules or notify their employees of the upcoming conservation period. Finally, the participants will be allow to override two conservation periods per year. They can do this before the conservation period starts or during the conservation period.

Audience

The Program is available to existing non-residential customers that are not opted-out of the DSM portion of the Company's EE/DSM rider, Rider DSM, have at least one air conditioner or heat pump that operates to maintain a conditioned space on weekdays during the calendar months of May through September, and are not served under Schedules BC and HP, Riders NM, SCG, IS, PS or PSC. Also, customers must have an average minimum usage of 1,000 kWh during those same calendar months.

B & C. Impacts, Participants and Expenses

EnergyWise for Business[1]

$ in millions, rounded	Vintage 2016 As Filed	Vintage 2016 YTD December 31, 2016	% of Target
NPV of Avoided Cost	N/A	$1.3	-
Program Cost	N/A	$0.5	-
MW	N/A	2.6	-
MWH	N/A	1,626.4	-
Units[3]	N/A	3,036	-

1) Values are reflected at the system level.
2) Units represent average monthly kW at meter for demand response measures (1,980), plus individual participants for smart thermostat energy efficiency measure (1,056).
3) As filed values not included as program was not included in filing.
4) Numbers rounded.

D. Qualitative Analysis

Highlights

With the Program being new in 2016, the Program struggled with generating Program adoption during the first half of 2016. The Program used a variety of marketing activities to generate some market awareness and interest. As the year went on, we honed the marketing strategy to focus on emails where Duke Energy had decision maker email address, outbound calling to those same decision makers and door to door marketing.

During the second half of the year the Program placed more focus on door to door marketing of the program that created face to face meetings at the door with the decision makers. This lead to a drastic increase in Program enrollments. The Program finished the year with 950 enrolled accounts with 486 of those accounts completing installation. 232 of those enrolled accounts are still waiting to be installed setting the Program up for a successful start to 2017.

Issues

The major issue facing the Program in 2017 is hiring new installers to reduce the number of customers enrolled and waiting to have their devices installed. The current wait time is hovering around 8 to 10 weeks in most areas. The new installers will allow the Program to get that wait time down to a more manageable 2 to 4 weeks, meet the current enrollment levels and allow for program growth beyond the current level.

Potential Changes

During the first quarter of 2017 the Program is going to introduce “Auto EE” or automatic temperature adjustments during periods the facility is unoccupied. The customer can select to participate in “Auto EE” from their portal. Once selected, the system will review the thermal performance of the facility and HVAC system and weather for the next day to maximize the amount of savings that can be generated through temperature adjustments during the unoccupied hours while returning the space temperature back to the set point for the occupied hours.

E. Marketing Strategy

The Program used a multi layered approach to build customer awareness throughout 2016. The first layer is the Program website on Duke-Energy.com with cross promotion from other areas of the website. In addition to the website content, marketing materials are provided to customers through email, newsletters and face to face conversation. Activities during 2016 include the following,

- Face to face with small business customers through the Small Business Energy Saver program and other door to door marketing resources
- Face to face with business customers through Duke Energy Business Energy Advisors and Account Managers
- Outbound calling
- Duke Energy Business Newsletter
- Quarterly email

In 2017 the Program will focus most marketing resources on door to door marketing though the different resources list above all throughout the year and adding in more email and Newsletter marketing during the second half of the year.

F. Evaluation, Measurement and Verification

The next process and impact evaluation report is scheduled for completion in second quarter of 2017 with activities beginning in early 2016. The evaluation report is planned to be combined for DEC and DEP. The allocation of combined EM&V costs is proposed to be based on the projected number of participants in the EnergyWise for Business Program for each company.

Evans Exhibit 7

Duke Energy Carolinas, LLC

Estimate - January 1, 2018 - December 31, 2018

Docket Number E-7, Sub 1130

Projected Program/Portfolio Cost Effectiveness - Vintage 2018

Program	UCT	TRC	RIM	PCT
Residential Programs				
· Appliance Recycling Program				
· Energy Education Program for Schools	1.72	2.32	0.90	
· Energy Efficient Appliances & Devices	3.19	3.43	0.91	4.36
· HVAC EE Products & Services	1.60	0.99	0.83	1.39
· Income-Qualified EE Products & Services	0.49	4.51	0.38	
· Multi-Family EE Products & Services	4.00	6.09	1.06	
· My Home Energy Report	1.98	1.98	0.86	
· Power Manager	5.18	10.33	5.18	
· Residential Energy Assessments	2.65	3.05	1.06	
Residential Total	**2.91**	**3.65**	**1.20**	**6.03**
Non-Residential Programs				
· Business Energy Report	1.39	1.39	0.71	
· Custom Assessment	5.87	1.64	1.56	1.36
· Custom Incentive	4.88	1.96	1.43	1.87
· EnergyWise for Business	1.44	2.70	0.94	
· Food Service Products	4.44	2.74	1.21	2.65
· HVAC	3.41	2.11	1.53	1.29
· Lighting	4.12	1.96	1.16	1.61
· Motors, Pumps & VFDs	3.71	3.51	0.85	3.35
· Non Res Information Technology	4.14	2.34	0.89	3.16
· Process Equipment	2.39	2.42	0.85	2.67
· Performance Incentive	3.53	1.14	1.29	1.08
· Small Business Energy Saver	3.91	2.50	1.46	2.38
· Smart Energy in Offices	3.75	5.84	1.69	
· PowerShare	3.24	60.80	2.05	
Non-Residential Total	**3.94**	**2.50**	**1.41**	**2.04**
Overall Portfolio Total	**3.44**	**2.88**	**1.31**	**2.78**

Exhibit 8

Duke Energy Carolinas
Changes to DSM/EE Cost Recovery Vintage 2016 True Up January 1, 2016 - December 31, 2016
Changes from Prior Filing Due to Application of M&V and Participation
System kWh and kW Impacts Net Free Riders at the Plant
Docket Number E-7, Sub 1130

Residential Programs

	Filed in Docket E-7, Sub 1073		Filed in Docket E-7, Sub 1130		Overall Variance		E-7 Sub 1073	E-7 Sub 1130	Delta	Variance due to Change in Impacts and Measure Mix		Variance due to Change in Participation		Sum of Variances	
Program Name	kWh	kW	kWh	kW	kWh	kW	System Participation		Participation	kWh	kW	kWh	kW	kWh	kW
Appliance Recycling Program	5,655,112	791	164,720	21	(5,490,392)	(770)	10,710	263	(10,447)	25,848	2	(5,516,240)	(772)	(5,490,392)	(770)
Energy Efficiency Education	6,580,248	691	6,441,283	1,512	(138,966)	821	26,250	30,170	3,920	(1,121,616)	718	982,650	103	(138,966)	821
Energy Efficient Appliances and Devices	36,348,269	4,061	120,218,684	14,517	83,870,415	10,456	955,750	3,868,812	2,913,062	(26,916,741)	(1,922)	110,787,156	12,378	83,870,415	10,456
HVAC Energy Efficiency	3,365,177	1,527	6,296,332	2,462	2,931,155	935	9,986	19,477	9,491	(267,213)	(516)	3,198,368	1,451	2,931,155	935
Income Qualified Energy Efficiency and Weatherization Assistance	5,010,021	1,004	4,259,297	668	(750,724)	(336)	10,421	9,336	(1,085)	(229,157)	(231)	(521,567)	(105)	(750,724)	(336)
Multi-Family Energy Efficiency	12,320,047	1,019	16,569,621	1,572	4,249,574	553	151,004	269,651	118,647	(5,430,544)	(247)	9,680,118	800	4,249,574	553
Energy Assessments	7,546,592	934	7,389,091	1,070	(157,501)	135	7,656	28,853	21,197	(21,051,586)	(2,452)	20,894,085	2,587	(157,501)	135
My Home Energy Report	204,879,939	55,319	283,569,925	71,814	78,689,985	16,495	1,050,000	1,202,664	152,664	48,901,613	8,452	29,788,372	8,043	78,689,985	16,495
PowerManager	-	504,194	-	455,393	-	(48,801)	474,675	428,731	(45,944)	-	-	-	(48,801)	-	(48,801)
Residential Programs Total	281,705,407	569,540	444,908,953	549,029	163,203,546	(20,511)	2,696,452	5,857,957	3,161,506	(6,089,397)	3,803	169,292,943	(24,314)	163,203,546	(20,511)

Non-Residential Programs

	Filed in Docket E-7, Sub 1073		Filed in Docket E-7, Sub 1130		Overall Variance		E-7 Sub 1073	E-7 Sub 1130	Delta	Variance due to Change in Impacts and Measure Mix		Variance due to Change in Participation		Sum of Variances	
Program Name	kWh	kW	kWh	kW	kWh	kW	System Participation		Participation	kWh	kW	kWh	kW	kWh	kW
Non Residential Smart Saver Custom Technical Assessments	17,528,673	2,001	16,953,402	1,584	(575,271)	(417)	14,202	199	(14,003)	16,707,788	1,556	(17,283,059)	(1,973)	(575,271)	(417)
Non Residential Smart Saver Custom	78,437,169	8,954	52,700,579	7,362	(25,736,590)	(1,593)	63,551	34,166	(29,385)	10,531,544	2,548	(36,268,135)	(4,140)	(25,736,590)	(1,593)
Energy Management Information Systems	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non Residential Smart Saver Energy Efficient Food Service Products	1,656,886	120	3,809,316	356	2,152,430	236	1,280	3,574	2,294	(817,183)	21	2,969,613	215	2,152,430	236
Non Residential Smart Saver Energy Efficient HVAC Products	7,233,762	2,912	3,316,901	808	(3,916,862)	(2,103)	1,873,678	4,198,078	2,324,400	(12,890,738)	(5,716)	8,973,877	3,612	(3,916,862)	(2,103)
Non Residential Smart Saver Energy Efficient Lighting Products	83,856,747	13,942	170,325,289	29,109	86,468,542	15,166	272,565	952,684	680,119	(122,775,066)	(19,623)	209,243,608	34,790	86,468,542	15,166
Non Residential Energy Efficient Pumps and Drives Products	7,239,343	876	2,494,340	368	(4,745,003)	(508)	6,773	3,361	(3,412)	(1,098,158)	(67)	(3,646,845)	(441)	(4,745,003)	(508)
Non Residential Energy Efficient ITEE	5,572,871	137	2,462,027	107	(3,110,844)	(30)	10,861	759	(10,102)	2,072,576	98	(5,183,420)	(128)	(3,110,844)	(30)
Non Residential Energy Efficient Process Equipment Products	97,022	19	313,131	50	216,108	31	478	1,351	873	38,909	(5)	177,199	35	216,108	31
Smart Energy in Offices	38,787,988	8,073	40,613,364	8,453	1,825,376	380	44,533,048	46,628,788	2,095,740	(0)	0	1,825,376	380	1,825,376	380
Small Business Energy Saver	68,899,042	16,596	86,253,784	16,266	17,354,742	(329)	72,805,295	70,239,423	(2,565,872)	19,782,946	256	(2,428,204)	(585)	17,354,742	(329)
Business Energy Report	-	-	5,561,349	388	5,561,349	388	-	14,947	14,947	-	-	5,561,349	388	5,561,349	388
EnergyWise for Business	-	-	1,626,421	2,644	1,626,421	2,644	-	3,036	3,036	-	-	1,626,421	2,644	1,626,421	2,644
PowerShare CallOption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PowerShare	-	424,800	-	368,900	-	(55,900)	399,929	347,302	(52,627)	-	-	-	(55,900)	-	(55,900)
Non-Residential Programs Total	309,309,503	478,430	386,429,902	436,396	77,120,399	(42,034)	119,981,660	122,427,668	2,446,008	(88,447,381)	(20,932)	165,567,780	(21,102)	77,120,399	(42,034)
Total Residential and Non-Residential Programs	591,014,910	1,047,970	831,338,854	985,426	240,323,944	(62,545)	122,678,112	128,285,625	5,607,513	(94,536,779)	(17,129)	334,860,723	(45,416)	240,323,944	(62,545)

NOTE - The actual per unit impacts are reflective of the following EM&V reports:

Program Name As Filed	Docket	Report Reference	Effective Date
Smart Saver® for Residential Customers	E-7, Sub 1050	Exhibit A - Process and Impact Evaluation of Duke Energy's Residential Smart $aver: Property Manager CFLs in the Carolinas (February 18, 2013)	10/1/2012
Residential Energy Assessments	E-7, Sub 1050	Exhibit B - Process and Impact Evaluation of the Residential Energy Assessments Program (Home Energy House Call) in the Carolina System (February 19, 2013)	12/1/2012
Smart Saver® for Residential Customers	E-7, Sub 1050	Exhibit C - Impact Evaluation of the Residential Smart $aver® HVAC Program in the Carolina System (February 28, 2013)	10/1/2012
Residential Energy Assessments	E-7, Sub 1050	Exhibit E - Process and Impact Evaluation of the Residential Energy Assessments Program (Personalized Energy Report®) in the Carolina System (March 29, 2013)	9/1/2012
Smart Saver® for Non-Residential Customers Lighting	E-7, Sub 1050	Exhibit F - Process and Impact Evaluation of the Non-Residential Smart $aver® Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors (April 5, 2013)	10/1/2012
PowerShare	E-7, Sub 1050	Exhibit H - Impact Evaluation and Review of the 2012 PowerShare® Program in the Carolina System (June 11, 2013)	1/1/2012
Energy Efficiency Education Program for Schools	E-7, Sub 1050	Exhibit J - Impact Evaluation of the Energy Efficiency for Schools Program (The National Theatre for Children (NTC)) in the Carolinas System (August 21, 2013)	9/1/2012
Non-Residential Custom Program	E-7, Sub 1050	Exhibit K - Smart $aver Custom - Final Process and Impact Evaluation Report - Nov 20 2013	1/1/2013
My Home Energy Report	E-7, Sub 1073	Exhibit A - Process and Impact Evaluation of the My Home Energy Report (MyHER) Program in the Carolina System (February 20, 2014)	11/1/2013
Appliance Recycling	E-7, Sub 1073	Exhibit C - Process and Impact Evaluation of Duke Energy's Residential Appliance Recycling Program (ARP) in the Carolina System (April 25, 2014)	1/1/2012
Income Qualified Energy Efficiency: Neighborhoods	E-7, Sub 1073	Exhibit D - Process and Impact Evaluation of the 2013-2014 Residential Neighborhood Program in the Carolina System (November 14, 2014)	1/1/2012
Energy Efficient Appliances and Devices: Specialty Bulbs	E-7, Sub 1073	Exhibit E - Process and Impact Evaluation of the Residential Energy Efficient Appliance and Devices: Lighting - Specialty Bulbs Program in the Carolina System (November 19, 2014)	4/1/2013
HVAC Energy Efficiency: Tune & Seal	E-7, Sub 1073	Exhibit F - Evaluation of the Residential Smart $aver® Additional Measures Program in the Carolina System (December 10, 2014)	8/1/2012
Multi-Family Energy Efficiency	E-7, Sub 1105	Exhibit 13 - Multifamily Energy Efficiency Program; Evaluation, Measurement, and Verification for Duke Energy Carolinas (November 3, 2015)	5/1/2014
Energy Efficient Appliances and Devices	E-7, Sub 1105	Exhibit 13 - Save Energy and Water Kit Program; Evaluation, Measurement, & Verification for Duke Energy Carolinas (November 18, 2015)	5/1/2014
PowerManager	E-7, Sub 1105	Exhibit 13 - Impact Evaluation and Review of the 2012 Power Manager® Program in the Carolina System (September 16, 2015)	1/1/2014
Appliance Recycling Program	E-7, Sub 1105	Exhibit 13 - Duke Energy Carolinas and Duke Energy Progress Appliance Recycling Program Draft Evaluation Report (November 25, 2015)	8/1/2015

Duke Energy Carolinas, LLC
List of Industrial and Commercial Customers that have opted-out Vintage 2016
Docket Number E-7, Sub 1130

	Number of Accounts
DSM YR 2016 RIDER OPT-OUT	4,284
EE YR 2016 RIDER OPT-OUT	3,534

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
200 NORTH COLLEGE CHARLOTTE LLC	1		**1**
301 COLLEGE STREET CENTER LLC	1		**1**
301 S MCDOWELL STREET HOLDING LLC	1		**1**
A & T STATE UNIV	13	10	**23**
A W NORTH CAROLINA INC	6	6	**12**
ABCO AUTOMATION INC	1	1	**2**
ABERCROMBIE TEXTILES LLC		1	**1**
ABSS FACILITIES DEPT	7	7	**14**
ADVANCED MACHINE & FABRICATION, INC.	2	2	**4**
ADVANCED TECHNOLOGY	2	2	**4**
AE & T COMPANY INC	1	1	**2**
AFFILIATED COMPUTER SERVICE	3	3	**6**
AFRO AMERICAN CULTUR	1	1	**2**
AIR PRODUCTS & CHEMICALS, INC	2	2	**4**
ALADDIN MANUFACTURING CORPORATION		2	**2**
ALAMANCE REGIONAL MEDICAL CENTER	2	2	**4**
ALCAN PACKAGING FOOD AND TOBACCO,INC	2	2	**4**
ALDERSGATE	9	9	**18**
ALEVO MANUFACTURING , INC	10	10	**20**
ALEXANDER COUNTY SCHOOLS	2	2	**4**
ALEXANDER FABRICS, INC	2	2	**4**
ALLIED DIE CASTING CO OF NC	2	2	**4**
ALLSTATE INSURANCE	1	1	**2**
ALLTEL MOBILE	1	1	**2**
ALLVAC, A DIVISION OF TDY INDUSTRIES, INC	1	1	**2**
AMERICAN & EFIRD LLC	7	9	**16**
AMERICAN AIRLINES	6	3	**9**
AMERICAN CAMPUS LLC	1	1	**2**
AMERICAN CAMPUS OPERATING CO LLC	3	3	**6**
AMERICAN CONVERTING, CO. LTD	2	2	**4**
AMERICAN EXPRESS TRAVEL RELATED SERVICES COMPANY, INC		1	**1**
AMERICAN FIBER & FINISHING	1	1	**2**
AMERICAN ROLLER BEARING	1	1	**2**
AMERICAN ROLLER BEARING CO OF NC	1	1	**2**
AMERICAN TOBACCO HH LLC	6	6	**12**
AMERICAN TOBACCO POWER HOUSE LLC	2	2	**4**
AMERICAN YARNS LLC	3	3	**6**
AMSTAR SUGAR CORP	1	1	**2**
ANDALE INC	4	4	**8**
APPLE INC	1	1	**2**
AQUA PLASTICS INC	2	2	**4**
ARARAT ROCK PRODUCTS	1	1	**2**
ARMACELL LLC	8	6	**14**
ASHLEY FURNITURE	5	5	**10**
AT&T BELLSOUTH	3	3	**6**
AT&T MOBILITY LLC	4	3	**7**
AT&T WIRELESS SERVICE	1	1	**2**
ATLANTIC SWEETNER CO	2	2	**4**
ATRIUM WINDOWS & DOORS	7	7	**14**
AVAGO TECHNOLOGIES WIRELESS(USA) MANUFACTURING, INC	1	1	**2**
B & E WOOD TURNING	1	1	**2**
B/E AEROSPACE, INC	13	13	**26**
BAKER FURNITURE COMPANY	9	9	**18**
BAKERY FEEDS INC	2	2	**4**
BALDOR ELECTRIC COMPANY	5	5	**10**
BALLANTYNE RESORT, LLC	1		**1**
BANK NOTE CORP	4	4	**8**
BANK OF AMERICA	5	3	**8**
BARNHARDT MANUFACTURING COMPANY INC	4		**4**
BARRDAY INC	3	3	**6**
BARTIMAEUS BY DESIGN INC	3	3	**6**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
BASF CORPORATION	4	4	**8**
BAY STATE MILLING	4	4	**8**
BB&T	7	6	**13**
BEAL MANUFACTURING CORP	1	1	**2**
BECO MANAGEMENT	2	2	**4**
BED,BATH & BEYOND	1	1	**2**
BELK	6		**6**
BELL SOUTH MOBILITY	1	1	**2**
BELLSOUTH	9	7	**16**
BELLSOUTH BSC	13	7	**20**
BELLSOUTH COMMUNICATIONS, LLC	1		**1**
BEMIS MANUFACTURING CO	3	3	**6**
BENJAMIN COOPER		1	**1**
BERNHARDT FURNITURE COMPANY	4		**4**
BERRY TRI PLASTICS		1	**1**
BESTCO	4	4	**8**
BESTREADS INC	2	2	**4**
BEVERLY KNITS INC	5	5	**10**
BIC CORPORATION	5	5	**10**
BI-LO, LLC	22	22	**44**
BIOMERIEUX, INC	4	4	**8**
BISSELL CO	4		**4**
BISSELL COMPANIES	62		**62**
BISSELL DEVELOPMENT	1		**1**
BISSELL GOLF	1		**1**
BISSELL HOTEL 6 LLC	1		**1**
BISSELL HOTELS #7, LLC	1		**1**
BISSELL HOTELS 5 LLC	1		**1**
BISSELL HOTELS 8, LLC	1		**1**
BJ'S WHOLESALE CLUB	3	3	**6**
BLUE RIDGE COMMUNITY COLLEGE	17	15	**32**
BLUE RIDGE HEALTH CARE	1		**1**
BONSET AMERICA CORP	1	1	**2**
BORAL BRICKS INC	1		**1**
BOXBOARD PROD INC	2	2	**4**
BOYLE BUILDING, LLC	1		**1**
BOYLE BUILDING,LLC	1		**1**
BRASS CRAFT MFG CO		1	**1**
BRAXTONS SAWMILL	1	1	**2**
BRAXTONS SAWMILL, INC	2	2	**4**
BREVARD COLLEGE	19	19	**38**
BRIGHT ENTERPRISES INC	2	2	**4**
BRIT CHARLOTTE LLC	1	1	**2**
BRIT-CHARLOTTE HOLDING LLC	3	3	**6**
BROAD RIVER WATER AUTHORITY	1		**1**
BSN MEDICAL INC	2	2	**4**
BUCKEYE MT HOLLY, LLC		1	**1**
BURKE COUNTY SCHOOLS	26	21	**47**
BURLINGTON COAT FACTORY	3	2	**5**
BURLINGTON TECHNOLOGIES INC	1	3	**4**
CABARRUS COUNTY SCHOOLS	63	62	**125**
CALICO TECHNOLOGIES INC	3	3	**6**
CAMBRIDGE CC HOLDING COMPANY LLC	1		**1**
CAMFIL USA INC	2	2	**4**
CAPITAL BROADCASTING COMPANY	10	10	**20**
CARAUSTAR INC	4	2	**6**
CARAUSTAR INDUSTRIES	3	2	**5**
CARDINAL FLOAT GLASS	1	1	**2**
CARDINAL HEALTH	1	1	**2**
CARDINAL HEALTH 200, LLC	1		**1**
CARDINAL HEALTH INC	2	1	**3**
CAREFUSION MANUFACTURING, LLC	1		**1**
CARGILL, INCORPORATED	4	4	**8**
CARLISLE FOOD SERVIC	1	1	**2**
CARMEL COUNTRY CLUB	27	25	**52**
CARMEL CTRY CLUB	1	1	**2**
CARMIKE CINEMAS, INC	4	4	**8**
CAROLINA BEVERAGE GROUP, LLC	4	4	**8**
CAROLINA CONTAINER	4	4	**8**
CAROLINA GLOVE COMPANY	6	4	**10**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
CAROLINA LASER CUTTING INC	1	1	**2**
CAROLINA PERLITE CO	1	1	**2**
CAROLINA PRECISION COMPONENTS, INC.	1		**1**
CAROLINA PRECISION PLASTICS LLC	6	6	**12**
CAROLINA SUNROCK CORP	10	9	**19**
CAROLINA TRACTOR & EQUIPMENT COMPANY	4	4	**8**
CAROLINA VILLAGE	4	4	**8**
CAROLINA YARN	2	2	**4**
CAROLINAS HEALTHCARE SYSTEM	22		**22**
CARPENTER COMPANY	4	3	**7**
CASE FARMS	3	3	**6**
CASTLE & COOKE NORTH CAROLINA LLC	4	4	**8**
CATAWBA COLLEGE	1		**1**
CATAWBA COUNTY SCHOOLS	23	23	**46**
CATAWBA VALLEY MEDICAL CENTER	1	1	**2**
CATERPILLAR	2	2	**4**
CBL ASSOCIATES MANAGEMENT, INC	1	1	**2**
CEDAR FAIR SOUTHWEST, INC	3	3	**6**
CELGARD, LLC	5	5	**10**
CENTRAL CAROLINA PLASTICS INC	2	2	**4**
CENTRAL CAROLINA PRODUCTS	1	1	**2**
CENTURION MOREHEAD LLC	1		**1**
CENTURY FURNITURE, LLC	9	15	**24**
CERTAINTEED CORP	1	3	**4**
CHAPEL HILL/ CARRBORO SCHO	59		**59**
CHARLOTTE COUNTRY DAY SCHOOL	12		**12**
CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT	1		**1**
CHARLOTTE LATIN SCHOOLS, INC	13	5	**18**
CHARLOTTE OBSERVER PUBLISHING COMPANY	2	2	**4**
CHARLOTTE PIPE & FOUNDRY	15	15	**30**
CHEMTURA CORPORATION	1	1	**2**
CHEROKEE BOYS CLUB	3	3	**6**
CHEROKEE INDIAN HOSPITAL	1	1	**2**
CHESAPEAKE TREATMENT COMPANY, LLC	1	1	**2**
CHILDRENS HOME INC	2	2	**4**
CIM URBAN REIT PROPERTIES VIII LP	1		**1**
CINEBARRE, LLC	2	2	**4**
CISCO SYSTEMS INC	1	1	**2**
CITY OF ASHEVILLE	1	2	**3**
CITY OF BELMONT	1	1	**2**
CITY OF BURLINGTON	5	3	**8**
CITY OF CHARLOTTE	91	99	**190**
CITY OF CHARLOTTE REGIONAL VISITORS AUTHORITY	4	3	**7**
CITY OF DURHAM	4	4	**8**
CITY OF GRAHAM	2	2	**4**
CITY OF GREENSBORO	24	26	**50**
CITY OF HENDERSONVILLE	4	4	**8**
CITY OF KANNAPOLIS		1	**1**
CITY OF REIDSVILLE	2	2	**4**
CITY OF SALISBURY	10	10	**20**
CITY OF WINSTON SALEM	18	22	**40**
CK THREE TOWER CENTER,LLC	1		**1**
CKA LAKEPOINTE ONE OWNER LLC	1	1	**2**
CKA LAKEPOINTE TWO OWNER LLC	1	1	**2**
CKS PACKAGING INC	4	4	**8**
CLAPPS NURSING HOME CENTER	1	1	**2**
CLARIANT CORPORATION	12	12	**24**
CLEARWATER PAPER CORPORATION	4	4	**8**
CLEMENT PAPPAS NC, INC	4	3	**7**
CLEVELAND CO BD OF ED	19	3	**22**
CLEVELAND CO BD OR ED	1		**1**
CLEVELAND COUNTY SCHOOLS	41	22	**63**
CMBE	153		**153**
CMC-NORTHEAST INC	9		**9**
CMHA	7		**7**
COATS AMERICAN	2	2	**4**
COCA COLA BOTTLING CO CON	5	5	**10**
COLONIAL PIPELINE		5	**5**
COLUMBIA PLYWOOD CORPORATION	8	8	**16**
COMMONWEALTH BRANDS	2	2	**4**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
COMMSCOPE, INC.	9	9	**18**
CONCRETE SUPPLY	3	3	**6**
CONCRETE SUPPLY CO	7	7	**14**
CONCRETE SUPPLY COMPANY LLC	1	1	**2**
CONOVER LUMBER CO	1	1	**2**
CONRAD HILL FEED &	1	1	**2**
CONSOLIDATED CONTAINER COMPANY	3	6	**9**
CONSOLIDATED METCO INC		1	**1**
CONTINENTAL AUTOMOTIVE SYSTEMS, INC	2	2	**4**
COPLAND FABRICS INC		1	**1**
CORMETECH INC	1	1	**2**
CORNING CABLE SYSTEMS	5	5	**10**
CORNING INC	5	5	**10**
COSTCO WHOLESALE INC	5	5	**10**
COVERIS ADVANCED COATINGS US LLC	5	5	**10**
CPCC	46	39	**85**
CPP INTERNATIONAL LLC	1	1	**2**
CREE INC	12	12	**24**
CSHV SOUTHPARK 6100 FAIRVIEW, LLC	1	1	**2**
CULP INC	1	1	**2**
CV COLISEUM HOLDING LLC	1	1	**2**
CV PRODUCTS CONSOLIDATED LLC	2	2	**4**
DAIMLER TRUCKS NORTH AMERICA, LLC	5	5	**10**
DAIRY FRESH	3	3	**6**
DALCO NONWOVENS, LLC	2	2	**4**
DANNY TERRELL	2	2	**4**
DAVIDSON COLLEGE	15	15	**30**
DAVIDSON COUNTY COMMUNITY COLLEGE	3	3	**6**
DAVIS AMBULATORY SURGICAL CENTER	1	1	**2**
DEERE HITACHI CONST MACH	15	15	**30**
DELTA APPAREL, INCORPORATED	2	2	**4**
DIAMOND VIEW I LLC	2	2	**4**
DIAMOND VIEW II	2	2	**4**
DISCOVERY PLACE INC	1	1	**2**
DISNEY WORLDWIDE SERVICES INC	1	1	**2**
DIVERSE LABEL PRINTING LLC	2	2	**4**
DIZE AWNING TENT CO	1	1	**2**
DIZE CO	1	1	**2**
DIZE COMPANY	2	2	**4**
DOOSAN INFRACORE PORTABLE POWER - A DIVISION OF CLARKE EQUIPMENT	2	2	**4**
DRAKA COMTEQ, INC		1	**1**
DUKE UNIVERSITY	12	12	**24**
DURHAM ACADEMY	7	7	**14**
DURHAM COCA COLA	4	4	**8**
DURHAM COUNTY GOVERNMENT	2	2	**4**
DURHAM COUNTY HOSPITAL CORPORATION	1	1	**2**
DURHAM FALCON HOTEL, LLC	1	1	**2**
DURHAM PUBLIC SCHLS	106		**106**
DURHAM TECH COMM COL	2		**2**
DYNAYARN USA, L.L.C.	1	1	**2**
E I DUPONT CO	1	1	**2**
E J VICTOR INC	1	1	**2**
EARTH FARE INC	3	3	**6**
EAST COAST LUMBER CO	1	1	**2**
EAST DECK INC	1	1	**2**
EASTERN BAND OF CHEROKEE INDIANS	6	6	**12**
ECMD INC	4	4	**8**
ECOFLO INC	3	3	**6**
ELASTIC FABRICS OF AMERICA	2	2	**4**
ELDER HOSIERY MILLS INC	1	1	**2**
ELON UNIVERSITY	68	68	**136**
EMC CORPORATION	2	2	**4**
ENGINEERED CONTROLS INTERNATIONAL INC	4	4	**8**
ESSENTRA PACKAGING US, INC		4	**4**
ETHAN ALLEN	2	2	**4**
EVANS,JAMES R	1	1	**2**
EVONIK STOCKHAUSEN,INC	2	2	**4**
EXOPACK-THOMASVILLE, LLC	6	6	**12**
FAIRYSTONE FABRICS	4	4	**8**
FAMILY DOLLAR STORES OF NORTH CAROLINA INC	4	4	**8**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
FERGUSON SUPPLY & BOX	1	1	**2**
FIBER & YARN PRODUCTS, INC	1	2	**3**
FILTRONA GREENSBORO, INC	4	4	**8**
FIRESTONE FIBERS & TEXTILES COMPANY, LLC	2		**2**
FLEXTRONICS AMERICA, LLC	3	3	**6**
FLINT TRADING CO	2	2	**4**
FMC-LITHIUM CORP	5	5	**10**
FOCKE & CO, INC	1	1	**2**
FOOD LION	225	190	**415**
FORESTVIEW HIGH SCHOOL PTA	1		**1**
FORSYTH TECHNICAL COLLEGE	10	5	**15**
FOSS AUTO RECYCLING INC	5	5	**10**
FREUDENBERG IT LP	4	4	**8**
FREUDENBERG PERFORMANCE MATERIALS LP	3	2	**5**
FRITO-LAY, INC	1	1	**2**
FRONTIER SPINNING MILLS, INC		2	**2**
FUJITSU AMERICA INC	1	1	**2**
FULLSTEAM BREWERY, LLC	1		**1**
FURNITURELAND SOUTH	8		**8**
G & I V RESOURCE SQUARE 5 LP		1	**1**
GALENOR DESIGNS, LLC	1	1	**2**
GASTON CO SCHOOLS	38	35	**73**
GASTON COLLEGE	7	6	**13**
GATEWAY UNIVERSITY RESEARCH PARK	4	3	**7**
GBORO NEWS & RECORD	2	2	**4**
GE LIGHTING SOLUTIONS LLC	6	6	**12**
GENERAL ELECTRIC	2	2	**4**
GENPAK LLC	3	3	**6**
GENUINE PARTS COMPANY	2	2	**4**
GEORGIA-PACIFIC MT HOLLY LLC	1	1	**2**
GERDAU AMERISTEEL US INC	2	2	**4**
GILDAN ACTIVE WEAR INC	3		**3**
GILDAN YARNS, LLC		1	**1**
GKN DRIVELINE NORTH AMERICA, INC	1	1	**2**
GLAXOSMITHKLINE LLC	7	7	**14**
GLEN HIGH SCHOOL	1	1	**2**
GLEN RAVEN INC	2	2	**4**
GLOBAL TEXTILE ALLIANCE INC	5	5	**10**
GOLDING FARMS FOODS	2	2	**4**
GOLF CLUB AT BALLANTYNE RESORT	2		**2**
GRANDEUR MFG	1	1	**2**
GRASS AMERICA INC	4		**4**
GRAY MANUFACTURING TECHNOLOGIES LLC	2	2	**4**
GREENSBORO COLLEGE	14	13	**27**
GRIFFIN INDUSTRIES	2	2	**4**
GRIFOLS THERAPEUTICS INC	1	1	**2**
GUILFORD COLLEGE	44	38	**82**
GUILFORD COUNTY SCHOOLS	244	238	**482**
GUILFORD TECH COMM COLL	17	17	**34**
HALYARD NORTH CAROLINA, INC		1	**1**
HAN FENG INC		1	**1**
HANES COMPANIES INC	1	1	**2**
HANSON BRICK EAST LLC	3	3	**6**
HARRIS TEETER INC	65	53	**118**
HENDERSON COUNTY GOVERNMENT	3	2	**5**
HENDERSON COUNTY SCHOOLS	14	15	**29**
HENDERSONVILLE HEALTH & REHAB	1	1	**2**
HENKEL CORPORATION	6	6	**12**
HERBALIFE INTERNATIONAL OF AMERICA INC	1	1	**2**
HERITAGE HOME GROUP LLC	3	6	**9**
HICKORY CITY SCHOOLS	13	13	**26**
HICKORY SPRINGS MANUFACTURING COMPANY	25	29	**54**
HIGHWOODS PROPERTIES	53	52	**105**
HIGHWOODS REALTY LIMITED PARTNERSHIP	1	1	**2**
HIGHWOODS REALTY LTP	1	1	**2**
HINES GLOBAL REIT HOCK PLAZA I LLC	1	1	**2**
HINES INTEREST LIMITED PARTNERSHIP	1		**1**
HITACHI METALS NC LTD	1	1	**2**
HOME DEPOT	18	1	**19**
HORSEHEAD CORPORATION	2	2	**4**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
HUNTSMAN INTERNATIONAL LLC	2	2	**4**
IAC OLD FORT II LLC	1		**1**
IAC OLD FORT, LLC	2	2	**4**
IBM CORPORATION	1	1	**2**
IGM RESINS USA INC		1	**1**
IMAGES OF AMERICA	2	1	**3**
IMC-METALSAMERICA, LLC		1	**1**
INCHEM CORPORATION	2	2	**4**
INDEPENDENT BEVERAGE CORPORATION	4	4	**8**
INDUSTRIAL WOOD PROD	3	3	**6**
INDUSTRIAL WOOD PRODUCTS	3	3	**6**
INFO-GEL, LLC	3	3	**6**
ING CLARION REALTY SERVICES LLC	3		**3**
INGLES MARKETS, INC.	45	45	**90**
INGREDION INCORPORATED	1	1	**2**
INSTEEL INDUSTRIES, INC	2	2	**4**
INSTITUTION FOOD HOUSE, INC	7	7	**14**
INTELLIGENT IMPLANT SYSTEMS	1	1	**2**
INTERNATIONAL PAPER	7	6	**13**
INTERNATIONAL TEXTILE GROUP INC	1	2	**3**
IPEX USA, INC	3	1	**4**
IQE INC	2	2	**4**
ISOTHERMAL COMMUNITY COLLEGE	5	5	**10**
ITG BRANDS LLC	2	2	**4**
ITL LLC	2	2	**4**
J E HERNDON CO	1	1	**2**
JACKSON BOE	7	7	**14**
JACKSON CREEK MFG INC	1	1	**2**
JACKSON PAPER MFG CO	1	1	**2**
JAMES M PLEASANTS CO	1	1	**2**
JAMESTOWN YMCA	1	1	**2**
JDL CASTLE CORP	1	1	**2**
JOHNSON & WALES UNIVERSITY	3	1	**4**
JOHNSON CONTROLS BATTERY GROUP, INC	1		**1**
JOHNSON CONTROLS INC	2		**2**
JOHNSTON PROP INC	1	2	**3**
JOWAT CORPORATION	8	8	**16**
JPS COMPOSITE MATERIALS CORP		1	**1**
KAYSER ROTH CORPORATION	1	2	**3**
KEATING GRAVURE USA, LLC	1	1	**2**
KEN SMITH YARN CO	1	1	**2**
KENDRION-SHELBY	2	2	**4**
KERRS HICKORY READY MIXED CONCRETE COMPANY INC	3	3	**6**
KEYSTONE FOODS LLC	2	2	**4**
KIMBERLY CLARK	5	4	**9**
KINCAID FURNITURE	14	14	**28**
KINDER MORGAN SOUTHEAST TERMINAL	3	3	**6**
KINDER MORGAN TRANSMIX GROUP	1	1	**2**
KOHLER COMPANY	1	1	**2**
KOOPMAN DAIRIES INC	2	2	**4**
KOURY CORPORATION	53	52	**105**
KOURY VENTURES	5	5	**10**
KROGER CO	5	5	**10**
KROGER LIMITED PARTNERSHIP I	1	1	**2**
KSM CASTINGS USA INC	1		**1**
KURZ TRANSFER PRODUCTS LP	4	4	**8**
KYOCERA INDUSTRIAL	1	1	**2**
L B PLASTICS INC	6	6	**12**
LEESONA CORP	1	1	**2**
LENOVO INC	1	1	**2**
LEXINGTON FURNITURE IND	2	3	**5**
LIDL US OPERATIONS LLC	1	1	**2**
LIGGETT GROUP INC	1		**1**
LINCOLN COMM HEALTH	1	1	**2**
LINDE LLC	1	1	**2**
LOUISIANA-PACIFIC CORPORATION	1	1	**2**
LOWES FOODS	40	34	**74**
LOWE'S HOME CENTERS, INC	90	89	**179**
LOWES OF FRANKLIN #717	2	2	**4**
LOWE'S OF FRANKLIN #717	1	1	**2**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
LYDALL THERMAL ACOUSTICAL INC	4	1	**5**
MAGNOLIA CASTLE LLC	1	1	**2**
MANNINGTON WOOD FLOORS	1		**1**
MANUAL WOODWORKERS & WEAVERS INC	2	2	**4**
MARKET AMERICA	3	2	**5**
MARTIN MARIETTA MATERIALS INC	71	74	**145**
MARVES INDUSTRIES, LLC	1	1	**2**
MAUSER CORP		4	**4**
MCCREARY MODERN INC	8	8	**16**
MCDOWELL HOSPITAL INC	1		**1**
MCMICHAEL MILLS INC	3	3	**6**
MDI MANAGEMENT	1		**1**
MECK CNTY JAIL CENTRAL	1	1	**2**
MECKLENBURG COUNTY	15	1	**16**
MEDIA GENERAL OPERATIONS INC	1	1	**2**
MERCHANTS DISTRIBUTORS INC	2	1	**3**
MERCK SHARP & DOHME CORP	3	3	**6**
MEREDITH WEBB PRINT	4	4	**8**
MERITOR HEAVY VEHICLE SYSTEMS	1	1	**2**
MERITOR HEAVY VEHICLE SYSTEMS LLC	1	1	**2**
METROLINA GREENHOUSE	14	12	**26**
METROLINA GREENHOUSES	1	1	**2**
METROLINA GREENHOUSES INC	4	4	**8**
METROLINA GREENHOUSES, INC	1	1	**2**
METROMONT CORPORATION	2	2	**4**
MICHELIN AIRCRAFT TIRE CO	1	1	**2**
MICHELIN NORTH AMERICA	10	10	**20**
MILES TALBOTT	2	2	**4**
MILLERCOORS LLC	1	1	**2**
MILLIKEN & COMPANY	2	2	**4**
MINT MUSEUM OF CRAFT & DESIGN	1	1	**2**
MODERN DENSIFYING		2	**2**
MOM BRANDS COMPANY	1	1	**2**
MOORE WALLACE NORTH AMERICA INC	1	1	**2**
MORINAGA AMERICA FOODS INC		1	**1**
MORTON CUSTOM PLASTICS, LLC	2	2	**4**
MOUNT VERNON MILLS INC	1	1	**2**
MULTI SHIFTER INC	1	1	**2**
NATIONAL GYPSUM CO	1	1	**2**
NATIONAL PIPE & PLASTICS	2	2	**4**
NC A&T UNIV FOUNDATION	1	1	**2**
NC BAPTIST HOSPITAL	10	9	**19**
NC BLUMENTHAL PAC	2	1	**3**
NC CENTER FOR PUBLIC TV	7	7	**14**
NC OWNER LLC	14		**14**
NCFLA II OWNER LLC	3		**3**
NETAPP, INC	2	2	**4**
NEW EXCELSIOR, INC		1	**1**
NEW GENERATION YARNS		1	**1**
NEW SOUTH LUMBER COMPANY INC	3	3	**6**
NGK CERAMICS USA	2	2	**4**
NIAGARA BOTTLING LLC	1	1	**2**
NORANDAL USA INC	1	1	**2**
NORDIC WAREHOUSE INC	1	1	**2**
NORDSTROM INC	2	1	**3**
NORFOLK SOUTHERN	2	2	**4**
NORTEL NETWORKS	12	12	**24**
NORTHROP GRUMMAN GUIDANCE & ELECTRONICS COMPANY, INC	2	2	**4**
NOVANT HEALTH INC	17	15	**32**
OAK FOREST HEALTH AND REHABILITATION CO	1	1	**2**
O'MARA, INC.	1	1	**2**
OMNISOURCE SOUTHEAST	5	9	**14**
ONEAL STEEL INC	4	4	**8**
OPTICAL EXPERTS MANUFACTURING	1	1	**2**
ORACLE FLEXIBLE PACKAGING	5	4	**9**
OWENS ILLINOIS, INC	2	2	**4**
PACKRITE LLC	5	5	**10**
PACTIV LLC		3	**3**
PAPER STOCK DEALERS	1	1	**2**
PARDEE MEMORIAL HOSPITAL	14	14	**28**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
PARK RIDGE HOSPITAL	8	9	**17**
PARKDALE AMERICA LLC	9	9	**18**
PARKER HANNIFIN CORPORATION	10	9	**19**
PARKWAY 214 N TRYON LLC	1		**1**
PARKWAY 550 SOUTH CALDWELL LLC	1		**1**
PARTON LUMBER CO	6	8	**14**
PBM GRAPHICS INC	2	2	**4**
PEAK 10 INC.	2	2	**4**
PEPSI BOTTLING VENTURES, LLC	3	3	**6**
PERFORMANCE FIBERS OPERATIONS INC	5	5	**10**
PERFORMANCE LIVESTOCK & FEED CO, INC.	1	1	**2**
PERMA TECH INC	1	1	**2**
PET DAIRY	3	3	**6**
PFRS SOUTH TRYON CORP	1		**1**
PHARR YARNS LLC	1	1	**2**
PHARR YARNS, LLC	4	4	**8**
PIERRE FOODS	6	6	**12**
PINE HALL BRICK COMPANY, INC	2	2	**4**
PINE NEEDLE LNG COMPANY	1	1	**2**
PIONEER COMMUNITY HOSPITAL OF STOKES	2		**2**
PIONEER DIVERSITIES CO	1		**1**
PITTSBURGH GLASS WORKS LLC	1	1	**2**
PLANTATION PIPE LINE	3	3	**6**
PLASTIC REVOLUTIONS	1	1	**2**
PLYCEM USA, INC	1	1	**2**
POLK COUNTY SCHOOLS	6	6	**12**
POLY PLASTIC PRODUCTS OF NC INC	3	3	**6**
POLYMER GROUP, INC	1	1	**2**
PPG INDUSTRIES FIBER GLASS PRODUCTS, INC	3	4	**7**
PPG INDUSTRIES INC	2	2	**4**
PRECISION FABRICS INC	2	1	**3**
PRECOR MANUFACTURING LLC	1	1	**2**
PRESBYTERIAN HOSPITAL	8	8	**16**
PRESBYTERIAN MEDICAL CARE CORP	1		**1**
PRINTPACK INC	1	1	**2**
PRO LINE PRINTING	5	5	**10**
PROCTER & GAMBLE MANUFACTURING COMPANY	6	6	**12**
PRYSMIAN CABLE AND SYSTEMS USA, LLC		1	**1**
PUBLIX NORTH CAROLINA LP	8	8	**16**
QUALICAPS INC	3	3	**6**
R F MICRO DEVICES	3	3	**6**
RALPH LAUREN CORPORATION	4	3	**7**
RD AMERICA LLC	1	1	**2**
REGAL CINEMAS INC	5	5	**10**
REMATTR, INC	2	2	**4**
RENWOOD MILLS LLC	1	1	**2**
REYNOLDA MANUFACTURING SOLUTIONS, INC	4	4	**8**
RITE AID CORPORATION	3	3	**6**
RITZ CARLTON CHARLOTTE		1	**1**
RJ REYNOLDS TOBACCO CO	5	4	**9**
ROCKINGHAM COMM COLLEGE	1		**1**
ROCK-TENN CONVERTING CO	1	1	**2**
ROCK-TENN CONVERTING CO.	8	8	**16**
ROGER MARK PENDLETON	4	4	**8**
RONNIE D MILES	1	1	**2**
ROUNDPOINT FINANCIAL GROUP	1		**1**
ROWAN SALISBURY SCHOOLS	5	1	**6**
RUTHERFORD COUNTY SCHOOLS	3	2	**5**
RUTHERFORD HOSPITAL INC	6	6	**12**
SALISBURY MACHINERY	1	1	**2**
SAMS EAST INC	19	16	**35**
SANS TECHNICAL FIBERS, LLC	4	4	**8**
SAPA BURLINGTON LLC	3		**3**
SCHAEFER SYSTEMS	8		**8**
SCHNEIDER MILLS, INC	1	1	**2**
SCM METAL PRODUCTS INC	3	3	**6**
SEALED AIR CORPORATION	2	2	**4**
SECURITY NATIONAL PROPERTIES HOLDINGS LLC	16		**16**
SELEE CORP	2	2	**4**
SENTINEL NC-1,LLC	4	4	**8**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
SGL CARBON, LLC	1	1	**2**
SHAMROCK CORPORATION	9		**9**
SHAW INDUSTRIES GROUP, INC	6	6	**12**
SHERATON IMPERIAL	3	3	**6**
SHERRILL FURNITURE	4	4	**8**
SHUFORD YARNS,LLC	2	2	**4**
SHURTAPE TECHNOLOGIES	6	7	**13**
SIEMENS ENERGY, INC	1	2	**3**
SIEMENS POWER GENERATION INC	2	2	**4**
SIERRA NEVADA BREWING CO	1	1	**2**
SNIDER TIRE,INC	3	3	**6**
SOCIAL SECURITY ADMINISTRATION	1		**1**
SONESTA INTERNATIONAL HOTELS CORPORATION	1		**1**
SONOCO CORRFLEX DISPLAY & PACKAGING,LLC	3	3	**6**
SONOCO CRELLIN INC	2	2	**4**
SOUTH COLLEGE STREET LLC	1	1	**2**
SOUTH GRANVILLE WATER AND SEWER AUTHORITY	3	3	**6**
SOUTHERN FURNITURE	4	3	**7**
SOUTHERN METALS CO	7	3	**10**
SOUTHERN PIPE INC	1	1	**2**
SOUTHERN PRECISION SPRING CO INC	2	2	**4**
SOUTHFORK INDUSTRIES	2	2	**4**
SOUTHWESTERN COMMUNITY COLLEGE	12	12	**24**
SPORTS MENAGERIE	2	1	**3**
SPORTS SOLUTIONS INC	2	2	**4**
SPRINT	1	1	**2**
ST LUKES HOSPITAL	1		**1**
STAMPSOURCE	1	1	**2**
STANDARD TOOLS AND EQUIPMENT	2	2	**4**
STAR PAPER TUBE INC	1		**1**
STEEL SPECIALTIES	2	2	**4**
STEFANO FOODS	3	3	**6**
STEWART SUPERABSORBENTS, LLC	1	1	**2**
STIEFEL LABORATORIES INC	3	3	**6**
STOCKHAUSEN INC	2	2	**4**
STONEFIELD CELLARS WINERY LLC	1	1	**2**
STONEVILLE LUMBER CO	2	2	**4**
SUMITOMO ELECTRIC ESC, INC		1	**1**
SUMITOMO ELECTRIC LIGHTWAVE CORPORATION	3	3	**6**
SUNSET HILL INVESTMENTS LLC	1	1	**2**
SWAIN COUNTY SCHOOLS	6		**6**
SYNGENTA BIOTECHNOLOGY INC	2	1	**3**
SYNTHETICS FINISHING	9	9	**18**
T5@KINGS MOUNTAIN II, LLC	1	1	**2**
TARGET STORES	23	23	**46**
TAYLOR KING FURNITUR	2	2	**4**
TEAM INDUSTRIES	1	1	**2**
TECHNIBILT LTD	3	3	**6**
TECHNIMARK INC	11	11	**22**
TELERX MARKETING INC	1	1	**2**
TERRA-MULCH PRODUCTS, LLC	3	4	**7**
THE CYPRESS OF CHARLOTTE CLUB, INC	11	11	**22**
THE DAVID H MURDOCK CORE LABORATORY BUILDING OWNERS ASSOCIATION, INC.	1	1	**2**
THE GC NET LEASE (CHARLOTTE) INVESTORS LLC	1	1	**2**
THE INSPIRATIONAL NETWORKS INC	2	2	**4**
THE LINCOLN NATIONAL LIFE INSURANCE COMPANY	1		**1**
THE NC A&T UNIVERSITY	1	1	**2**
THE NC AT UNIVERSITY A&T FOUNDATION LLC	1	1	**2**
THE NC OFFICE OF INFORMATION TECHNOLOGY SERVICES	3	3	**6**
THE TIMKEN COMPANY	3	3	**6**
THOMAS BUILT BUSES	4	4	**8**
TIERPOINT, LLC	4	4	**8**
TIME WARNER CABLE SE LLC	13	13	**26**
TIME WARNER CABLE, INC.	1	1	**2**
TIMKENSTEEL CORPORATION	1	1	**2**
TJX COMPANIES	3	3	**6**
TKC MANAGEMENT SERVICES	1	1	**2**
TOSAF USA, INC	1	1	**2**
TOWN OF MOORESVILLE		2	**2**
TOWN OF VALDESE	3	3	**6**

Customer Bill Name	DSM YR16 (1/1/16-12/31/16) RIDER OPT-OUT	EE YR16 (01/01/16-12/31/16) RIDER OPT-OUT	Grand Total
TRANSCONTINENTAL GAS	2	3	**5**
TRANSYLVANIA COMMUNITY HOSPITAL	1		**1**
TRANSYLVANIA COUNTY SCHOOLS	11	11	**22**
TRELLEBORG COATED SYSTEMS US, INC	1	1	**2**
TRIAD HOSPITALITY CORPORATION	1		**1**
TRIAD WINDOW DES & I	1	1	**2**
TRIBAL CASINO GAMING ENTERPRISES HARRAH'S CASINO & HOTEL	1		**1**
TROPICAL NUT & FRUIT CO	1	1	**2**
TURBOCOATING CORP	1	1	**2**
TYCO ELECTRONICS CORPORATION	19	19	**38**
U S POSTAL SERVICE	5	5	**10**
U.S. COTTON, LLC	3	3	**6**
UNC - CHAPEL HILL	11	11	**22**
UNC GREENSBORO	21	21	**42**
UNC SCHOOL OF THE ARTS	34	33	**67**
UNCC	17	16	**33**
UNIFI INC	1	1	**2**
UNIFI MANUFACTURING, INC	3	5	**8**
UNILIN FLOORING NC LLC	4	4	**8**
UNION COUNTY PUBLIC SCHOOLS	2	2	**4**
UNITED PARCEL SERV	2	2	**4**
UNITED STATES COLD STORAGE	1	1	**2**
UNIVERSAL FOREST PRODUCTS	2	2	**4**
UNIVERSITY OF NC HOSPITALS	7	7	**14**
UPM - RAFLATAC, INC	1	1	**2**
US AIRWAYS INC	1	1	**2**
US AIRWAYS, INC.	4	1	**5**
US FOODS, INC	1	1	**2**
VALASSIS COMMUNICATIONS	1	1	**2**
VALDESE WEAVERS	6	6	**12**
VALSPAR CORP	3	3	**6**
VANGUARD FURNITURE INC	8	8	**16**
VERIZON WIRELESS	5	5	**10**
VIC INC	1	1	**2**
VICTORY INDUSTRIAL PARK, LLC	10	9	**19**
VULCAN CONSTRUCTION MATERIALS, L P	50	48	**98**
W S FORSYTH COUNTY SCHOOLS	94	92	**186**
W&G ASSOCIATES	1	1	**2**
WAGER,ROBERT CO,INC	4	4	**8**
WAKE FOREST UNIVERSITY	4	3	**7**
WAKE FOREST UNIVERSITY HEALTH SCIENCES	12	12	**24**
WAL-MART STORES EAST,LP	80	77	**157**
WATTS REGULATOR COMPANY	7	7	**14**
WAYNE FARMS LLC	10	10	**20**
WBTV LLC	2	2	**4**
WELLS FARGO BANK NA	8		**8**
WESTERN CAROLINA UNIVERSITY	1	1	**2**
WEYERHAEUSER COMPANY	1		**1**
WF PROPERTY OWNER LP	1		**1**
WIELAND COPPER PRODUCTS LLC	1	1	**2**
WINDWARD PRINT STAR INC	1	1	**2**
WINGATE UNIVERSITY	20	20	**40**
WINSTON SALEM STATE UNIVERSITY	21	19	**40**
WINSTON TOWER MAIN LLC	1	1	**2**
WORLD MEDIA ENTERPRISES, INC	1	1	**2**
WSOC TELEVISION INC	4	2	**6**
WXII TELEVISION	2	2	**4**
YMCA GREENSBORO	7	7	**14**
ZINK IMAGING INC	1	1	**2**
Grand Total	**4,284**	**3,534**	**7,818**

Duke Energy Carolinas, LLC
List of Customers that Opted-out and subsequently Opt-In
Docket Number E-7, Sub 1130

EE Programs

Opted-Out of Vintage 2015 and not Vintage 2016	Number of Accounts
A & T STATE UNIV	1
ABERCROMBIE TEXTILES LLC	1
AIR PRODUCTS & CHEMICALS, INC	1
ASHLEY FURNITURE	1
BEMIS MANUFACTURING CO	1
BI-LO, LLC	1
CAROLINA TRACTOR & EQUIPMENT COMPANY	1
CAROLINAS HEALTHCARE SYSTEM	3
CELGARD, LLC	3
CHARLOTTE PIPE & FOUNDRY	1
CITY OF WINSTON SALEM	1
COPLAND FABRICS INC	1
CREE INC	2
CULP INC	1
DUKE UNIVERSITY	1
ELON UNIVERSITY	1
EVONIK STOCKHAUSEN,INC	1
GILDAN YARNS, LLC	1
GUILFORD COLLEGE	4
GUILFORD TECH COMM COLL	1
HARRIS TEETER INC	16
HIGHWOODS PROPERTIES	3
JACKSON BOE	1
KOURY VENTURES	1
KYOCERA INDUSTRIAL	1
MCMICHAEL MILLS INC	3
NC BAPTIST HOSPITAL	1
OMNISOURCE SOUTHEAST	1
PARKDALE AMERICA LLC	1
PET DAIRY	1
PHARR YARNS, LLC	1
POLK COUNTY SCHOOLS	1
ROCK-TENN CONVERTING CO.	1
RUTHERFORD COUNTY SCHOOLS	1
SEALED AIR CORPORATION	1
SUMITOMO ELECTRIC LIGHTWAVE CORPORATION	1
UNC - CHAPEL HILL	13
VALDESE WEAVERS	1
VULCAN CONSTRUCTION MATERIALS, L P	1
Total	**78**

DSM Programs

Opted-Out of Vintage 2015 and not Vintage 2016	Number of Accounts
A & T STATE UNIV	1
AIR PRODUCTS & CHEMICALS, INC	1
ALADDIN MANUFACTURING CORPORATION	2
ASHLEY FURNITURE	1
BANK OF AMERICA	1
BEMIS MANUFACTURING CO	1
BISSELL COMPANIES	6
CAROLINA TRACTOR & EQUIPMENT COMPANY	1
CELGARD, LLC	3
CHARLOTTE PIPE & FOUNDRY	1
CITY OF WINSTON SALEM	1
CLEMENT PAPPAS NC, INC	1
CMBE	4
CREE INC	1
CULP INC	1
DAIMLER TRUCKS NORTH AMERICA, LLC	1
DUKE UNIVERSITY	1
ELON UNIVERSITY	1
EVONIK STOCKHAUSEN,INC	1
GUILFORD TECH COMM COLL	1
HARRIS TEETER INC	4
HIGHWOODS PROPERTIES	2
HINES INTEREST LIMITED PARTNERSHIP	1
JACKSON BOE	1
KOURY CORPORATION	1
KOURY VENTURES	1
KYOCERA INDUSTRIAL	1
MARTIN MARIETTA MATERIALS INC	1
MCMICHAEL MILLS INC	3
PARKDALE AMERICA LLC	1
PET DAIRY	1
PHARR YARNS, LLC	1
POLK COUNTY SCHOOLS	1
PROCTER & GAMBLE MANUFACTURING COMPANY	2
ROCK-TENN CONVERTING CO.	1
RUTHERFORD COUNTY SCHOOLS	1
SEALED AIR CORPORATION	1
STAR PAPER TUBE INC	1
SUMITOMO ELECTRIC LIGHTWAVE CORPORATION	1
UNC - CHAPEL HILL	13
UNCC	1
VALDESE WEAVERS	1
Total	**72**

Evans Exhibit 10

Duke Energy Carolinas, LLC
Shared Savings Incentive Calculation
Docket Number E-7, Sub 1130
Estimate January 1, 2018 - December 31, 2018

			System
NPV of AC - Res EE[1]		$	134,553,804
NPV of AC - Non Res EE			234,995,040
NPV of AC - DSM			114,602,691
Total NPV of Avoided Costs	**A**	**$**	**484,151,534**
Program Costs - Res EE[1]		$	49,460,209
Program Costs - Non Res EE			55,533,534
Program Costs - DSM			29,301,500
Total Program Costs	**B**	**$**	**134,295,243**
Net Savings	**C=A-B**	**$**	**349,856,291**
Sharing Percentage	**D**		**11.50%**
Shared Savings - Res EE		$	9,785,763
Shared Savings - Non Res EE			20,638,073
Shared Savings - DSM			9,809,637
Total Shared Savings	**E=(A-B)*D**	**$**	**40,233,474**

1) Excludes AC and Program Costs associated with Income Qualified Energy Efficiency and Weatherization Assistance, which is deemed to be cost recovery only.

EM&V Activities

Planned Evaluation, Measurement and Verification (EM&V) Activities through the rate period (Dec. 31, 2018)

Evaluation is a term adopted by Duke Energy Carolinas (DEC), and refers generally to the systematic process of gathering information on program activities, quantifying energy and demand impacts, and reporting overall effectiveness of program efforts. Within evaluation, the activity of measurement and verification (M&V) refers to the collection and analysis of data at a participating facility/project. Together this is referred to as "EM&V."

Refer to the accompanying Evans Exhibit 12 chart for a schedule of process and impact evaluation analysis and reports that are currently scheduled.

Energy Efficiency Portfolio Evaluation

DEC has contracted with independent, third-party evaluation consultants to provide the appropriate EM&V support, including the development and implementation of an evaluation plan designed to measure the energy and demand impacts of the residential and non-residential energy efficiency programs.

Typical EM&V activities:

- Develop evaluation action plan
- Process evaluation interviews
- Collect program data
- Verify measure installation and performance through surveys and/or on-site visits
- Program database review
- Impact data analysis
- Reporting

The process evaluation provides unbiased information on past program performance, current implementation strategies and opportunities for future program improvements. Typically, the data collection for process evaluation consists of surveys with program management, implementation vendor(s), program partner(s), and participants; and, in some cases, non-participants. A statistically representative sample of participants will be selected for the analysis.

The impact evaluation provides energy and demand savings resulting from the program. Impact analysis may involve engineering analysis (formulas/algorithms), billing analysis, statistically adjusted engineering methods, and/or building simulation models, depending on the program and the nature of the impacts. Data collection may involve surveys and/or site visits. A statistically representative sample of participants is selected for the analysis. Duke Energy Carolinas intends to follow industry-accepted methodologies for all measurement and verification activities, consistent with International Performance Measurement Verification Protocol (IPMVP) Options A, C or D depending on the measure.

The field of evaluation is constantly learning from ongoing data collection and analysis, and best practices for evaluation, measurement and verification continually evolve. As updated best practices are identified in the industry, DEC will consider these and revise evaluation plans as appropriate to provide accurate and cost-effective evaluation.

Demand Response Program Evaluation

DEC has contracted with independent, third-party evaluation consultants to provide an independent review of the evaluation plan designed to measure the demand impacts of the residential and non-residential demand response programs and the final results of that evaluation.

Typical EM&V activities:

- Collect program data
- Process evaluation interviews
- Verify operability and performance through on-site visits
- Collect interval data
- Program database review
- Benchmarking research
- Dispatch optimization modeling
- Impact data analysis
- Reporting

The process evaluation provides unbiased information on past program performance, current implementation strategies and opportunities for future improvements. Typically, the data collection for process evaluation consists of surveys with program management, implementation vendor(s), program partner(s), and participants; and, in some cases, non-participants. A statistically representative sample of participants will be selected for the analysis.

The impact evaluation provides demand savings resulting from the program. Impact analysis for Power Manager involves a simulation model to calculate the duty cycle reduction, and then an overall load reduction. Impact analysis for PowerShare involves statistical modeling of an M&V baseline load shape for a customer, then modeling the event period baseline load shape and comparing to the actual load curve of the customer during the event period.

The field of evaluation is constantly learning from ongoing data collection and analysis, and best practices for evaluation, measurement and verification continually evolve. As updated best practices are identified in the industry, DEC will consider these and revise evaluation plans as appropriate to provide accurate and cost-effective evaluation.

Evans Exhibit 12

EM&V EFFECTIVE DATE TIMELINE

This chart contains the expected timeline with end of customer data sample period for impact evaluation and when the impact evaluation report is expected to be completed.

Unless otherwise noted, original impact estimates are replaced with the first impact evaluation results, after which time subsequent impact evaluation results are applied prospectively.

Program	Program/Measure	2014				2015			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Appliance Recycling	Refrigerator, Freezer	1st EM&V	Report					2nd EM&V	Report
Energy Efficiency Education (K12 Curriculum)	Energy Efficiency Education (K12 Curriculum)							3rd EM&V	Report
Energy Efficient Appliance and Devices	Lighting - Smart Saver RCFL							3rd EM&V	Report
	Lighting - Specialty Bulbs			1st EM&V	Report				
	SF Water EE Products							1st EM&V	Report
	HP Water Heater & Pool Pumps								
HVAC Energy Efficiency	Residential Smart $aver AC and HP								
	Tune & Seal Measures			1st EM&V	Report				
Income-Qualified Energy Efficiency	Weatherization								
	Refrigerator Replacement								
	Low Income Neighborhood			1st EM&V	Report				
Multi-Family Energy Efficiency	MF Water EE Products							1st EM&V	Report
	Lighting (CFL Property Manager)								
My Home Energy Report	MyHER	Report							
Residential Energy Assessments	Home Energy House Call								
Non-Residential Smart $aver Energy Efficiency Custom	Non-Res Smart$aver Custom Rebate								
Non-Residential Smart $aver Energy Effiency Food Service	Non-Res Smart $aver Energy Efficiency Food Service								2nd EM&V
Non-Residential Smart $aver Energy Effiency HVAC Products	Non-Res Smart $aver Energy Efficiency HVAC Products								2nd EM&V
Non-Residential Smart $aver Energy Effiency Lighting	Non Re Smart Saver Prescriptive Lighting								
	Non Res Smart Saver Prescriptive Other								
Non-Residential Smart $aver Energy Effiency Motors Pumps Drives	Non-Res Smart$aver Prescriptive (VFDs or other)								2nd EM&V
Non-Residential Smart $aver Energy Effiency Process Equipment	Non-Res Smart $aver Energy Efficiency Process Equip								2nd EM&V
Small Business Energy Saver	SBES								
Smart Energy in Offices	SEiO	Report							

Key

	Original Estimate
	1st EM&V
	2nd EM&V
	3rd EM&V
	4th EM&V

Program	Program/Measure	2016				2017				2018			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Appliance Recycling	Refrigerator, Freezer												
Energy Efficiency Education (K12 Curriculum)	Energy Efficiency Education (K12 Curriculum)									4th EM&V	Report		
Energy Efficient Appliance and Devices	Lighting - Smart Saver RLED (Free LED)							1st EM&V	Report				
	Lighting - Smart Saver Retail						1st EM&V	Report					
	Lighting - Specialty Bulbs									2nd EM&V	Report		
	SF Water EE Products						2nd EM&V	Report					
	HP Water Heater & Pool Pumps								Report				
HVAC Energy Efficiency	Referral and Non-Referral HVAC Measures							2nd EM&V	Report				
Income-Qualified Energy Efficiency	Weatherization								1st EM&V	Report			
	Refrigerator Replacement											1st EM&V	Report
	Low Income Neighborhood				2nd EM&V	Report						3rd E&MV	Report
Multi-Family Energy Efficiency	Lighting & Water EE Products			2nd EM&V	Report								
My Home Energy Report	MyHER				3rd EM&V	Report						4th EM&V	Report
Residential Energy Assessments	Home Energy House Call						3rd EM&V	Report					
Business Energy Reports	BER								1st EM&V	Report			
EnergyWise Business	EnergyWise Business (EE measure)					1st EM&V	Report						
Non-Residential Smart $aver Energy Efficiency Custom	Custom Rebate & Custom Assessment									2nd EM&V	Report		
Non-Residential Smart $aver Prescriptive	All Prescriptive Technologies	Report						3rd EM&V	Report				
Non-Residential Energy Assessment							1st EM&V	Report					
Small Business Energy Saver	SBES			1st EM&V	Report					2nd EM&V	Report		

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 Residential Neighborhoods Program
Final Evaluation Report

December 5, 2016

Opinion Dynamics

Contributors

Antje Flanders
Vice President, Opinion Dynamics

Adam Burke
Managing Director, Opinion Dynamics

John Tortorella
Project Analyst, Opinion Dynamics

Seth Wayland
Director, Opinion Dynamics

Matt Drury
Senior Engineering Manager, Opinion Dynamics

Eric Ziemba
Project Analyst, Opinion Dynamics

Opinion Dynamics

Table of Contents

Opinion Dynamics

Table of Tables

Opinion Dynamics

Opinion Dynamics

Table of Figures

1. Evaluation Summary

1.1 Program Summary

Duke Energy Carolinas's (DEC) Residential Neighborhood Program (RNP)[1] provides one-on-one energy education, on-site energy assessments, and energy conservation measures to customers in selected low-income neighborhoods. These services are offered free of charge to all customers in qualifying neighborhoods. Qualifying neighborhoods are those where at least 50% of households have incomes equal to or less than 200% of the federal poverty level. The program employs a neighborhood canvass approach to drive participation, while working with existing organizations in each community to maximize the number of customers benefiting from the program. The program aims to reach approximately 8,900 customers each year in several preselected communities throughout the DEC service territory in North Carolina and South Carolina.

1.2 Evaluation Objectives and High-Level Findings

The overall objectives of the RNP evaluation are to:

- Verify and update deemed savings estimates through review of measure assumptions and calculations
- Verify measure installation and persistence
- Estimate program energy (kWh) savings, summer and winter peak demand (kW) savings, and realization rates
- Identify barriers to participation in the program and how barriers can be addressed
- Identify program strengths and the potential for increasing the average per-household savings attributable to the program
- Identify ways in which DEC may be able to improve the RNP in the future

To achieve these objectives, Opinion Dynamics completed a number of data collection and analytic activities, including interviews with program staff members, a participant survey, an analysis of the survey results, an analysis of program-tracking data, a deemed savings review, an engineering analysis, and a billing analysis. The program period under evaluation is January 1, 2015 through December 31, 2015.

As part of the impact evaluation, we conducted an engineering analysis to provide insight into the individual measure contributions to overall program savings. The engineering analysis also allows us to develop a ratio of overall kW to kWh savings, which we then apply to the energy savings from the billing analysis to determine evaluated demand savings for the program. Table 1-1 presents the total gross impacts for each measure installed through the program and the estimated individual measure contribution to the overall energy (kWh) savings from the engineering analysis.

[1] In January 2016, the name of the DEC RNP was changed to the Neighborhood Energy Saver Program. This is the name now used by all Duke Energy subsidiaries offering the program.

Table 1-1. Measure-Level Gross Impact Results from Engineering Analysis

Measure	Energy (MWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Percent of Total MWh
CFLs	772	90.3	68.4	37%
Infiltration Reduction	340	90.3	85.0	16%
Efficient Faucet Aerator	312	53.8	107.6	15%
Efficient Shower Head	242	21.0	42.0	11%
HVAC Filter	171	56.0	34.8	8%
Hot Water Temperature Setback	106	12.1	12.1	5%
Hot Water Pipe Wrap	145	16.5	16.5	7%
Water Heater Blanket	26	3.0	3.0	1%
Total*	**2,113**	**343.1**	**369.4**	**100%**

* Totals may not sum due to rounding of individual measure savings

Opinion Dynamics's estimates of program savings are derived primarily from the results of our billing analysis, which are calculated and presented on a per-household basis. Table 1-2 presents the net savings results of our billing analysis, which includes savings from equipment installed by program representatives, as well as savings from any additional behavioral changes and participant spillover attributable to the program. Demand savings are calculated from the ratios of engineering analysis kW to kWh savings, which are applied to the billing analysis energy savings.

Table 1-2. Net Program Impact Results from Billing Analysis

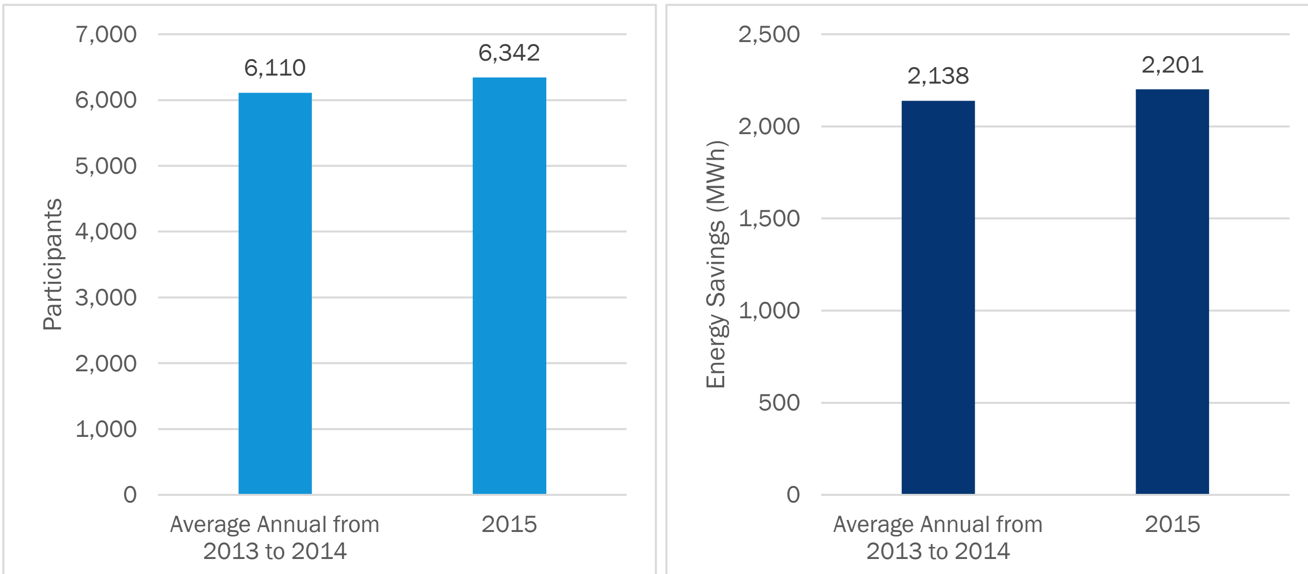
Net Participant Savings			Net Program Savings		
Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Energy (MWh)	Summer Coincident Demand (MW)	Winter Coincident Demand (MW)
347	0.0563	0.0607	2,200.67	0.3573	0.3847

Per-participant energy savings from the billing analysis are slightly higher, 347 kWh, than that estimated from the engineering analysis (333 kWh per year). The average evaluated energy and demand savings per treated household in 2015 is very close to that estimated in the prior evaluation, which spanned 2013–2014. Annual savings declined from 350 kWh to 347 kWh per home, a realization rate of 99%.

Opinion Dynamics applied a robust billing analysis methodology that utilized a comparison group of DEC customers selected as future RNP participants to create a baseline of what would have occurred in the absence of RNP participation. Comparing the energy use of 2015 RNP participants to those who have been selected to participate in 2016, but who have not already done so, allows us to isolate the effect of RNP participation on savings between two comparable groups of participants. The 2013–2014 billing analysis model used a simple comparison of RNP participants' billing data before and after participation to determine savings attributable to the RNP. The use of a comparison group in a billing analysis typically provides a better estimate of the savings attributable to a program. In addition, billing analyses, using an appropriate comparison group, incorporate the effects of both free-ridership and spillover, thus providing program net savings. Although the results of the billing analysis performed as part of the 2013–2014 evaluation are similar to the results of our billing analysis performed for the 2015 evaluation, we believe that the model we have employed provides a more robust, comprehensive, and defensible calculation of the program's impact.

Participation in the RNP increased slightly from the prior evaluation, when normalized over a 12-month period, as shown in Figure 1-1. Overall program savings increased slightly, from 2,138 MWh to 2,201 MWh on an annual basis.

Figure 1-1. Annualized RNP Participation and Total Energy Savings, 2013–2015



Despite the increase in participation compared to the 2013–2014 period, the program did not achieve its overall participation goals in 2015. In addition, the rate of participation in each neighborhood remained relatively low. In 2015, the RNP achieved an average participation rate of 35%–45%, while treating homes in approximately 20 neighborhoods. For comparison, in 2014 the Duke Energy Progress (DEP) Neighborhood Energy Saver (NES) program achieved a participation rate of 70%–80% annually among its treated neighborhoods using a similar program model and measure mix, but a different approach to program outreach, marketing, and recruiting. In 2016, the DEC RNP program began using the implementation vendor and recruitment approach used by the DEP NES. Given the record of high rates of program participation in DEP, we anticipate improved participation rates and overall participation going forward for the DEC RNP.

Overall participant satisfaction with the program was high. Eighty-eight percent of RNP participants in 2015 were satisfied with the program, and 93% were satisfied with the program representative who installed measures at their home.

1.3 Evaluation Recommendations

Opinion Dynamics has the following recommendations for improving program performance and overall savings. We include more details on these recommendations in Section 7 and throughout this report.

- **Specialty Lighting and LED Lighting.** The RNP should assess additional opportunities to include specialty CFL or LED lighting as part of the program. With the increasing prevalence and affordability of efficient lighting technology, and the presence of other Duke Energy lighting programs in the marketplace, baseline efficiency levels are increasing and opportunities to install CFLs in standard high-use sockets are decreasing. In general, baseline efficiency levels for specialty lighting (e.g., dimmables, reflectors) have not increased as much as standard lighting measures have in recent years. Specialty lighting products may be an opportunity for additional savings. The program should also consider changing the standard bulbs offered by the RNP from CFLs to LEDs when a regulatory filing is next made for this program. It is our understanding that such a change is being considered.

- **ENERGY STAR® Appliances.** DEC RNP staff should assess the potential savings and costs of including additional deeper-savings measures frequently offered through income-qualified programs. ENERGY STAR dehumidifiers, window air conditioners, and refrigerator replacements are often offered by income-qualified programs. These measures can add significant program savings and diversify the sources of energy savings away from lighting measures.

- **Targeting Neighborhoods with Highest Savings Opportunities.** As with the 2014 DEP NES evaluation, there may be opportunities to target neighborhoods with lower median home values and lower median household incomes to increase per-home program savings. Each of these factors was correlated with higher savings in an analysis of 2010–2014 DEP NES participation. In addition, targeting homes with electric heat and hot water will likely increase savings per home.

- **Improve Program Participation Rates.** The program should continue to make efforts to reach the greatest number of participants in each selected neighborhood. Maximizing the number of treated homes in each neighborhood reduces the overall number of neighborhoods required to meet program-wide participation goals. Over the long term, this would increase participation while reducing the costs associated with selecting and setting up operations in additional neighborhoods. Raising the visibility of the program in each neighborhood by using multiple crews on the same street or area and providing customers with as much flexibility as possible in scheduling has been shown to increase participation rates for similar programs. If canvassers are used, the implementers should develop outcome-based goals, specifically based on the number of appointments generated and the participation rate in each neighborhood.

- **Continue to Focus on Energy Education.** The program's energy education component is effective and likely results in real savings for participants in addition to the installed program measures. Survey research shows that for those who receive education and training from program auditors, it is successful in increasing awareness of energy consumption and results in energy-saving behavior changes. The program should build on this success to offer it more consistently to all program participants.

- **Improve and Expand Data Collection.** Auditor and implementer staff should take steps to ensure high-quality data collection and compilation throughout the implementation process. During this evaluation, the evaluation team encountered issues with incomplete and inconsistent data collected during implementation of the RNP in 2015. Maintaining robust, accurate, and consistent data is necessary to verify participation and savings associated with the program. We understand that additional steps have been taken to improve data collection and verification. These data checks should validate implementer data against Duke program data to ensure that there are no discrepancies between the two.

2. Program Description

2.1 Program Design

Duke Energy Carolinas's (DEC) Residential Neighborhood Program (RNP) provides one-on-one energy education, on-site energy assessments, and appropriate packages of no-cost energy conservation measures to customers in income-qualified neighborhoods. The program is available to active DEC account holders who are individually metered homeowners or tenants living in predetermined low-income communities. Neighborhoods targeted for this program are eligible to participate if the income of at least 50% of the households within the community is equal to or less than 200% of the federal poverty level, corresponding with the eligibility requirements set for the federal Weatherization Assistance Program (WAP). Individual participants are limited to one-time receipt of energy efficiency measures through the RNP.

In 2015, the DEC RNP aimed to reach at least 2,410 customers in South Carolina and 6,516 customers in North Carolina in approximately 15 neighborhoods across the DEC service territory. The goal was to offer persistent energy and demand savings to these customers through the direct installation of energy savings measures and by educating customers on other ways that they can mitigate their household's energy usage. The program provides equipment and education at no cost to customers and, when possible, works with community leaders to maximize the number of customers receiving benefits from the program.

2.2 Program Implementation

GoodCents was the primary implementer of the RNP in 2015.[2] GoodCents performed assessments and installations, while DEC program staff were primarily responsible for the selection of specific neighborhoods. The program was marketed to residents in preselected neighborhoods through three waves of personalized mailings. The implementation team also organized at least one community launch event in each targeted neighborhood, both to make residents aware of the program and to introduce the equipment that the RNP program offers. Implementer staff then canvassed each neighborhood, and then attempted to schedule appointments for the crews to perform assessments and installations at homes in the neighborhood. During 2015, GoodCents operated three implementation crews, two in North Carolina and one in South Carolina. Based on a schedule determined by the RNP program manager, each of the three implementation teams performed assessments and installations in one neighborhood at a time. The program typically planned to have each implementation crew spend 6–8 weeks in its assigned neighborhood before moving on to other areas.

The implementers tracked the dates that assessments were performed and the types and counts of each measure installed at each premise in their own program-tracking databases. These data are provided to DEC and incorporated into the Duke Energy tracking system. DEC program staff also conducted quality assurance visits during the implementation period by visiting some of the homes that had been served by the program and looking for improvements that the implementation teams could make as they continued with assessments. Duke program managers also sometimes attended town hall meetings, community watch meetings, and other types of events to answer questions about the program and the participation process.

[2] GoodCents was not retained as the implementation contractor for the RNP in 2016. Implementation was transferred to Honeywell in December 2015. Honeywell will now be the implementer of the low-income neighborhoods program in DEC and DEP territory, which may allow for combined evaluations in the future.

2.3 Program Performance

The program period under evaluation is January 1, 2015 through December 31, 2015. Over this time period, the program served 6,342 unique participants.[3] The program saved, on average, 347 kWh per household per year. Coincident demand savings per household were 0.0563 kW in summer and 0.0607 kW in winter.

[3] The program treated 4,372 homes in North Carolina and 1,970 homes in South Carolina during 2015.

3. Key Research Objectives

This evaluation includes a process analysis and an impact analysis. The overall objectives of this evaluation are to:

- Verify and update deemed savings estimates through review of measure assumptions and calculations
- Verify measure installation and persistence
- Estimate program energy (kWh) savings, summer and winter peak demand (kW) savings, and realization rates
- Identify barriers to participation in the program and how barriers can be addressed
- Identify program strengths and the potential for increasing the average per-household savings attributable to the program
- Identify ways in which DEC may be able to improve the RNP in the future

4. Overview of Evaluation Activities

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

- Program staff interview (n=1)
- Program materials review
- Impact analyses (including engineering analysis and billing analysis)
- Process analyses
- Participant survey (n=151)

In Section 5 and Section 6, we provide more details on the methods and results of the impact and process analyses, respectively. Below, we summarize the scope and sampling approach (if applicable) for the staff interviews, program materials review, deemed savings review, billing analysis, and participant survey. Each of these components supported the impact and process evaluation.

4.1 Program Staff Interview

We conducted an in-depth interview with the current RNP program team at DEC.[4] The purpose of the interview with DEC program staff was to ascertain the current environment of and expectations for the RNP program in 2015, and to assist in the development of a research plan for the 2015 evaluation. The interview allowed us to learn more about the program in 2015, including how the implementation contractor performed, the program goals, and areas in which the program may look to improve in the future.

4.2 Program Materials Review

DEC staff provided Opinion Dynamics with information on the program, as well as examples of marketing materials used by the program and information about the implementation contractor's onsite auditing and direct installation procedures. The materials we received included:

- **Marketing materials:** the leave-behind brochure, the customer survey booklet, the pre-participation program informational brochure, the leave-behind door hanger, the energy efficiency brochure about other Duke programs, the introduction letter to the RNP program and the informational session, the presentation shown at the informational sessions, and postcards sent to participants with information about how to participate.
- **Program documents:** presentation about the RNP program design, onsite procedures from the 2015 implementation contractor, and statements of work between Duke Energy and the implementation contractor.
- **Prior evaluation report for the RNP**, which covered March 2013 through July 2014.

[4] The interview with DEC program staff occurred on December 16, 2015. Because DEC changed implementers at the end of 2015, we did not have the opportunity to interview any implementation contractor staff while they were still implementing the program.

The information from the marketing materials, program documentation, and past evaluation report informed our research design, provided insight into program design and delivery, and supported the assessment of program impacts.

4.3 Deemed Savings Review and Engineering Analysis

Opinion Dynamics conducted a review of the deemed savings values and assumptions for each of the RNP measures. The primary source for 2015 evaluated program savings is our billing analysis, but the deemed savings review was used to estimate demand savings from the billing analysis results and to provide estimates of savings at the measure level. The goal of the deemed savings review is to develop updated savings algorithms and input assumptions that are consistent with standard industry practice and comparable with applicable Technical Reference Manuals (TRMs). Opinion Dynamics reviewed the 2013–2014 Evaluation, Measurement, and Verification (EM&V) report[5] and appendices and used this report, TRMs, and other secondary resources to develop estimated deemed savings for each RNP measure. Appendix A describes the methodology for each measure in more detail.

To conduct our deemed savings review, we performed the following steps:

- Reviewed inputs and algorithms (as available) from the 2013–2014 EM&V report for CFLs, infiltration reductions, efficient faucet aerators, efficient shower heads, HVAC filters, hot water temperature setbacks, hot water pipe wraps, and water heater blankets.
- Performed an engineering analysis using various TRMs and secondary sources to develop per-unit savings estimates for each RNP measure.
- For each of the reviewed measures, identified recommendations and suggested approaches for quantifying savings for the 2015 evaluation.

Our evaluation also relied on telephone survey data to confirm measure installation and persistence, which was combined with engineering estimates for each measure to develop program-level savings by measure type. Program-level energy savings are estimated through a billing analysis. Appendix A provides more detail on the methods used in the deemed savings review and engineering analysis.

4.4 Billing Analysis

Opinion Dynamics conducted a billing analysis to determine the net savings attributable to the RNP in 2015. We used a linear fixed effects regression (LFER) model to estimate the overall net 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. The billing analysis used participants from the second half of 2014 and first half of 2015 as the treatment group, while the comparison group consisted of participants from the second half of 2015 and first half of 2016. A summary of the billing analysis approach is provided in Section 5.1.2 and a detailed description of the billing analysis methodology is presented in Appendix B.

[5] Process and Impact Evaluation of the 2013–2014 Residential Neighborhood Program in the Carolina System. TECMARKET Works. November 14, 2014.

4.5 Participant Survey

Opinion Dynamics implemented a computer-assisted telephone interviewing (CATI) survey with 2015 RNP participants between May 17, 2016 and June 7, 2016. The sample frame consisted of a preliminary extract of 17,830 participants in the RNP who participated from 2013 to 2016. We first dropped participant records for those participants who were part of the program outside of 2015 and were left with 6,342 unique 2015 participants. We then dropped records that had missing or invalid phone numbers, were listed on DEC's "Do Not Call" list, were business accounts, or were duplicate phone numbers. We then developed a simple random sample of the remaining 2,603 participants. To meet precision targets for measure-level installation and persistence analyses, the evaluation team set quotas for each measure. Quotas were set at 68 to ensure that analyses met the industry-standard two-tail 90/10 criterion in terms of sampling error at a measure level. This means that we would be 90% confident that our results are within 10% of the true value in the population.

5. Impact Evaluation

This section describes the process by which the evaluation team calculated RNP impacts through the engineering analysis and billing analysis, as well as the results from these analyses.

5.1 Methodology

5.1.1 Engineering Analysis

As part of our impact evaluation, Opinion Dynamics conducted an engineering analysis for each RNP measure installed in 2015. The purposes of the engineering estimates are to:

1. Provide a ratio of kW demand to kWh energy savings, which is then applied to the billing analysis energy savings to estimate demand savings

2. Provide insight into the individual measure contributions to the overall savings

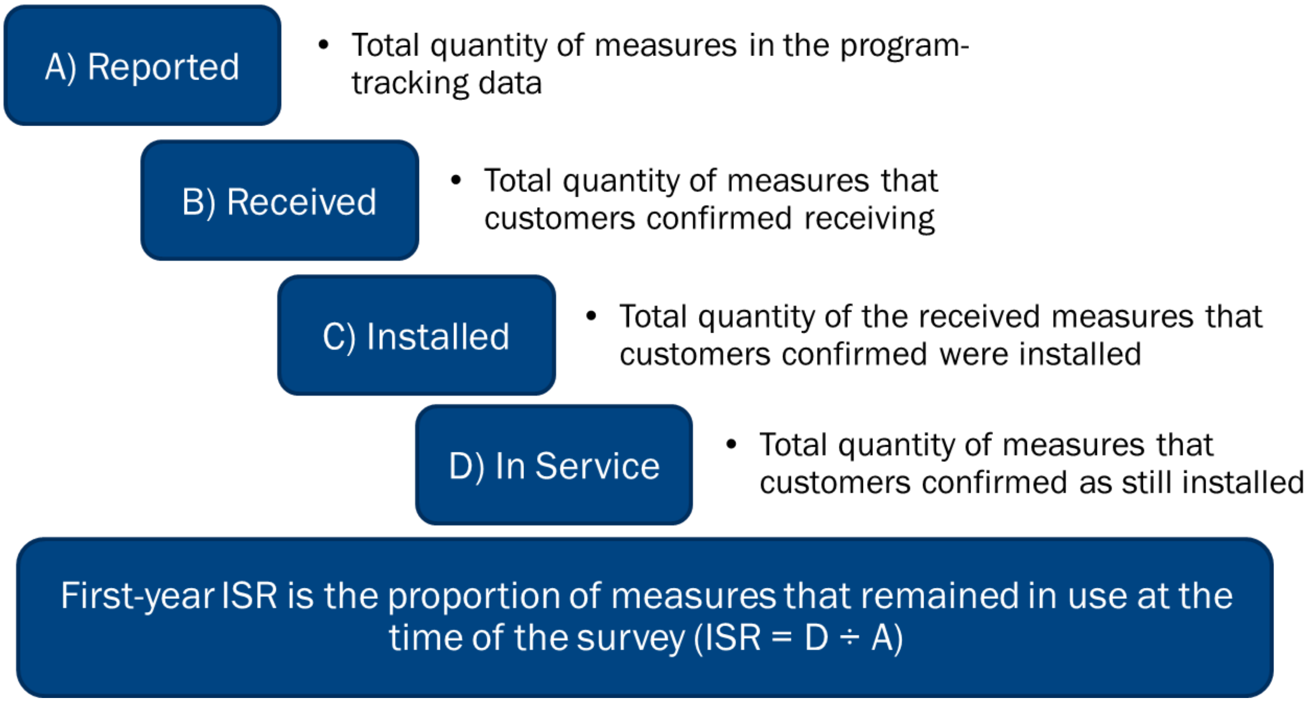
We used several resources and assumptions to conduct our engineering analysis. Since neither North Carolina nor South Carolina has a statewide TRM, we used DEC-specific assumptions whenever possible and relied on other TRMs for algorithms and assumptions where appropriate. The engineering analysis takes into consideration the measure in-service rates (ISRs) to ensure that program-level savings estimates reflect savings for installed measures only. We provide additional details and information on the engineering analysis methods and results in Appendix A.

Note that the billing analysis determines net evaluated energy (kWh) impacts for the program. The engineering analysis only supplements the billing analysis for the aforementioned reasons.

Installation Verification and Persistence

The participant survey instrument included questions designed to verify that participants received and installed program measures and that those measures remained in place and operational. We used the survey results to estimate measure-level ISRs. Our engineering estimates use the ISR values in calculations for annual per-household 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 verification rate. We then asked respondents how many of the verified quantity of measures had been installed to calculate an installation rate. Finally, we asked respondents 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.

Figure 5-1. In-Service Rate Components



Our results showed relatively high ISRs for almost all RNP measures, as shown in Table 5-1. We strove to achieve a relative precision of 10% with 90% confidence; however, this was not possible for some measures that had lower frequencies of installation among customers surveyed. In other instances, participants were unaware that the program representative had installed specific equipment, such as a pipe wrap or a water heater wrap, and therefore were unable to verify its installation. For those measures, we have reverted to an ISR of 100% because the database quantities are likely more accurate than what the respondents were able to recall.

Table 5-1. In-Service Rates for Residential Neighborhood Program Measures

Measure	ISR
CFLs	79%
Infiltration Reduction*	91%
Efficient Faucet Aerator	87%
Efficient Shower Head	91%
HVAC Filter	71%
Hot Water Temperature Setback**	100%
Hot Water Pipe Wrap**	100%
Water Heater Blanket**	100%
Weather Stripping	80%
Door Sweep	93%

* Infiltration reduction ISR calculated as the weighted average of ISRs for all categories of infiltration measures, which included weather stripping, caulking, foam spray, and door sweeps.
** ISRs deemed to be 100% for measures participants did not associate with program audit.

5.1.2 Billing Analysis

Opinion Dynamics conducted a billing analysis to determine the overall evaluated net program savings of the RNP. Due to the timing of the evaluation, and to ensure that we had a robust comparison group, we included participants from the second half of 2014 (July–December) through the first half of 2016 (January–June) in our analysis. Our method requires that participants in the treatment group have post-installation electricity usage data for at least 6 months after participating in the program. Therefore, participants from July 2014 to June 2015 comprise our treatment group, while the comparison group consists of households that participated in the program between July 2015 and June 2016. The comparison group allows us to establish baseline usage for participants in the absence of program participation. Because the comparison group represents energy use in the absence of the program, results from the billing analysis are net results, and application of a net-to-gross ratio (NTGR) is unnecessary.

The billing analysis employed a LFER model, which accounted for all time-invariant factors in the constant terms of the equation, such as square footage, appliance stock, habitual behaviors, household size, and any other factors that do not vary over time. The model also accounted for differences in weather and pre-program energy use between participants.

To improve our estimate of what baseline usage for participants would be absent the program, we added dummy variables for each calendar month, i.e., binomial terms with "1" signifying that the bill occurred in that month of year. Including these variables in the model helped control for monthly trends that were unrelated to the comparison group and allowed for a more accurate estimate of baseline usage absent the program. The model included weather terms, and interaction terms between weather and the post-participation period for the treatment group, to account for differences in weather patterns across years. We also controlled for differences seen in baseline usage between the treatment and comparison groups. Table 5-2 shows the breakdown of participants in the treatment and comparison groups.

Table 5-2. Accounts Included in Final Billing Analysis Model

Home Type	Treatment Group (July 2014–June 2015)	Comparison Group (July 2015–June 2016)	Total
Total Accounts	5,121	4,869	9,990

A more detailed discussion of the billing analysis methodology, including data cleaning steps, a comparison group assessment, and the final model, is provided in Appendix B.

5.2 Engineering Analysis Results

This section provides deemed energy and demand savings estimates for each measure offered by the RNP in 2015. Appendix A contains all detailed algorithms and assumptions used in the engineering analysis.

Table 5-3 provides a breakdown of estimated per-unit energy and demand savings across the various measures installed through the program, as determined through our engineering analysis. As described in Section 5.1, we based the measure-level savings on secondary research and applied RNP-specific assumptions on housing characteristics, such as the portion of homes using electricity for heating, cooling, and hot water heating. These energy savings estimates also include the ISRs presented in Table 5-1 based on responses to the participant survey. Table 5-3 also presents the per-measure engineering analysis results used in the 2013–2014 evaluation for comparison.

Table 5-3. Engineering Analysis Gross Impact Results

Measure	2013–2014*		2015**		
	Energy Savings (kWh)	Demand (kW)	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
9-Watt CFL	Not Determined	Not Determined	17	0.0020	0.0015
13-Watt CFL	Not Determined	Not Determined	14	0.0016	0.0012
18-Watt CFL	Not Determined	Not Determined	30	0.0035	0.0027
20-Watt CFL	Not Determined	Not Determined	28	0.0033	0.0025
23-Watt CFL	Not Determined	Not Determined	42	0.0049	0.0037
CFLs***	33.0	0.0029	20	0.0024	0.0018
Efficient Shower Head	128.0	0.0100	59	0.0052	0.0103
Efficient Faucet Aerator	8.8	0.0011	35	0.0061	0.0122
Hot Water Temperature Setback	86.1	0.0098	82	0.0093	0.0093
Hot Water Pipe Wrap	24.6	0.0028	14	0.0016	0.0016
Water Heater Blanket	126.0	0.0144	115	0.0131	0.0131
HVAC Filter	23.0	0.0017	34	0.0113	0.0070
Infiltration Reduction: Weather Stripping	0.36	0.0002	Not Determined	Not Determined	Not Determined
Infiltration Reduction: Caulking	0.22	0.0001	Not Determined	Not Determined	Not Determined
Infiltration Reduction: Door Sweep	1.36	0.0007	Not Determined	Not Determined	Not Determined
Infiltration Reduction: Foam Spray	2.83	0.0014	Not Determined	Not Determined	Not Determined
Infiltration Reduction****	Not Determined	Not Determined	69	0.0184	0.0173

* Source: Process and Impact Evaluation of the 2013–2014 Residential Neighborhood Program in the Carolina System, TecMarket Works.
** The 2015 deemed values presented in this table differ from those presented in Appendix A because of the inclusion of ISRs in this table.
*** The 2013–2014 report did not report savings for individual bulb types. We therefore calculated a weighted average of bulbs across all categories in 2015 to compare to the past evaluation report.
**** In 2015, we calculated savings for all infiltration measures in a single category. The 2013–2014 evaluation reported savings for individual infiltration reduction measures.

Using the deemed savings values from Table 5-3, we calculated energy savings of 333 kWh per household, which is 48% lower than the engineering analysis from the 2013–2014 program evaluation (612 kWh). Additionally, we calculated an overall kW per kWh savings ratio from the engineering analysis, as shown in Table 5-4, which we used to estimate demand savings from the billing analysis results for both summer and winter peak savings.

Table 5-4. Engineering Demand-to-Energy Ratios

	Summer Coincident Peak	Winter Coincident Peak
Average energy (kWh) savings per household	333	333
Average demand (kW) per household	0.0541	0.0582
Ratio multiplier (kW/kWh)	0.0001623	0.0001748

5.3 Billing Analysis Results

This section provides billing analysis results and savings estimates for the 2015 RNP program year. Appendix B contains a detailed methodology for data cleaning and modeling used for this analysis, as well as complete results of the models. Table 5-5 shows the results of the billing model for each home type. The variable "RNP" represents our treatment effect, i.e., the change in average daily consumption (ADC) attributable to participation in the RNP.

Table 5-5. Results of Billing Analysis Models

Variable	Coefficient
RNP (Participation)	−2.256**
Cooling Degree Days (CDD)	0.0827**
Heating Degree Days (HDD)	0.0292**
Post-Participation Period CDD	−0.00403
Post-Participation Period HDD	0.00168*
Constant	18.83**
Observations	493,512
R-squared	0.655
Monthly Effects Included	YES
Post-Participation Period Interacted with Months Included	YES
Treatment Group Interacted with Months Included	YES

* $p<0.05$, ** $p<0.01$.

Due to post-participation period interaction terms in the model, it is necessary to recalculate the coefficient of the treatment effect (RNP) by combining the average value with the coefficient for each interaction term. The coefficient seen in the regression represents the reduction of daily consumption during the post-participation period, separate of any effect of the included interaction terms. Making these adjustments (detailed in Appendix B), Opinion Dynamics found that 2015 RNP participants realized 0.95 kWh of daily energy savings, on average, because of their participation. Table 5-6 shows the per-home and program-level savings for the program. Overall, customers who participated in the RNP saved 347 kWh per year. For the 2015 program year, the RNP realized 2,201 MWh of energy savings.

Table 5-6. Annual Savings from Billing Analysis

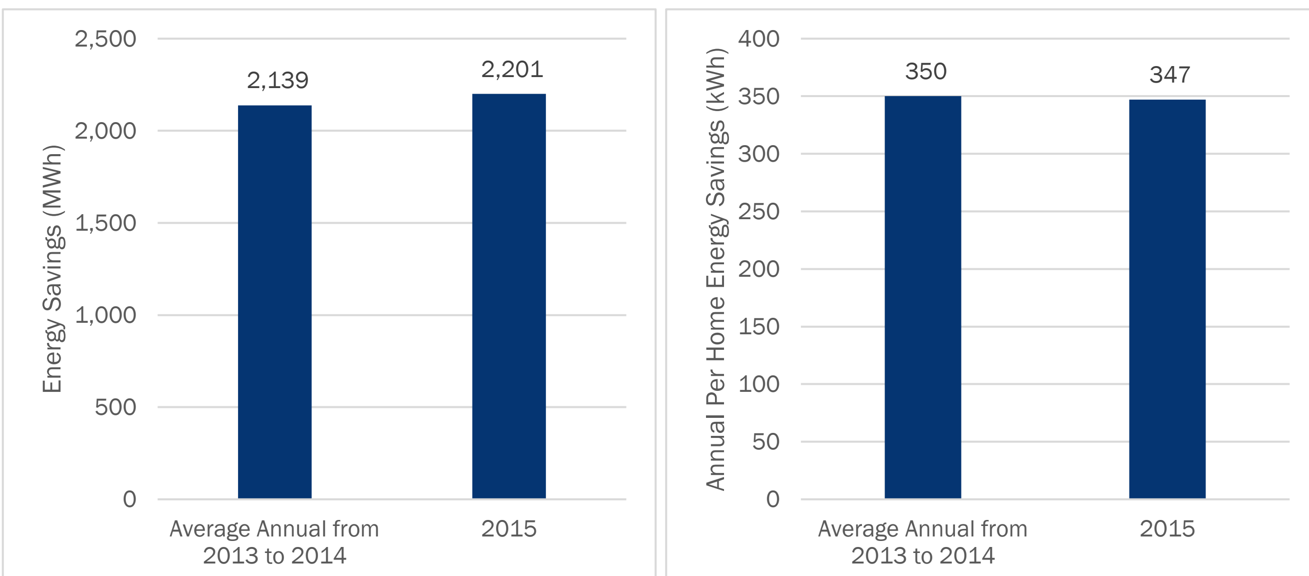
2015 Participants	6,342
Per-Home Savings Daily (kWh)	0.95
Per-Home Savings Annual (kWh)	347
Program Savings (MWh)	**2,201**

Among survey respondents, 42% of 2015 participants reported that they heated their home with natural gas; 50% heated their home with electricity; and 7% used oil, kerosene, or some other fuel. One percent did not respond to this survey question. In general, customers with electric heat use more energy than customers who heat their homes with gas, and often realize higher savings. While it is common to investigate differences in energy savings for customers with different heating fuels and different home types, we were unable to separate our billing analysis by either group due to data quality issues for those fields in the computer-based information system (CBIS) and program-tracking databases. Through a careful review of the data, we identified inconsistencies between the program-tracking databases and the CBIS data warehouse. After in-depth discussions with Duke Energy and RNP program staff, we determined that the home types from the participant tracking data were likely more accurate than those shown in CBIS data. However, the data were not fully populated and some of the home type designations used by the implementer did not map directly to either single- or multifamily home types (e.g., condo, townhouse). We also found that heating fuel data were not reliable in the CBIS data, and that data were not fully populated in program-tracking data collected by the implementer.

5.4 Program Savings

The billing analysis results show that the RNP saved 2,201 MWh in 2015. The 2013–2014 evaluation estimated that the RNP saved participants 2,139 MWh,[6] indicating an overall increase of 3% between the 2013–2014 period and 2015. Figure 5-2 shows the annual savings levels for the program in the 2013–2014 period compared to 2015 and the per-household savings between the two evaluations.

Figure 5-2. RNP Total Savings and Per-Household, Per-Year Savings from 2013 to 2015



One explanation for the slightly higher savings seen in the billing analysis compared to the engineering analysis is that our billing analysis provides net savings that account for free-ridership and participant spillover through the use of a comparison group. For programs like the RNP that provide education and encouragement to participants to take additional energy-saving actions, significant participant spillover can result. Additional savings attributable to behavior change and additional purchases of energy-efficient equipment would be captured in the energy savings observed through the billing analysis, but would not be captured in estimates of savings derived from the engineering analysis. Forty percent of participants reported that they had taken at least one energy-saving action following their participation in the program. These follow-on actions after RNP participation include behavior changes, such as turning off lights more frequently, washing clothes in cold water, unplugging unused appliances, and purchasing additional energy-saving equipment.

[6] Results of 2013–2014 evaluation were normalized for a 12-month period from the original 16-month period in order to compare to the 2015 results that are determined over a 12-month period.

6. Process Evaluation

6.1 Researchable Questions

After discussions with RNP program staff, the evaluation team developed the following process-related research questions for the 2015 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?
- Is the current measure mix appropriate? Or are there measures that the program could add to increase its effectiveness?
- What are the barriers to implementing this program (i.e., are there limiting factors to achieving greater participation and realizing additional program-attributable savings)?
- Is the educational component of the RNP leading to persistent behavioral change?

6.2 Methodology

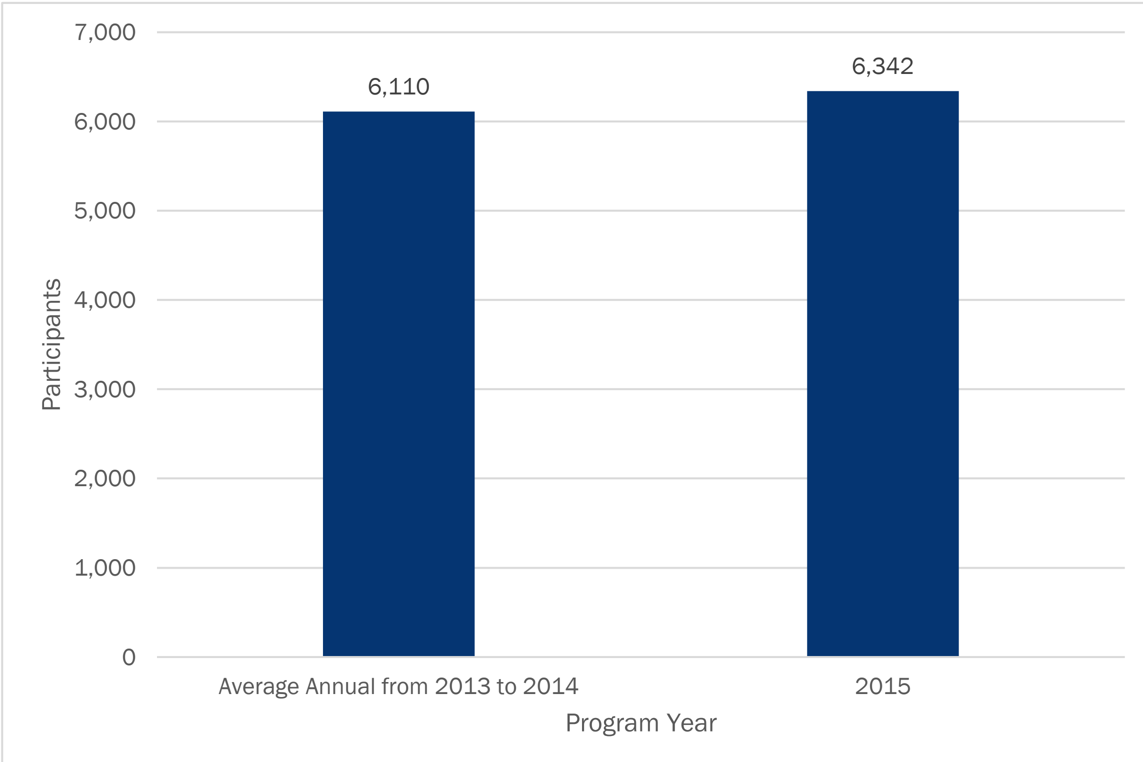
Our process evaluation relied primarily on our interview with program staff, our review of program materials and RNP tracking data, and our analysis of the participant survey results. Each of these activities is described in more detail in Section 4.

6.3 Key Findings

6.3.1 Program Participation

Participation remained steady in 2015 compared to prior years. There were 6,342 unique participants served by the RNP in 2015, as shown in Figure 6-1. However, participation was below the program's goals. Overall, the RNP achieved 71% of its total participation goal, which was 8,926 customers. In North Carolina, the program reached 67% of its goal, and in South Carolina, it reached 82% of its goal. The program managers reported that the program treated only 35%–45% of eligible customers in each neighborhood, requiring the program to target more neighborhoods than would be necessary if participation rates were higher. In 2015, the implementation contractor added a canvassing position to conduct door-to-door canvassing of the neighborhoods to facilitate program outreach and participation.

Figure 6-1. Program Participation in 2015 Compared to Prior Evaluation Period[7]



To evaluate how successfully the program was providing energy-saving measures to participants, and to determine if there were missed savings opportunities or measures that were being provided less frequently than in past years, Opinion Dynamics examined the number of measures provided to each home. As shown in Table 6-1, most participants received measures from each measure category. Eighty-four percent of participants received CFLs. Seventy-seven percent received at least one of the domestic hot water measures, with the most common being faucet aerators. Seventy-nine percent of participants received at least one air infiltration measure, with weather stripping appearing as the most commonly installed measure. Seventy-eight percent of participants received HVAC filters.

[7] Participation counts were extracted from the prior evaluation, which covered March 2013 through July 2014. These project counts were normalized for a 12-month period from the original 16-month period to compare to the 2015 participation. Some 8,147 participants were included in the original 16-month evaluation period in the 2013–2014 evaluation.

Table 6-1. 2015 Measure Installation Rates

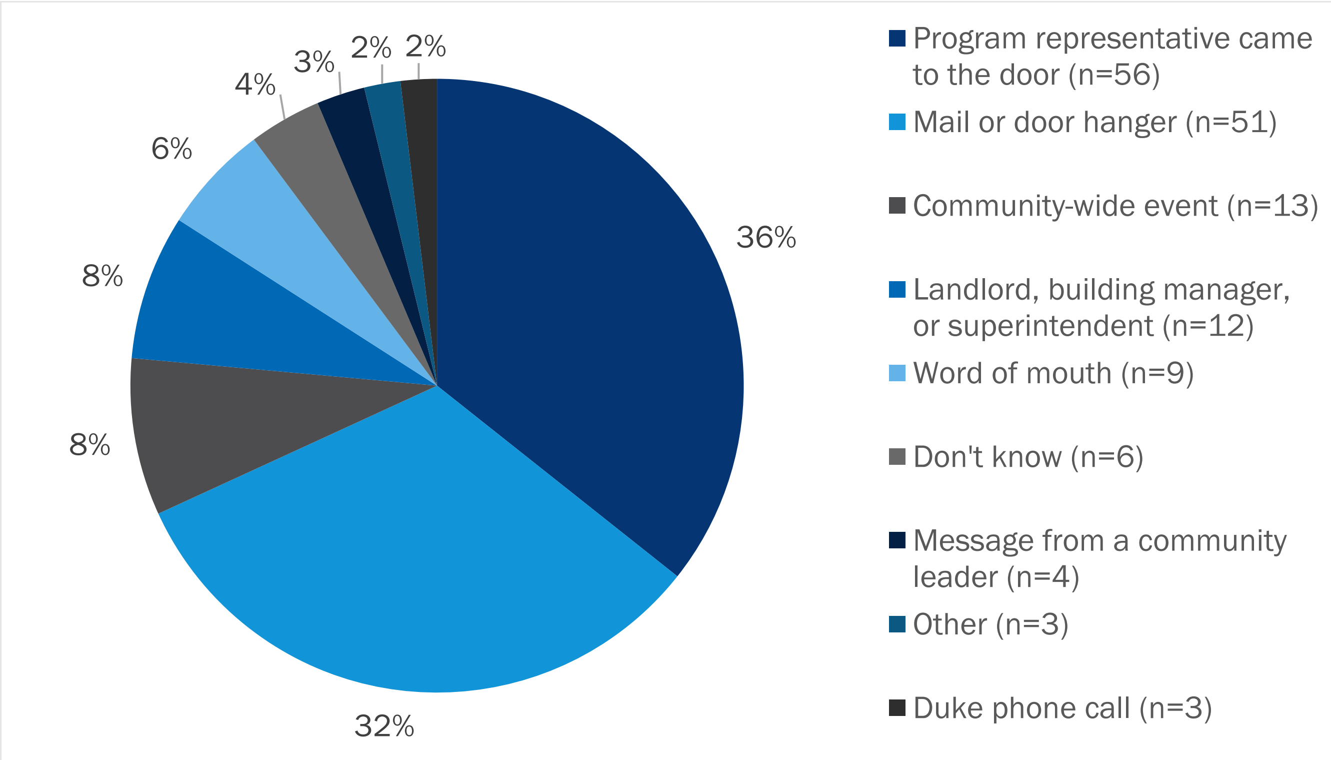
Measure Category	Percent of Projects with Measure Category	Measure	Percent of Projects with Measure	Average Number of Measures Per Project
Lighting	84%	CFLs*	84%	7.20
Hot Water	77%	Efficient Faucet Aerator	73%	1.91
		Efficient Shower Head	55%	1.16
		Hot Water Temperature Setback	20%	1.00
		Hot Water Pipe Wrap	16%	2.03
		Water Heater Blanket	3%	1.06
Air Infiltration	79%	Weather Stripping	67%	1.52
		Door Sweep	47%	1.59
		Caulking	31%	1.40
		Foam Spray	20%	1.36
		Winterization Kit	16%	1.66
		Glass Patch Tape	2%	1.10
HVAC Filters/ Educational/Other	94%	HVAC Filter	78%	1.43
		Thermometer	74%	1.00
		Calendar	13%	1.00

* Includes 9-, 13-, 18-, 20-, 23-watt CFLs.

6.3.2 Marketing and Outreach

An important component of the RNP is the extensive marketing and outreach that is performed among program participants to generate interest in the program and in energy efficiency. Prior to working in each neighborhood, the program conducted a direct mailing, staged neighborhood launch events, and canvassed the neighborhood to generate appointments. Opinion Dynamics examined how program participants first learned about the RNP to assess which communication and marketing channels were most responsible for making participants aware of the program. Among surveyed program participants, the most common answer when asked about how they first heard about the program was when a program representative or canvasser came to the door (36%). The second most frequently cited mode of learning about the program was through a mailing or door hanger (32%). Smaller percentages of participants reported that they heard about the program through a community-wide event (8%) or from their landlord or other building staff (8%). These responses are summarized in Figure 6-2. While the door-to-door canvassing appears to be the most common means of informing participants about the program, as discussed in section 6.3.1, the rate of participation within each neighborhood was relatively low.

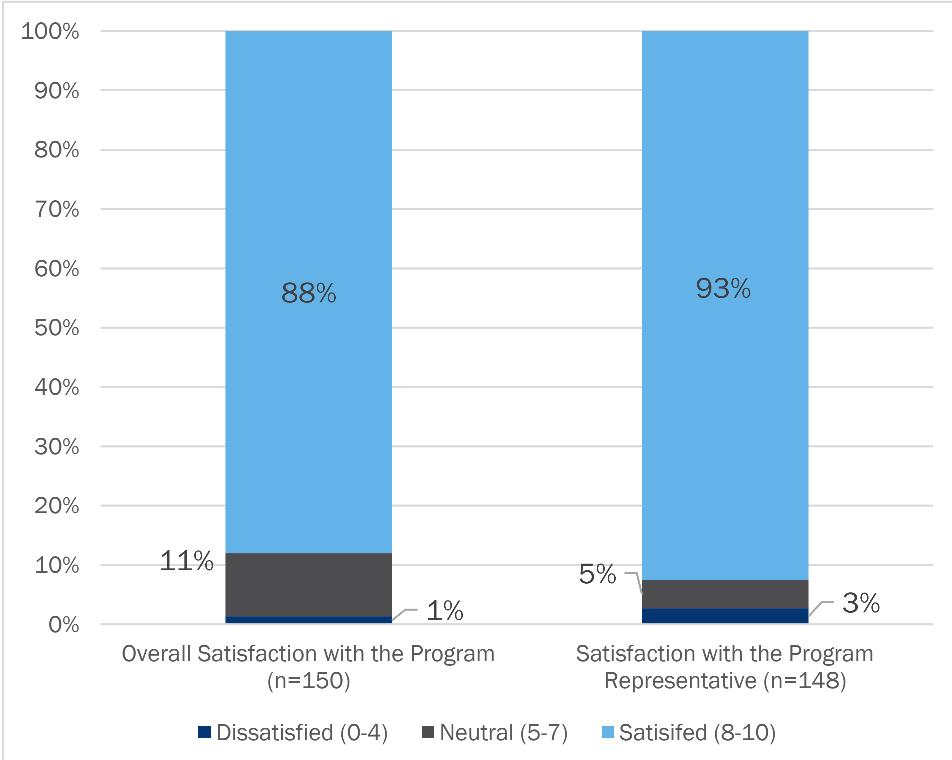
Figure 6-2. How Participants First Learned about the RNP (multiple responses)



6.3.3 Program Satisfaction

RNP participants are highly satisfied with the program, with 88% of survey respondents saying that they are satisfied with the program overall. Only 11% said that they had neutral satisfaction with the program, and only 1% said that they were dissatisfied. Survey respondents were also asked to rate their satisfaction with the program representative who visited their home. Ninety-three percent of respondents said that they were satisfied with the program representative, with only 5% giving a neutral rating, and 3% giving a dissatisfied rating. These results are summarized in Figure 6-3.

Figure 6-3. Satisfaction with the Residential Neighborhood Program and the Program Representative



6.3.4 Energy Education

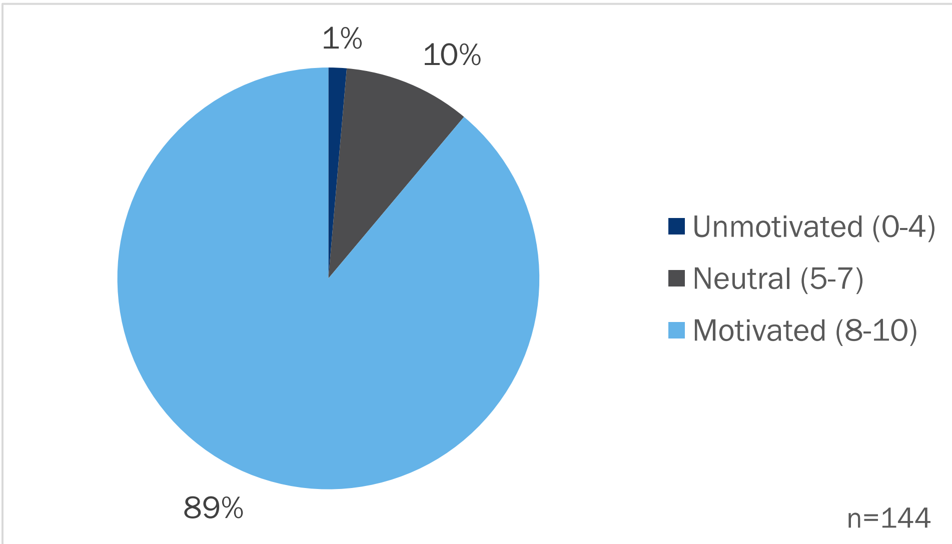
A key component of the RNP is the energy education that the program provides to participants during their home energy assessment. During the assessment, a program representative discusses the measures that will be installed and describes other ways that the customer can save energy beyond what is installed during the visit. The program representative provides the participants with a brochure that describes the measures that were installed and reinforces the message about the energy savings from each measure. The brochure also provides tips on how to keep the installed measures working well and ways that participants can learn about other Duke Energy programs that can help them save energy.

Overall, the RNP is providing energy education effectively to most participants. We asked survey respondents if they recalled receiving the brochure from the program representative who visited their home, and if the program representative discussed additional ways that they could save energy during the visit. Eighty-three percent said that the program representative discussed ways to save energy, and 77% reported that they received a brochure with additional information. Of those who discussed ways to save energy with the program representative, most thought the discussion was very useful, rating it an average of 8.7 on a scale of 0 to 10, where 0 is “not at all useful” and 10 is “extremely useful.” On the same scale, those that received a brochure rated the usefulness of its information as 8.5 out of 10.

We also asked participants to rate their knowledge of ways to save energy before participating in the program and after participating in the program on a scale of 0 to 10, where 0 is “not at all knowledgeable” and 10 is “very knowledgeable.” On average, participants rated their knowledge before participating as 7.2 (n=147) and after participating as 8.8 (n=149), indicating that there were positive educational impacts of the program among participants.

We also asked participants about their motivation to reduce their energy use at home following their participation in the RNP. Eighty-nine percent of participants reported that they were motivated to reduce their energy use, as shown in Figure 6-4.

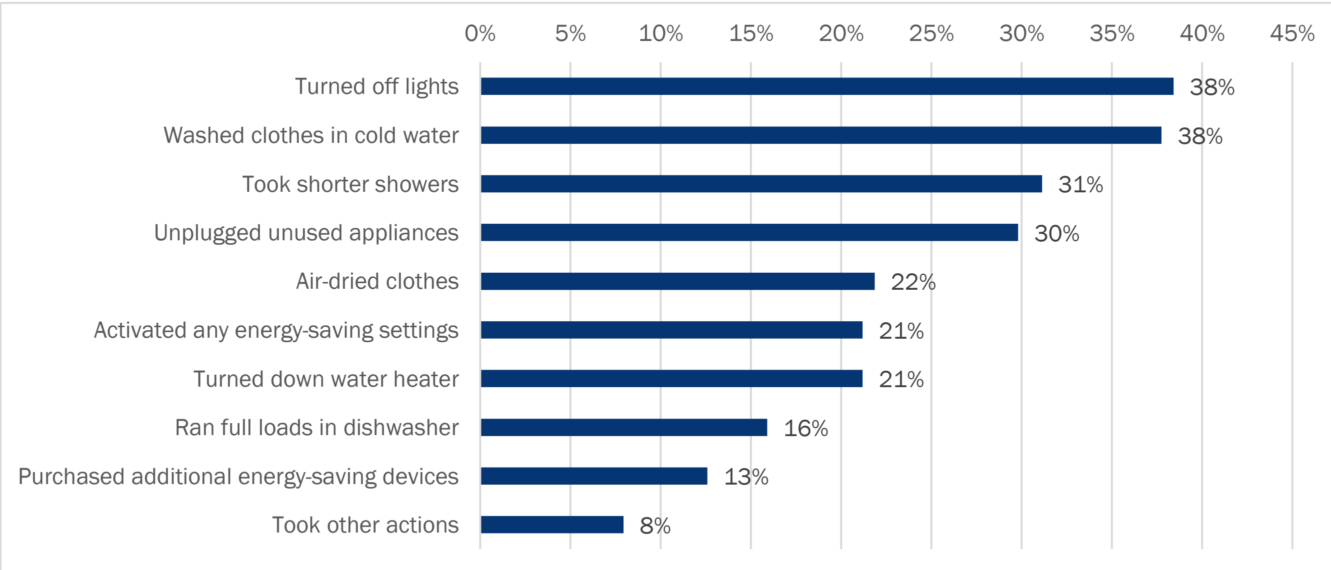
Figure 6-4. Motivation to Reduce Energy Use after RNP Participation (n=144)



The participants' reported motivation to reduce energy use, as well as their increased knowledge of ways to save energy after participating in the program, indicate that the program's energy education component is robust and effective.

To determine if the education resulted in actual energy-saving behavioral changes after, we asked survey respondents who recalled receiving written materials at the time of the RNP visit what energy-saving actions they had taken after participating in the program. The most frequent responses were that they had turned off lights (38%) and washed clothes in cold water (38%). More than a quarter also took shorter showers and unplugged unused appliances. Forty percent of participants had taken at least one energy saving action.

Figure 6-5. Energy-Saving Actions Taken (multiple responses)*



* All reported actions are significant at the 90% confidence interval.

6.3.5 Additional Opportunities for Program Savings

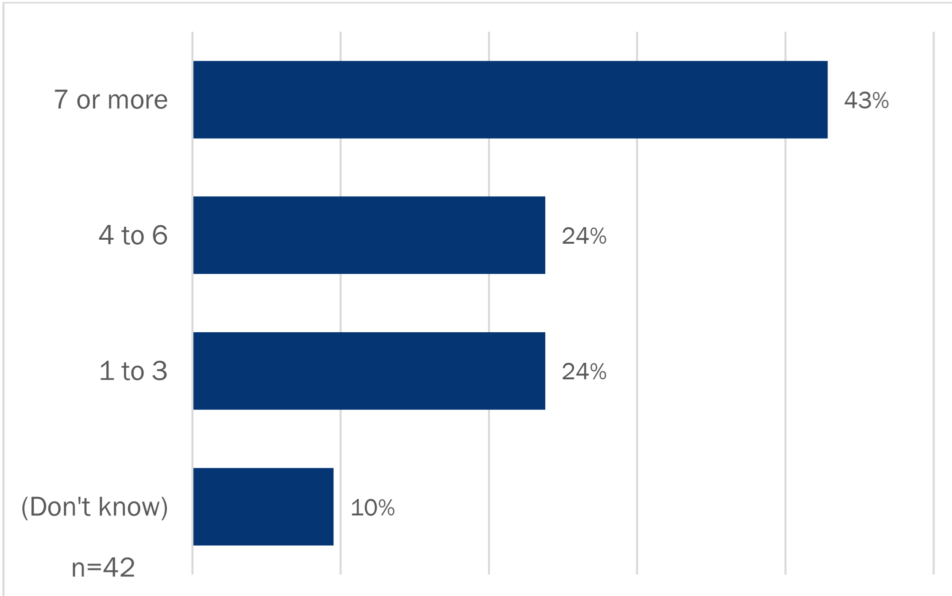
One objective of the process evaluation was to determine if there are opportunities for increasing program savings with additional types of measures. For example, some income-qualified programs provide energy-efficient replacements for older inefficient appliances. Further, with increasing efficiency of existing standard lighting, some programs are offering LEDs and other specialty lighting options.

To identify potential opportunities, Opinion Dynamics surveyed participants about their existing lighting and appliances. Specifically, we asked respondents about any light bulbs that were not replaced during the visit, as well as about the presence and age of refrigerators, dehumidifiers, and window air conditioners.

Lighting

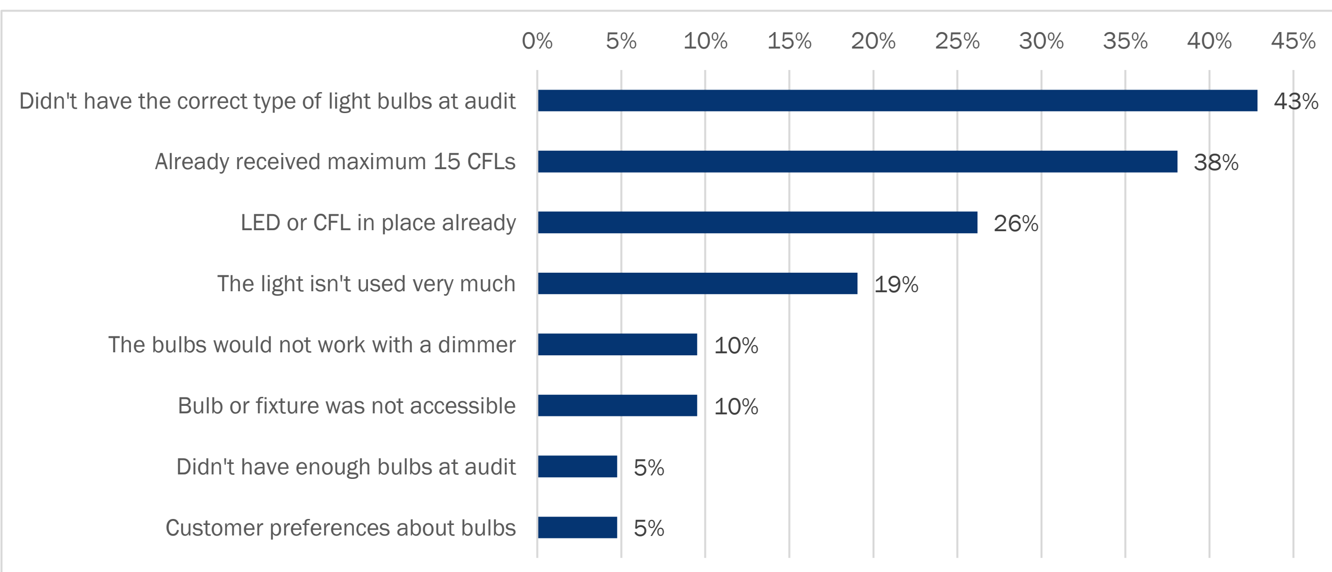
With the rapid efficiency improvements in the standard lighting market that resulted from the 2007 Energy Independence and Security Act (EISA) and technological advances, the opportunities for installing high-efficiency bulbs in standard high-use sockets are becoming scarcer. Existing standard lighting is more efficient, reducing baseline energy use and associated energy savings from efficiency upgrades. Not as significantly affected by EISA, specialty lighting may be a source of additional savings opportunities for the RNP, which currently does not offer specialty lighting measures. To identify potential specialty lighting applications, we asked RNP participants about bulbs in their homes that were not replaced by the program representative. Twenty-eight percent of participants reported that there were bulbs not replaced during the visit. We asked participants who said they had bulbs that were not replaced during the visit to estimate the number of bulbs that were not replaced. Forty-three percent of those reporting that at least some bulbs were not replaced said that seven or more bulbs were not replaced, 24% said four to six bulbs were not replaced, and 24% said one to three bulbs were not replaced, as shown in Figure 6-6.

Figure 6-6. Number of Bulbs Not Replaced During Assessment



Of the respondents who said that they had bulbs not replaced during the assessment, we also asked why they thought the bulbs were not replaced. Forty-three percent of respondents to this question said that the program representative did not have the correct type of bulbs, and 10% said that the program bulbs would not work with a dimmer, as shown in Figure 6-7. These responses indicate that there may be opportunities for additional savings from specialty bulbs (e.g., dimmable bulbs, reflectors) to be offered through the program. As further evidence of the changing lighting baseline to higher efficiency, 26% of respondents reported that some bulbs were not replaced because LEDs or CFLs were already in place.

Figure 6-7. Reasons Bulbs Were Not Replaced (multiple responses)

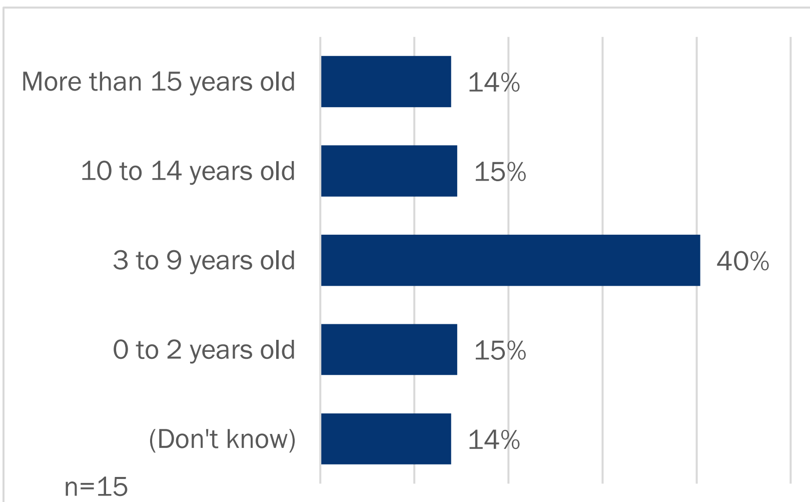


Refrigerators

Older model refrigerators, frequently found in low-income homes, can account for a significant portion of annual household energy use. Although they are high cost measures, new ENERGY STAR® refrigerators are being offered by some income-qualified programs cost-effectively. Refrigerators typically qualify for replacement based on their age or metered energy use. Typical annual deemed savings values for refrigerator replacement used in engineering analyses of similar programs range from 750 kWh to 940 kWh.[8]

To characterize the prevalence of older, inefficient refrigerators among the RNP participants, we asked participants to estimate the age of their refrigerator. The most recent Department of Energy efficiency standards for refrigerators went into effect in September 2014; prior standards were in effect from July 2001 to September 2014.[9] As shown in Figure 6-8, approximately 14% of the refrigerators among the population of RNP participants likely predate two of the last federal efficiency standards updates, and 29% of respondents reported that their refrigerator was 10 years old or more.

Figure 6-8. Approximate Ages of Refrigerators



The percent of refrigerators qualifying for replacement in two similar income-qualified programs that Opinion Dynamics recently evaluated were in the range of 27%–30%, as shown in Table 6-2. Program 1's installation percentage is based on the most recent 2015 results, and Program 2's installation percentage is based on results from the past 5 years of the program. Based on these results, we would estimate that a similar percent of refrigerators among RNP participants might qualify for replacement. However, additional analysis would be necessary to determine actual savings, costs, and cost-effectiveness of providing this measure.

[8] Opinion Dynamics calculation based on inputs from Illinois TRM Version 4.0, Mid-Atlantic TRM Version 4.0, Indiana TRM Version 2.2, and Pennsylvania TRM.

[9] See U.S. Department of Energy Standards for Refrigerators here: https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=37&action=viewlive.

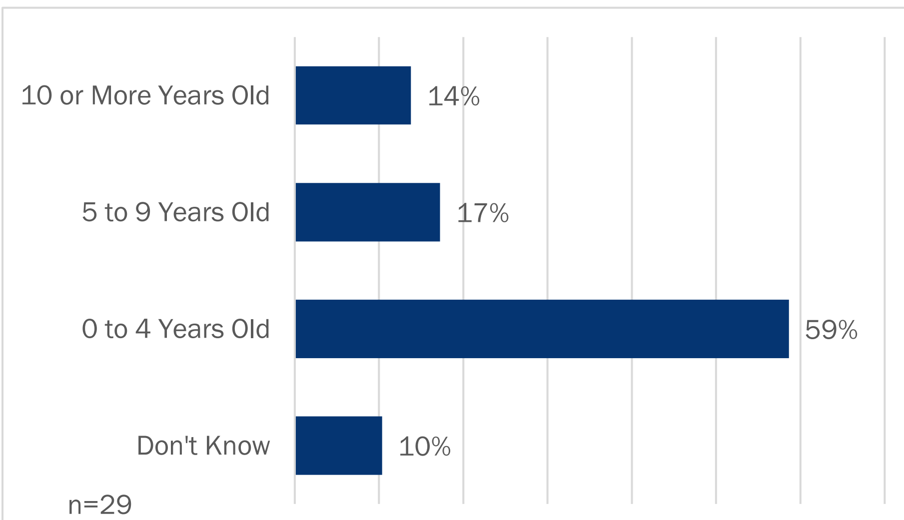
Table 6-2. Observed Installation Percentages of Refrigerators in Similar Income-Qualified Direct Install Programs

Measure	Percent of Participants Receiving Measure	
	Program 1	Program 2
Refrigerator	27%	13%–47% (30% on average)

Dehumidifiers

Older and inefficient dehumidifiers are also the target of some income-qualified programs. Replacing these dehumidifiers with new ENERGY STAR units can save approximately 260–360 kWh per year.[10] We asked RNP participants if they have a dehumidifier and, if so, to estimate its age. Nineteen percent reported having a dehumidifier. Most (59%) of those respondents said that their dehumidifier was between 0 and 4 years old, as shown in Figure 6-9. A further 17% of respondents said that their dehumidifier is 5–9 years old, and 14% said that their dehumidifier is 10 years old or more. The most recent Department of Energy dehumidifier standards went into effect for products manufactured in or after October 2012. Participants' dehumidifiers that are 0–4 years old are likely up to date with the most recent standard, but those that are 5–9 years old were probably manufactured under the efficiency standard that was in place from October 2007 to October 2012.[11]

Figure 6-9. Approximate Age of Dehumidifier



For two similar income-qualified programs recently evaluated by Opinion Dynamics, we found that between 3% and 13% of program participants received energy-efficient dehumidifiers in exchange for an older unit that was less efficient but still functioning, as shown in Table 6-3. Program 1[12] requires that a dehumidifier meet one of the following thresholds to be replaced by a more efficient unit:

[10] Opinion Dynamics calculation based on inputs from Illinois TRM Version 4.0, Mid-Atlantic TRM Version 4.0, and Pennsylvania TRM.

[11] See U.S. Department of Energy Standards for Dehumidifiers here: https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=24&action=viewcurrent.

[12] IESO Home Assistance Program Evaluation Report, 2015. http://www.ieso.ca/Pages/Conservation/Conservation-First-Framework/Evaluation-Measurement-and-Verification.aspx

- The humidifier uses Freon 11 or 12 refrigerant.
- The dehumidifier was manufactured before the year 2000.
- The humidifier has an energy factor of less than 0.8.

The dehumidifier must also be used enough to warrant replacement with an ENERGY STAR unit. This determination is made based on the equipment's wattage rating and the number of weeks it is operated annually.

Program 2[13] uses different criteria to determine if a dehumidifier can be exchanged. In program 2, a dehumidifier must be at least 5 years old and in working condition, unless the unit is an ENERGY STAR unit, in which case it must be at least 11 years old and operational to be exchanged for a more efficient unit. Additional research would be required to verify the age, condition, and efficiency levels of the existing stock of dehumidifiers among the RNP population in DEC's territory. However, these results suggest that approximately 2.6% (assuming all units 10 years old or more qualify) to 3.8% (assuming all units 5 years old or more qualify) of participants would qualify for a dehumidifier replacement.

Table 6-3. Observed Installation Percentages of Dehumidifiers in Other Income-Qualified Direct Install Programs

Measure	Percent of Participants Receiving Measure	
	Program 1	Program 2
Dehumidifier	3%	13%

Window Air Conditioners

To determine if there is potential for the RNP to offer efficient window air conditioner replacements, we asked participants if they have window air conditioners and, if so, to estimate their ages. Twenty-six percent of survey respondents reported that they have at least one window air conditioner. Of the 26% of survey respondents with window air conditioners, most (62%) are 3–10 years old. Fewer than 10% are 11–15 years old, and approximately 23% are relatively new at 0-2 years old. Department of Energy room air conditioner standards most recently went into effect in June 1, 2014, when energy efficiency ratio (EER) levels increased for room air conditioners.[14] Prior to this most recent federal standard, a standard was in place from October 1, 2000 to May 31, 2014.[15] Therefore, among survey respondents, approximately 70% of the window air conditioner units were likely manufactured prior to the most recent efficiency standard. Figure 6-10 summarizes the ages of window air conditioners among survey respondents with this equipment in their home.

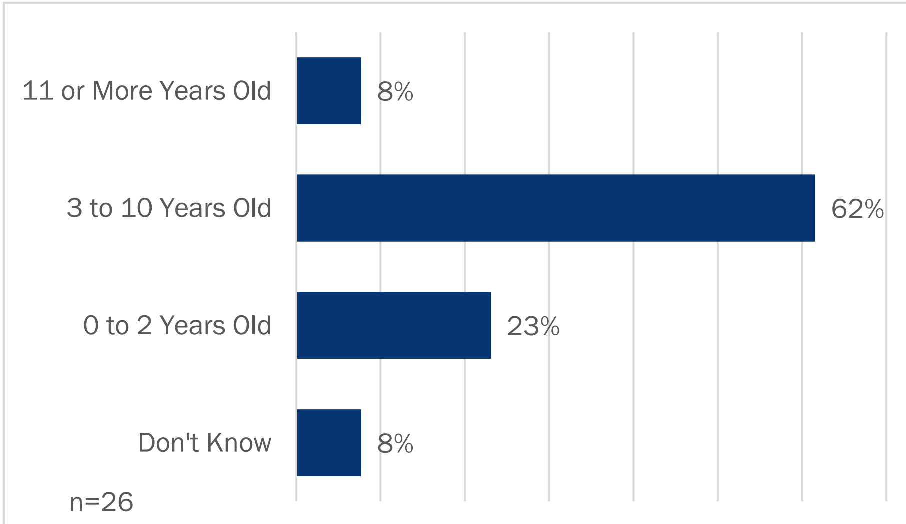
---

[13] PSEG Long Island Efficiency Long Island and Renewable Energy Portfolio Evaluations, REAP program, 2009-2015. https://www.psegliny.com/page.cfm/AboutUs/CompanyProfile/DocumentLibrary/Reports/ELI

[14] U.S. Department of Energy standards for room air conditioners apply to window air conditioners and those designed to be mounted through a wall.

[15] See U.S. Department of Energy Standards for Window Air Conditioners here: https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=52&action=viewlive

Figure 6-10. Approximate Age of Oldest Window Air Conditioner



Program 2, an income-qualified program that Opinion Dynamics recently evaluated, determines unit eligibility according to the age of the unit. Non-ENERGY STAR window air conditioners that are 5 or more years old and operational are eligible to be exchanged, while ENERGY STAR units must be operational and at least 11 years old. Based on these criteria, we estimate that 2%–11% of RNP participants would qualify for window air conditioner replacement. These results indicate that there may be additional savings opportunities for the RNP by offering window air conditioner replacements to program participants.

Table 6-4. Observed Installation Percentages of Window Air Conditioners in Other Income-Qualified Direct Install Programs

Measure	Program 1 Observed Installation (Percent of Participants Receiving Measure)	Program 2 Observed Installation (Percent of Participants Receiving Measure)
Window Air Conditioner	3%	31%

7. Conclusions and Recommendations

7.1 Conclusions

Opinion Dynamics conducted a billing analysis of RNP participants to determine overall ex post net program savings. We also conducted an engineering analysis for each measure provided by the program, the purposes of which were to:

1. Provide a ratio of kW demand to kWh energy savings, which is then applied to the billing analysis energy savings to estimate demand savings
2. Provide insight into the individual measure contributions to the overall program savings

Table 7-1 presents a comparison of the estimated ex post results of both analyses at the per-household and program-wide levels.

Table 7-1. Comparison of 2015 Billing Analysis Savings and Engineering Savings Estimates

	Participant Savings			Program Savings		
Method	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Energy (MWh)	Summer Coincident Demand (MW)	Winter Coincident Demand (MW)
Billing Analysis (evaluated)	347	0.0563	0.0607	2,201	0.357	0.385
Engineering Analysis	333	0.0541	0.0582	2,113	0.343	0.369

Key findings, which we discuss below, include:

- The program did not reach the desired number of homes in 2015, reaching 6,342 homes out of a goal of 8,926 homes.
- Per-household savings decreased slightly from the prior evaluation period, from 350 kWh in the 2013–2014 evaluation to 347 kWh in the 2015 evaluation. The program in 2015 achieved a realization rate of 99%.[16] This realization rate was calculated as the change in evaluated savings per treated home compared to the reported per-home savings from the 2013–2014 evaluation.
- Opportunities may exist for additional savings through new program measures.

Program Participation

The program did not meet its goal of reaching 8,926 homes in 2015. According to program staff, the RNP treated only 35%–45% of eligible customers on average in each neighborhood. To make up for the lower participation rates, the program needed to target a larger number of neighborhoods, approximately 20 in total, from which to recruit participants. Participation rates may improve in 2016, as a new implementer, Honeywell, has taken over RNP implementation in DEC territory. Honeywell has had more success, in terms of participation rate, in implementing the program for DEP.

[16] 2013–2014 evaluation reported savings that were adjusted for EISA effects, which lowered the per-home first-year savings from 393 kWh to 350 kWh for the final reported net evaluated savings.

Per-Home Savings

The program achieved savings of 347 kWh per home per year, as determined by our billing analysis, while our engineering analysis estimated 333 kWh per year. The higher savings estimate provided by the billing analysis may be the result of participants taking additional energy-saving actions because of their participation (i.e., participant spillover). Any additional behavior changes or energy-saving equipment purchases that participants make after the RNP assessment would not be accounted for in the program-tracking data and engineering analysis. However, the savings associated with these changes would be captured in the billing analysis. Forty percent of participants reported taking some additional energy-saving actions after participating in the RNP and receiving educational information about energy conservation.

The per-home savings estimate changed only slightly compared to the evaluation conducted in 2013–2014. Notably, the 2013–2014 evaluation adjusted the billing analysis results downward to account for EISA effects on lighting baselines for 4 years. This approach reduced the billing analysis savings from 400 kWh to 350 kWh. Opinion Dynamics did not make this kind of adjustment to the billing analysis results because our billing analysis provides first-year energy savings.

Opportunities for Additional Savings

As efficiency baselines for lighting products continue to grow more stringent, the RNP risks achieving lower savings from efficient lighting installations than have been achievable in the past. In 2015, the program obtained approximately 37% of its savings through installation of standard CFLs, per our engineering analysis. As lighting baselines become more efficient, the program will need to adapt to continue to achieve significant energy savings. Other income-qualified programs that Opinion Dynamics has evaluated offer additional energy-saving measures that provide value to customers and help the program achieve savings from diversified sources. Some of the measures offered by other income-qualified programs include ENERGY STAR dehumidifiers, window air conditioners, and refrigerator replacements. These types of deeper-savings measures may be an opportunity for the DEC to diversify its savings and rely less on the lighting end use. Our survey research among 2015 RNP participants showed that there may be opportunities in the DEC territory for these measures, but more research is needed to assess the opportunity. In addition, the program may consider diversifying its lighting offerings to include specialty bulbs, such as dimmables, non-A-line bulbs, and exterior bulbs. Survey research indicated that there may be additional high-use sockets in participating homes that cannot be retrofitted with the current lighting measures offered by the program. As it moves toward adding LEDs to the measures it offers, the program may be able to address some of these specialty applications.

7.2 Recommendations

Below we discuss Opinion Dynamics's recommendations for potential program improvements. These recommendations are based on the results of the participant survey, a billing analysis, interviews with program staff, and experience evaluating similar income-qualified programs.

- **Targeting Neighborhoods with the Highest Savings Opportunities.** As with the 2014 DEP NES evaluation, there may be opportunities to target neighborhoods with lower median home values and lower median household income to maintain or increase program savings. Each of those factors was correlated with higher savings in an analysis of 2010–2014 DEP NES participation. In addition, targeting homes with electric heat and hot water is likely to increase per-home and overall program savings.
- **Specialty Lighting.** There may be opportunities to provide additional efficient lighting equipment. The program should evaluate the opportunities for specialty lighting products. The increasing prevalence

of efficient lighting technology may limit opportunities to install CFLs in standard high-use sockets and specialty lighting may be an opportunity for additional savings.

- **ENERGY STAR Appliances.** DEC should assess the potential savings and costs of including additional measures frequently offered through income-qualified programs. The results of the participant survey show that there may be opportunities to replace older appliances in some homes. Replacing older and less-efficient equipment with ENERGY STAR equipment could generate increased savings for the program and may also improve program participation rates.
- **Improve Program Participation Rates.** The program should continue to make efforts to reach the greatest number of participants in each selected neighborhood. Maximizing the number of treated homes in each neighborhood reduces the overall number of neighborhoods required to meet program-wide participation goals. Over the long term, this would increase participation while reducing the costs associated with selecting and setting up operations in additional neighborhoods. Raising the visibility of the program in each neighborhood by using multiple crews on the same street or area and providing customers with as much flexibility as possible in scheduling has been shown to increase participation rates in other jurisdictions. If canvassers are used, the implementers should develop outcome-based goals, specifically based on the number of appointments generated and the participation rate in each neighborhood.
- **Continue to Focus on Energy Education.** The program's energy education component is effective and likely results in real savings for participants in addition to the installed program measures. Survey research shows that for those who receive education and training from program auditors, it is successful in increasing awareness of energy consumption and results in energy-saving behavior changes. The program should build on this success to offer it more consistently to all program participants.
- **Continue to Improve Consistency and Quality Control of Data Sources:** Data available for the 2015 program from CBIS, including participation dates and home characteristics, did not match data from sources managed and populated by the program implementation contractor. In addition, key information necessary for evaluation and collected by the implementers was not entered into the program-tracking database. In discussing these data issues with program and evaluation staff, we learned that additional steps have been taken to improve the consistency and accuracy of data-tracking processes between the program team and the implementation contractor. With changes that were recently made, issues observed in 2015 program data should be minimized and eliminated in the next evaluation cycle and in future years of the program. Areas that we observed for data quality and consistency improvements in the 2015 data include the following:
  - Ensure that all data sources have consistent and up-to-date participation dates and measure installation dates. One method to check these data sources for consistency is to compare year-to-date participation counts from implementer and program data at set intervals (e.g., monthly, bimonthly, quarterly).
  - Expand data collection efforts to consistently capture home characteristics at each visit, including type of home; fuel types for space heating, water heating, and cooking; wattage of removed bulbs; location of faucet aerators; size of hot water heater tanks; fuel source; pre- and post-temperature adjustments; presence of central air conditioning, room air conditioners, and dehumidifiers; and age and efficiency levels of each piece of equipment.

8. Summary Form

Residential Neighborhood Program

Completed EMV Fact Sheet

The Residential Neighborhood Program (RNP) provides a home energy assessment free of cost, and installs energy-saving measures in the homes of income-qualified customers living in DEC service territory. During the assessment, program representatives discuss what was installed and provide additional recommendations on ways participants can save energy in their homes.

Date	December 7, 2016
Region(s)	Duke Energy Carolinas
Evaluation Period	January 1, 2015 – December 31, 2015
Annual kWh Savings	2,200,674
Per Participant kWh Savings	347
Coincident kW Impact	357 (Summer), 385 (Winter)
Measure Life	Not evaluated, so remains unchanged at 7 years
Net-to-Gross Ratio	N/A
Process Evaluation	Yes
Previous Evaluation(s)	November 2014

Evaluation Methodology

The evaluation team verified deemed savings estimates using an engineering analysis of savings assumptions and calculations. The evaluation team also leveraged a participant survey to verify installation and an ISRs for each measure and characterized behavior change resulting from the program's educational component. The evaluation team conducted a billing analysis to estimate energy savings and a combination of billing analysis results and engineering analysis to estimate peak demand savings.

Impact Evaluation Details

- Neighborhoods in DEC service territory where at least 50% of residential customers are at or below 200% of the federal poverty guidelines are eligible to participate in the RNP.
- The engineering analysis applied deemed savings values to measures distributed and in service.
- Results from the billing analysis reflect savings associated with measures installed, assessment recommendations, spillover, and potential behavioral changes from energy-efficiency knowledge gained through participation in the RNP.

Appendix A. Engineering Algorithms and Assumptions

Opinion Dynamics originally provided these algorithms and assumptions to Duke Energy in a memo dated January 19, 2016.[17]

This section documents the engineering algorithms and assumptions used to estimate energy and demand savings for each measure installed through the RNP. As previously mentioned, the program does not use these deemed savings values to estimate kWh savings. The program estimates energy impacts via a billing analysis. These engineering savings estimates produce a ratio between energy and demand savings, and we apply this ratio to the billing analysis energy savings to estimate demand savings and to gain insight on individual measure contributions to overall savings.

CFLs

CFL Results

Table A-1 documents the inputs and methodology for estimating savings for CFLs for the 2015 RNP.

Table A-1. Algorithms and Inputs for CFLs

Algorithms Used		
kWh Savings	= (Baseline Watts – CFL Watts) / 1,000 * Hours * WHFe	
kW Savings	= (Baseline Watts – CFL Watts) / 1,000 * CF * WHFd	
Parameter	**Value**	**Source/Notes**
Baseline Watts	Varies	From ENERGY STAR website, converts CFL wattage to equivalent incandescent wattage and then adjusts based on EISA requirements. See Table A-2.
CFL Watts	Varies	Actual wattage of installed bulb (9, 13, 14, 19, 20, or 23 watts).
Hours	1,097	Weighted average between data collected during 2012 and 2013 DEP evaluations and consistent with the previous DEC EM&V report assumption.
WHFe	0.99	Applied weights to the Arkansas TRM waste heat factors using the 2014 DEP participant survey based on presence of central air conditioning and heating fuel type.
WHFd	1.1	
Summer Coincidence Factor (CF)	0.1138	2013 Evaluation of DEP's Energy Efficient Lighting Program.
Winter CF	0.096	

Table A-2 displays a crosswalk between installed CFL wattage and assumed baseline incandescent wattage taken from the ENERGY STAR website. We then adjust the incandescent wattages to account for EISA requirements[18] and use the reduced EISA baseline in our engineering estimates.

[17] Deemed Savings Review for Duke Energy Carolinas Residential Neighborhoods Program. January 18, 2016.

[18] EISA set in place standards for general service light bulbs, with the first phase going into effect in January 2012. The standard essentially eliminates the manufacture and sale of 40W, 60W, 75W40-, 60-, 75-, and 100-watt incandescent light bulbs and sets new standards as shown in the table.

Table A-2. ENERGY STAR Equivalent Incandescent Wattages

CFL Wattage	Equivalent Incandescent Wattage*	EISA Baseline (watts)
9 to 13 watts	40	29
13 to 15 watts	60	43
18 to 25 watts	75	53
23 to 30 watts	100	72

* http://goo.gl/XjRoUk.

Table A-3 displays the deemed savings values used for the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. The 2013–2014 EM&V report does not provide individual savings estimates for the different types of CFLs; therefore, we assumed the energy and demand savings from the 2013–2014 EM&V report are average values across all CFLs.

Table A-3. Per-Measure Savings for CFLs

Measure (per bulb)	Savings Unit	2015	2013–2014 EM&V Report
9-Watt CFL	Energy Savings (kWh)	21.7	32.98 kWh 0.0029 kW
	Summer Demand Savings (kW)	0.0025	
	Winter Demand Savings (kW)	0.0019	
13-Watt CFL	Energy Savings (kWh)	17.3	
	Summer Demand Savings (kW)	0.0020	
	Winter Demand Savings (kW)	0.0015	
14-Watt CFL	Energy Savings (kWh)	31.4	
	Summer Demand Savings (kW)	0.0037	
	Winter Demand Savings (kW)	0.0028	
19-Watt CFL	Energy Savings (kWh)	36.8	
	Summer Demand Savings (kW)	0.0043	
	Winter Demand Savings (kW)	0.0033	
20-Watt CFL	Energy Savings (kWh)	35.7	
	Summer Demand Savings (kW)	0.0042	
	Winter Demand Savings (kW)	0.0032	
23-Watt CFL	Energy Savings (kWh)	53.1	
	Summer Demand Savings (kW)	0.0062	
	Winter Demand Savings (kW)	0.0047	

CFL Recommendations

Our methodology generally agrees with the methodology used during previous evaluations.

Moving forward, the program should consider collecting the wattage of the removed bulbs to provide a more accurate energy savings estimate. Alternatively, to minimize increased time spent in each home, these data could be collected from a random sample of participants in each neighborhood and the results could be applied to the remaining participant population.

LEDs

While the RNP does not presently offer LEDs, Duke Energy has expressed interest in adding these measures in the future. This section provides deeded savings methods and estimates for LEDs as background information to help inform a decision on whether to include LEDs as a program measure.

LED Results

The following section documents the expected savings from LEDs, assuming an incandescent baseline and identical hours of use and CFs used in the CFL savings calculations.[19] Table A-4 documents the proposed inputs and methodology for estimating savings for LEDs.

Table A-4. Algorithms and Inputs for LEDs

Algorithms Used		
kWh Savings	= (Baseline Watts – LED Watts) / 1,000 * Hours * WHFe	
kW Savings	= (Baseline Watts – LED Watts) / 1,000 * CF * WHFd	
Parameter	**Value**	**Source/Notes**
Baseline Watts	Varies	Varies according to installed LED wattage. See Table A-5.
LED Watts	Varies	Actual wattage of installed bulb.
Hours	1,097	Weighted average between data collected during 2012 and 2013 DEP evaluations and consistent with the previous DEC EM&V report assumption.
WHFe	0.99	Applied weights to the Arkansas TRM waste heat factors using the 2014 DEP participant survey based on presence of central air conditioning and heating fuel type.
WHFd	1.1	
Summer CF	0.1138	2013 Evaluation of DEP's Energy Efficient Lighting Program.
Winter CF	0.096	

Table A-5 displays a crosswalk of wattages between incandescent bulbs and the equivalent CFL and LEDs.[20] Most resources provide a range of equivalent wattages for CFLs and LEDs since exact wattage comparisons with incandescent bulbs are not always accurate. We adjust the incandescent wattages to account for EISA requirements and use the reduced EISA baseline in our engineering estimates.

[19] While there is reason to believe that hours of use and CFs for LEDs may be different from CFLs, there currently are no LED-specific values that we recommend using. We propose to update these assumptions with LED-specific information, based on the forthcoming residential logging study planned for the DEC Residential Lighting Program.

[20] http://eartheasy.com/live_energyeff_lighting.htm.

Table A-5. Equivalent CFL and LED Wattages

Incandescent (baseline) Watts	CFL Watts	LED Watts	Lumens (Brightness)
40	8–12	6–9	400–500
60	13–18	8–12.5	650–900
75–100	18–22	13+	1,100–1,750
100	23–30	16–20	1,800+
150	30–55	25–28	2,780

To estimate savings from installing LED bulbs, we assume an equivalent LED wattage based on the CFL wattages currently installed through the program. Table A-6 provides this comparison between CFLs and LEDs in the first column. Table A-6 also displays the proposed deemed savings for LEDs, compared with the deemed savings of equivalent CFLs currently installed through the program.

Table A-6. Per-Measure Savings for LEDs

Measure (per bulb)	Savings Unit	CFL Savings	LED Savings
9-Watt CFLs (7-Watt LEDs)	Energy Savings (kWh)	21.7	23.8
	Summer Demand Savings (kW)	0.0025	0.0028
	Winter Demand Savings (kW)	0.0019	0.0021
13-Watt CFLs (8-Watt LEDs)	Energy Savings (kWh)	17.3	37.9
	Summer Demand Savings (kW)	0.0020	0.0044
	Winter Demand Savings (kW)	0.0015	0.0034
19-Watt CFLs (14-Watt LEDs)	Energy Savings (kWh)	36.8	42.2
	Summer Demand Savings (kW)	0.0043	0.0049
	Winter Demand Savings (kW)	0.0033	0.0037
20-Watt CFLs (15-Watt LEDs)	Energy Savings (kWh)	35.7	61.7
	Summer Demand Savings (kW)	0.0042	0.0072
	Winter Demand Savings (kW)	0.0032	0.0055
23-Watt CFLs (16-Watt LEDs)	Energy Savings (kWh)	53.1	60.6
	Summer Demand Savings (kW)	0.0062	0.0071
	Winter Demand Savings (kW)	0.0047	0.0054

Efficient Shower Heads

Efficient Shower Head Results

Table A-7 documents the inputs and methodology for estimating efficient shower head savings for the RNP in 2015.

Table A-7. Algorithms and Inputs for Efficient 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	
kW Savings	= (Baseline GPM – Efficient GPM) * 60 * 8.33 * (Tmix – Tinlet) / RE / 3,412 * CF * %Elec	
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	Will use value from database if available. In the absence of a database value, we will use the number from the TVA TRM (1.9 GPM), which takes the average of two studies. Through discussions with Duke, 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 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	2.5	2014 DEP NES Participant Survey (n=250).
Shower fix/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). In addition, the Michigan study allows us to distinguish between single-family and multifamily.
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	63.94°F	NREL Domestic Hot Water Event Generator calculator for Greensboro, NC. TVA TRM uses the average temperature for entire U.S. (60°F).
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	72.4%	2014 DEP NES Participant Survey (n=250).
Summer CF	0.00371	TVA TRM does not provide a CF. We use CF from IN TRM, which comes from Aquacraft Water Engineering and Management "Disaggregated Hot Water Use"; assumes 9% of showers take place during peak.
Winter CF	0.00742	According to Duke, the winter peak is from 7 AM to 8 AM. Reliable data do not exist for winter CFs for showers during the 7–8 AM hour. We expect customers to use showers 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.

Table A-8 displays the deemed savings values used in the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. Our proposed methodology generally agrees with the methodology used during previous evaluations, with the exception of the people/household and shower fixtures/household parameters, which the 2013–2014 EM&V report excluded. For other parameters, we cannot confirm the reference for assumptions in the 2013–2014 EM&V report, such as temperatures, shower head flow rates, shower duration, number of showers per day, and CFs. We chose to use assumptions that we can reference clearly from recent studies, which leads to the discrepancy in deemed savings across program years.

Table A-8. Per-Measure Savings Comparison for Efficient Shower Heads

Measure (per shower head)	Savings Unit	2015	2013–2014 EM&V Report
Efficient Shower Head	Energy Savings (kWh)	71.36	127.6
	Summer Demand Savings (kW)	0.006	0.01
	Winter Demand Savings (kW)	0.012	

Efficient Shower Head Recommendations

Moving forward, the program should consider documenting the new shower head flow rate (in gallons/minute) and, if possible, the flow rate of the removed shower head to more accurately estimate savings.

Alternatively, to minimize increased time spent in each home, these data could be collected from a random sample of participants in each neighborhood and the results could be applied to the remaining participant population.

Efficient Aerators

Efficient Aerator Results

Table A-9 documents the inputs and methodology for estimating efficient aerator savings for the RNP in 2015. We estimate savings for bathroom faucet aerators and kitchen aerators separately as the two measures perform differently in their use. For example, households tend to use kitchen faucets more than bathroom faucets throughout the day and they typically have a higher flow rate.

Table A-9. 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	
kW Savings	= (Baseline GPM − Efficient GPM) * 60 * 8.3 * (Tmix − Tinlet) / RE / 3,412 * CF * DF * %Elec	
Parameter	**Value**	**Source/Notes**
Baseline GPM (bathroom)	2.25	IL TRM. The IL TRM distinguishes between kitchen and bath aerators while the TVA TRM does not.
Baseline GPM (kitchen)	2.75	
Efficient GPM (bathroom)	1.0	Will use the value from the database if available. In the absence of a database value, we will use 1.0 GPM for bathrooms and 1.5 GPM for kitchens, based on the IN TRM. The TVA TRM does not distinguish between kitchen and bath aerators.
Efficient GPM (kitchen)	1.5	
Mins/person/day (bathroom)	1.6	Michigan Showerhead/Faucet Aerator Study.
Mins/person/day (kitchen)	4.5	
People/household	2.5	2014 DEP NES Participant Survey (n=250).
Faucets/household (bathroom)	2.0	TVA TRM. Assumes two bathrooms and one kitchen.
Faucets/household (kitchen)	1.0	
Tmix (bathroom)	86°F	Michigan Showerhead/Faucet Aerator Study
Tmix (kitchen)	93°F	
Tmix (unknown)	91°F	Assumes that 70% of household water runs through kitchen faucet and 30% through the bathroom faucet.
Tinlet	63.94	NREL Domestic Hot Water Event Generator calculator for Greensboro, NC. TVA TRM uses the average temperature for entire U.S. (60°F).
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	72.4%	2014 DEP NES Participant Survey (n=250).
Summer CF	0.00262	IN TRM.
Winter CF	0.00524	Duke Energy's winter peak is from 7 AM to 8 AM. Reliable data do not exist for winter CFs 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. This represents the portion of the water that actually flows directly down the drain and is not collected for another purpose. If the water is collected, it will not save any energy, as the volume is constant regardless of the flow rate.
DF (kitchen)	75%	

Table A-10 displays the deemed savings values used in the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. We distinguish between bathroom and kitchen aerators for the 2015 participants, but also calculate a weighted average based on data from another direct install income-qualified program that found approximately a 50/50 split of bathroom and kitchen aerators installed.

We generally agree with the algorithm used in the 2013–2014 EM&V report, but that report does not provide clear references to the different assumptions, such as aerator flow rates, people per home, and faucets per home, among others. We chose to use assumptions that we can reference clearly from recent studies, which leads to the discrepancy in deemed savings across program years.

Table A-10. Per-Measure Savings Comparison for Efficient Aerators

Measure (per aerator)	Savings Unit	2015	2013–2014 EM&V Report
Faucet Aerator (bathroom)	Energy Savings (kWh)	21.78	8.8 kWh 0.0011 kW
	Summer Demand Savings (kW)	0.007	
	Winter Demand Savings (kW)	0.014	
Faucet Aerator (kitchen)	Energy Savings (kWh)	67.26	
	Summer Demand Savings (kW)	0.007	
	Winter Demand Savings (kW)	0.015	
Weighted Average	Energy Savings (kWh)	44.52	
	Summer Demand Savings (kW)	0.007	
	Winter Demand Savings (kW)	0.015	

Efficient Aerator Recommendations

The implementation contractor should begin to record whether aerators are installed in the kitchen or in the bathroom because they have significantly different associated savings. Additionally, the program should consider measuring and documenting the new aerator flow rate (in gallons/minute) and, if possible, the flow rate of the removed aerator to more accurately estimate savings.

Alternatively, to minimize increased time spent in each home, these measurements could be taken from a random sample of participants in each neighborhood and the results could be applied to the remaining participant population.

Infiltration Reductions

Infiltration Reduction Results

Table A-11 documents the inputs and methodology for estimating infiltration reduction savings for the RNP in 2015. This measure includes savings for all infiltration reduction measures associated with the RNP, including door sweeps, caulking, foam spray, glass patch tape, weather stripping, and winterization kits.

Table A-11. Algorithms and Inputs for Infiltration Reductions

Algorithms Used		
kWh Savings	Cooling Savings = (CFM50Exist − CFM50New) / Nfactor * 60 * 24 * CDD * DUA * 0.018 / 1,000 / nCool * AF * LM * %AC Heating Savings = (CFM50Exist − CFM50New) / Nfactor * 60 * 24 * HDD * 0.018 / 3,412 / nHeat * AF * %electric heat	
kW Savings (summer)	Cooling kWh Savings / FLHcool * CF	
kW Savings (winter)	Heating kWh Savings / FLHheat	
Parameter	**Value**	**Source/Notes**
Baseline ACH50	17.4	ENERGY STAR savings analysis assumptions for North Carolina (Climate Zone 4). Assume air sealing for "Windows, Doors and Walls." https://www.energystar.gov/ia/home_improvement/home_sealing/Measure_Upgrade_Assumptions.pdf?945a-eddc.
Upgrade ACH50	17.0	
Home volume (ft³)	13,936	From U.S. Energy Information Administration, 2009 RECS, North Carolina, average size of home in North Carolina is 1,742 ft². Assume ceiling height of 8 ft.
CFM50Exist	4,041	Converts ACH50 to CFM50 (= ACH50 * Volume / 60 minutes). http://www.pureenergyaudits.com/docs/Blower_Door_Handout_ACI_Baltimore.pdf.
CFM50New	3,949	
Nfactor	20	Mid-Atlantic TRM. Normal exposure. Lawrence Berkeley National Laboratory (LBNL) study.
Conversion	1,440	Converts ft³/min to ft³/day.
CDD	1,713	ASHRAE Fundamentals 2013. Assume Charlotte, NC.
DUA	0.75	Discretionary Use Adjustment. Common to most TRMs.
Heat capacity	0.018	Volumetric heat capacity of air.
Efficiency of air conditioning (nCool)	13	Assume 13 SEER based on several TRMs. Assume equipment installed after 2006.
Latent multiplier (LM)	6.9	Most TRMs assume a LM to account for latent cooling demand. Use Mid-Atlantic TRM assumption.
%AC	49.6%	2014 survey, 87% of respondents had AC, 57% of which had central AC.
Cooling kWh Savings	40.7	Calculated.
HDD	3,065	ASHRAE Fundamentals 2013. Assume Charlotte, NC.
nHeat	1.5	Calculated. Weighted average based on type of heating in North Carolina and South Carolina.
%electric heat	49%	2014 survey.
%heat pump	46%	U.S. Energy Information Administration, 2009 RECS, North Carolina and South Carolina.
%resistance	49%	
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.0	
Heating kWh Savings	35	Calculated.
FLHcool	1,324	EPA Calculator. Assume Charlotte, NC.
Summer CF	0.7	Mid-Atlantic TRM. PJM CF for central AC.
Winter CF	1.0	Review of several TRMs. Assume heating operates during peak winter hour.
FLHheat	1,865	EPA Calculator. Assume Charlotte, NC.

Table A-12 displays the deemed savings values used for the 2015 evaluation. We group all infiltration reduction measures together to calculate savings as they all relate to air sealing and calculating savings for the individual measures can be imprecise. The 2013–2014 EM&V report provides savings by measure, but references DOE-2 simulations in addition to ASHRAE calculations, and it is not clear how these two methods were used to arrive at the final deemed savings.

Due to the significant differences in methods used to quantify and report savings between the method described above and that used in the 2013–2014 EM&V report, providing a comparison is not feasible.[21] Therefore, we present only our deemed savings values in Table A-12.

Table A-12. Per-Measure Savings for Infiltration Reductions

Measure	Savings Units	2015
Infiltration Reductions (per home)	Energy Savings (kWh)	75.5
	Summer Demand Savings (kW)	0.0203
	Winter Demand Savings (kW)	0.0186

Infiltration Reduction Recommendations

We can revisit this proposed methodology and update it as necessary in the future if a more accurate protocol for estimating savings from individual infiltration reduction measures becomes available.

HVAC Filters

HVAC Filter Results

Table A-13 documents the inputs and methodology for estimating HVAC filter savings for the RNP in 2015. We based savings on the Residential Energy Consumption Survey (RECS) 2009 data and a study performed by LBNL that measures the effects of HVAC filters in residential homes.[22] The LBNL study states that regularly[23] replacing air filters reduces the energy consumption for HVAC equipment by 1%. We applied the 1% reduction to the average annual energy consumption for different types of HVAC equipment to arrive at average annual filter energy savings per home. The average annual energy consumption was determined using RECS 2009 data for North and South Carolina.

[21] The 2013–2014 EM&V report provides savings broken out by measure (weather stripping, caulking, door sweep, foam insulation spray), which are all in different units of measure (linear foot, per sink, etc.). For this reason, comparing their deemed savings to our household-level savings estimate is not accurate.

[22] LBNL. "System Effects of High Efficiency Filters in Homes". March 2013. http://eetd.lbl.gov/sites/all/files/lbnl-6144e.pdf.

[23] Air filters should be replaced monthly or bimonthly (depending on frequency of use and the levels of dust or contaminants within the home) according to the U.S. Department of Energy. http://energy.gov/energysaver/articles/maintaining-your-air-conditioner.

Table A-13. Algorithms and Inputs for HVAC Filters

Algorithms Used		
kWh Savings	= Annual kWh consumption * % savings	
kW Savings (summer)	= Cooling kWh * % savings * CF / FLHcooling	
kW Savings (winter)	= Heating kWh * % savings * CF / FLHheating	
Parameter	**Value**	**Source/Notes**
Annual kWh consumption	4,856	RECS 2009 data for North and South Carolina.
% savings	1%	LBNL study.
Cooling kWh	3,013	RECS 2009 data for North and South Carolina.
Heating kWh	1,843	
CF (summer)	0.7	Mid-Atlantic TRM. PJM CF for central AC.
CF (winter)	1.0	Review of several TRMs. Assume heating operates during peak winter hour.
FLHcooling	1,324	EPA Calculator. Assume Charlotte, NC.
FLHheating	1,865	

Table A-14 displays the deemed savings values used for the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. The 2013–2014 EM&V report based savings on a Southern California Edison Company work paper for efficiency reductions due to dirty filters and building simulations for annual fan energy use. Our methodology uses the LBNL study for estimating the percent reduction in energy savings due to changing filters regularly and uses RECS data for average HVAC energy consumption across homes in North and South Carolina.

Table A-14. Per-Measure Savings for HVAC Filters

Measure	Savings Unit	2015	2013–2014 EM&V Report
HVAC Filters	Energy Savings (kWh)	48.6	23.01
	Summer Demand Savings (kW)	0.016	0.0017
	Winter Demand Savings (kW)	0.010	

HVAC Filter Recommendations

This methodology should be revisited and updated, as necessary, in the future to determine if a more accurate protocol for estimating savings from HVAC filters has become available.

Pipe Wraps

Pipe Wrap Results

Table A-15 documents the inputs and methodology for estimating pipe wrap savings for the RNP in 2015.

Table A-15. Algorithms and Inputs for Pipe Wraps

Algorithms Used		
kWh Savings	= (1 / Rexist – 1 / Rnew) * L * C * ΔT * 8,766 / nDHW / 3,412	
kW Savings	= kWh saved / 8,766	
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" insulation based on standard pipe insulation thickness. 4. R-alue = 0.5" 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	1	Assume 1-foot length and multiply by total length for each project.
Circumference (C) 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.
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 CFs.

Table A-16 displays the deemed savings used for the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. Our proposed algorithm is consistent with the algorithm used in the 2013–2014 EM&V report. Slight differences exist between the R-value of the insulation that is added and the circumference of the pipe. All other inputs are identical between the two methods. Since the 2013–2014 EM&V report does not clearly source all inputs, we chose to use our own values taken from ASHRAE. The 2015 deemed savings is per foot of insulation and should multiply by the total length of pipe to accurately claim savings.

Table A-16. Per-Measure Savings Comparison for Pipe Wraps

Measure (per foot of pipe wrap)	Savings Unit	2015	2013–2014 EM&V Report
Hot Water Pipe Wrap	Energy Savings (kWh)	13.7	24.64
	Summer Demand Savings (kW)	0.0016	0.0028
	Winter Demand Savings (kW)	0.0016	

Pipe Wrap Recommendations

This methodology should be revisited and updated, as necessary, in the future to determine if a more accurate protocol for estimating savings from hot water pipe wrap has become available.

Water Heater Adjustments

Water Heater Adjustment Results

Table A-17 documents the inputs and methodology for estimating water heater adjustment savings for the RNP in 2015. If additional data become available from DEC or from the implementation team, we will revise assumptions and algorithms accordingly.

Table A-17. Algorithms and Inputs for Water Heater Adjustments

Algorithms Used		
kWh Savings	= (U * A * (Tpre – Tpost) * Hours) / (3,412 * RE_electric)	
kW Savings	= kWh saved / 8,766 * CF	
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 become available.
Tpre (°F)	135	According to 2013 (DEP) Appendix B, 135°F was the lower-bound threshold for water heater temperature adjustments.
Tpost (°F)	120	Target temperature after adjustments, according to 2013 (DEP) EM&V report.
Hours	8,766	Hours in a year that the savings occur, assumed to be constant over the year (IL TRM).
RE_electric	0.98	Recovery efficiency of electric hot water heater (IL TRM).
CF	1	Savings are realized 8,766 hours/year and through the full peak hours. There is no difference between summer and winter peak CFs.

Table A-18 displays the deemed savings values used for the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. The 2013–2014 EM&V report does not clearly indicate the algorithm and inputs used to estimate savings for this measure. We therefore used a method that is common for water heater temperature adjustments and consistent across multiple TRMs.

Table A-18. Per-Measure Savings Comparison for Water Heater Adjustments

Measure (per water heater)	Savings Unit	2015	2013–2014 EM&V Report
Water Heater Adjustment	Energy Savings (kWh)	81.6	86.08
	Summer Demand Savings (kW)	0.0093	0.0098
	Winter Demand Savings (kW)	0.0093	

Water Heater Adjustment Recommendations

We recommend collecting the size of the hot water tanks if possible and the pre- and post-adjustments to more accurately estimate savings moving forward. Alternatively, to minimize increased time spent in each home, these measurements could be taken from a random sample of participants in each neighborhood and the results could be applied to the remaining participant population.

Water Heater Wraps

Water Heater Wrap Results

Table A-19 documents the inputs and methodology for estimating water heater wrap savings for the RNP in 2015. If additional data become available from DEC or from the implementation team, we will revise assumptions and algorithms accordingly.

Table A-19. Algorithms and Inputs for Water Heater Wraps

Algorithms Used		
kWh Savings	= (Abase / Rbase – Ainsul / Rinsul) * ΔT * 8,766 / nDHW / 3,412	
kW Savings	= kWh saved / 8,766 * CF	
Parameter	**Value**	**Source/Notes**
Surface area of tank before wrap (Abase)	24.99	IL TRM. Assumes 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.

Table A-20 displays the deemed savings values used for the 2015 evaluation, compared with the deemed values from the 2013–2014 EM&V report. The previous evaluation used the same methodology that we used in this 2015 evaluation. However, slight differences exist in assumed R-values and surface area of the tank. The 2013–2014 EM&V report does not provide references for the assumptions used. We therefore used assumptions from the Illinois TRM.

Table A-20. Per-Measure Savings Comparison for Water Heater Wraps

Measure (per water heater)	Savings Unit	2015	2013–2014 EM&V Report
Water Heater Wrap	Energy Savings (kWh)	114.8	125.8
	Summer Demand Savings (kW)	0.0131	0.0144
	Winter Demand Savings (kW)	0.0131	0.0144

Water Heater Wrap Recommendations

We recommend collecting the size of the hot water tanks if possible and the R-value of the insulation installed through this measure to more accurately estimate savings. Alternatively, to minimize increased time spent in each home, these measurements could be taken from a random sample of participants in each neighborhood and the results could be applied to the remaining participant population.

Key References

Reference	Source
DEP EM&V Reports	2012 and 2013 DEP Evaluation Reports.
Arkansas TRM	Arkansas Technical Reference Manual Version 4.0. Volume 1. August 29, 2014.
Tennessee Valley Authority (TVA) TRM	Tennessee Valley Authority Technical Reference Manual Version 3.0. January 2015.
Michigan Showerhead/Faucet Aerator Study	Michigan Evaluation Working Group Showerhead and Faucet Aerator Meter Study Memorandum. June 2013.
Indiana TRM	Indiana Technical Reference Manual. Version 2.2. July 28, 2015.
Illinois TRM	Illinois Technical Reference Manual. Version 4.0. February 24, 2015.
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.

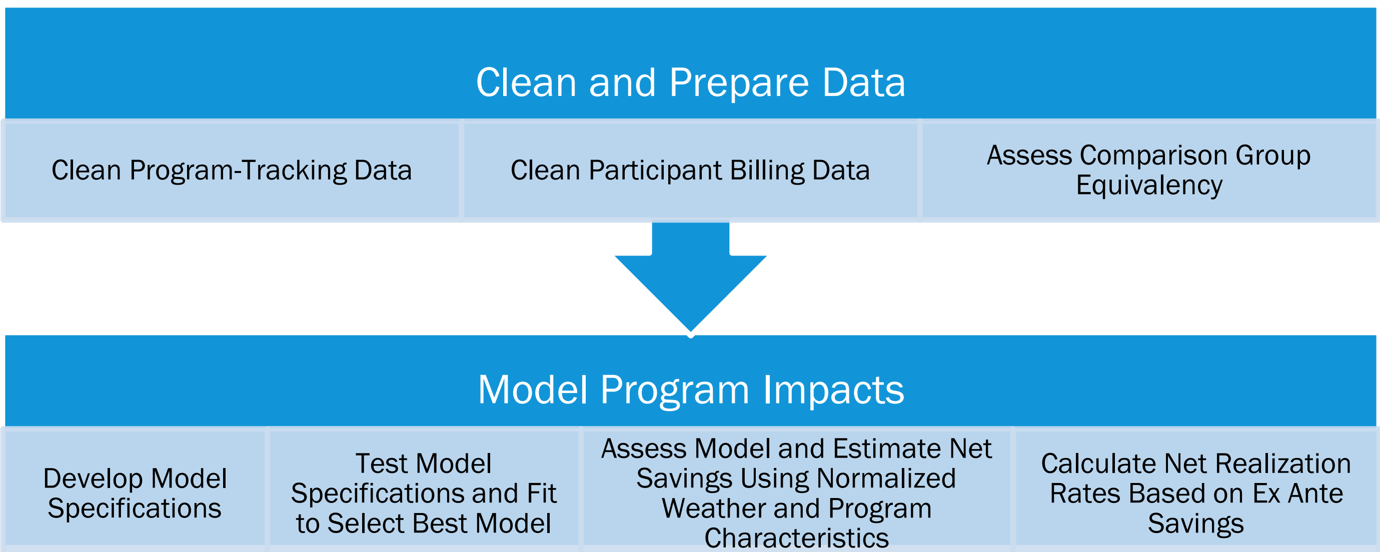
Appendix B. Detailed Methodology: Billing Analysis

The evaluation team conducted a billing analysis using a LFER model, with the goal of determining the overall ex post net program savings of the DEC RNP. 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.

Data Collection

As part of the billing analysis of RNP participants, the evaluation team followed a standard series of steps for data collection, model specification, and analysis. Figure B-1 provides a summary of our billing analysis approach.

Figure B-1. Billing Analysis Approach



Data Quality

During our review of program tracking and customer billing data sources, we found significant inconsistencies in a customer's date of participation, home type, and heating source fuel. The largest concern here was over participation dates. Accuracy of this date is critical, since we use a customer's date of participation as the indicator of treatment in this quasi-experiment. We noticed two important items, which lead to additional reviews of data received, and in-depth conversations with program staff. First, the number of 2015 RNP participants was inconsistent between program tracking and the Customer Billing Information System (CBIS) data warehouse. Second, we noticed that participation dates for some customers, as seen in CBIS data, were not consistent with measure installation dates in the program tracking data. Additionally, fields for a customer's home type were not consistent between data sources. After discussions with Duke Energy and RNP program staff, we determined that participation dates, and home types from the participant tracking data were accurate, and the shown in CBIS data for a given customer was not directly tied to program tracking. Further review of those data, in an effort to determine separate program savings for electric and gas heat customers, lead us to believe that the CBIS data on heating fuel is similarly unreliable.

The final analysis utilizes measure installation from program tracking data, and billing records from the CBIS data warehouse. We do not report savings separately for sub-groups of participants (Electric vs. Gas Heat, Single vs. Multi-Family Homes), as we do not have reliable data on these characteristics for many accounts.

Comparison Group Selection

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).

Billing analyses, using an appropriate comparison group, incorporate the effects of both free-ridership and spillover, thus providing program net savings. For example, the energy use patterns of the members of the 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. In addition, any measures installed during the evaluation period beyond program measures (spillover) are a factor in an increased coefficient for the participation variables.

Due to the timing of the evaluation, and to ensure we were able to have a robust comparison group, we utilized participants from the second half of 2014 through the first half of 2015 as our treatment group. Our method requires that participants in the treatment group have post-installation electricity usage data for at least 6 months after participating in the program. Therefore, participants from July 2014 to June 2015 act as our treatment group.

In an ideal experimental design, a comparison group would be identical to the treatment group in all aspects, save for the treatment being evaluated (participation in the RNP in our case). A match of this type is impossible when studying the effects of energy efficiency programs, since no two customers are exactly alike. Given this, we 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 of the actual effects that the program has on a customer's energy use. Using future participants as a comparison group is attractive because we know that both groups will eventually participate, meaning that they are similar in many respects. To ensure that the groups are similar, we determined the overall average baseline and pre-period kWh consumption to be able to compare usage patterns of the treatment and comparison groups.

Weather is also of interest when selecting a comparison group, as stark differences in weather between the treatment and comparison groups can leave the model open to error. With the RNP, participants are located in different regions of North Carolina and South Carolina, which means there will likely be differences in the weather experienced and potentially different reactions to changes in weather. Because of this potential, we examined differences in weather and energy use, between the states, and found that participants in South Carolina experienced slightly warmer summers and milder winters and showed higher energy usage overall. However, because we have an equivalent mix of participants from each state in both groups, we found that the average weather is very consistent between the treatment and comparison groups (see the section on weather below).

Pre-participation energy usage of our comparison group follows a nearly identical pattern as that of the treatment group, with the exception of higher peaks in average usage during the coldest months (see the section on baseline average daily energy consumption below). To account for these differences in pre-participation energy usage, the evaluation team incorporated several adjustments into our fixed effects models to control for the differences in pre-period usage between treatment and comparison groups.

Data Cleaning and Preparation

This section summarizes how we cleaned and prepared the 2014, 2015, and 2016 program participant databases and billing data for the billing analysis.

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 RNP 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 RNP participation dates, in relation to previous program-tracking data.
- **Participation in other programs:** Customers who participated in multiple energy efficiency programs during the time period being analyzed may skew the observed effect of the RNP if they are not accounted for or removed.
- **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 2011 to July 2016, obtained directly from Duke Energy. To develop the final dataset used for statistical analysis, we used a multi-step approach to combining and cleaning the 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 usage for each observation (based on usage and number of billing days in the period)
  - Assigned seasonal dummy variables to each of the monthly observations:
    - Winter: December, January, February
    - Spring: March, April, May
    - Summer: June, July, August
    - Fall: September, October, November
- **Remove all duplicate billing records:** Due to the small number of duplicate records in each dataset used to create our final analysis file, we chose to drop all billing records that had duplicates at the account/date level with conflicting kWh values. A small number of duplicates were not dropped, as

they were exactly the same, in which case we kept one of the records. Duplicate records represented fewer than 0.75% of the records in the data pulled from the CBIS data warehouse.

- **Combine 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-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.

- **Extremely high or low average daily consumption:** We removed customers with entire pre- or post-participation periods having very high or very low usage. This is to ensure that participants spent equivalent amounts of time in their homes in the months before and after program participation. We dropped households with average daily consumption 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 assess changes in consumption due to program measures before and after installation, we included participants with a billing history covering, at a minimum, six billing records or 180 days before the first day of program participation, and the same amount of time after participation for our treatment group.

- **Inadequate billing history in the cooling season before and after program participation:** We included participants having a minimum of two billing records in the summer (cooling season). This is because we expect the measures installed to be generally weather sensitive both in terms of temperature and in terms of daylight hours. By ensuring that we have enough billing data in the months of June, July, and August, we allow for more rigorous savings estimates.

- **Participated in other Duke Energy program:** Due to a high rate of customers who participated in other programs, but received only free or discounted light bulbs, we defined cross-participation two ways: 1) cross-participants who received only light bulbs and 2) cross-participants who received other program benefits. These other program benefits included appliance rebates, direct install measures, and education. We chose to remove only those cross-participants who received those other program benefits from final analysis.

Table B-21 shows how many accounts were removed from the analysis overall for each reason.

Table B-21. Accounts Removed from Analysis

Reason for Dropping Account	Accounts	Percent of Total
Total Unique Accounts	**14,068**	**100%**
Cross Participation	1,207	9%
Less Than 2 Summer Billing Post Period (Treat)	149	1%
Less Than 2 Summer Billing Pre Period	419	3%
Less Than 6 Months in Post Period Days (Treat)	22	0.2%
Less Than 6 Months in Pre Period Days	80	1%
Less Than 6 Pre Billing Periods	1,265	9%
Less Than 6 Post Billing Periods (Treat)	889	6%
Low Overall ADC < 2 kWh	25	0.2%
Low Overall Post ADC < 2 kWh	16	0.1%
Low Overall Pre ADC < 2 kWh	6	0.04%
Accounts Remaining for Analysis	**9,990**	**71%**

Comparison Group Equivalency

Because program participants are not randomly selected, the best option for a comparison group is to utilize future participants. Using an actual group of later participants mitigates self-selection bias that may be present when comparing 2015 participants to some non-participating group of customers. Due to the timing of the evaluation, and to ensure we were able to have a robust comparison group, we utilized participants from the second half of 2014 (July–December) through the first half of 2016 (January–June) in our analysis. Participants from July 2014 to June 2015 act as our treatment group, and customers who participated between July 2015 and June 2016 are the comparison group. It is important to ensure that the two groups of participants are equivalent on as many dimensions as possible. Based on the information at our disposal, we analyzed three criteria to determine that treatment participants were equivalent to the comparison participants, and could be used as a valid comparison group. These criteria are:

- **Weather:** Compared average monthly HDD and CDD.
- **Baseline period average daily consumption:** Similarity in ADC before engaging with the program might be a general proxy for behavioral similarities. As such, the evaluation team compared the baseline monthly ADC of participants in each group.
- **State:** Compared the rate of customers residing in North Carolina and South Carolina, as well as the weather and energy consumption of customers in each state.

Because of the equivalency check, we determined that the treatment and comparison participant groups were comparable for analyzing the impacts of the program. We discuss each of these criteria in more detail below.

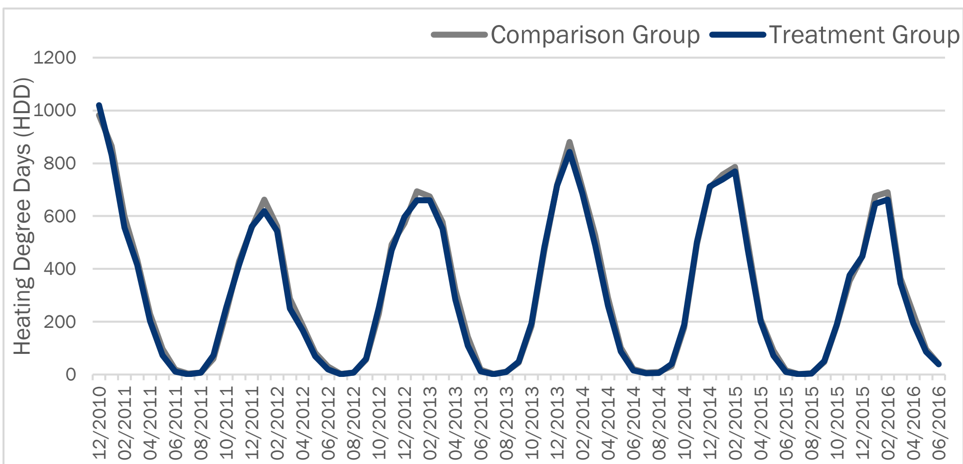
Weather

In order 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 applied to 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 temperature using the same formula used in weather forecasting.[24] 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[25]). For analysis purposes, we then calculated average daily HDD and average daily CDD, based on the number of days within each billing period.

Participants in the treatment and comparison groups experienced similar weather over time. However, Figure B-2 and Figure B-3 show that the treatment group experienced slightly warmer temperatures during seasonal peaks. Including monthly averages for HDD and CDD in the model helps control for differences in seasonal weather experienced by participants.

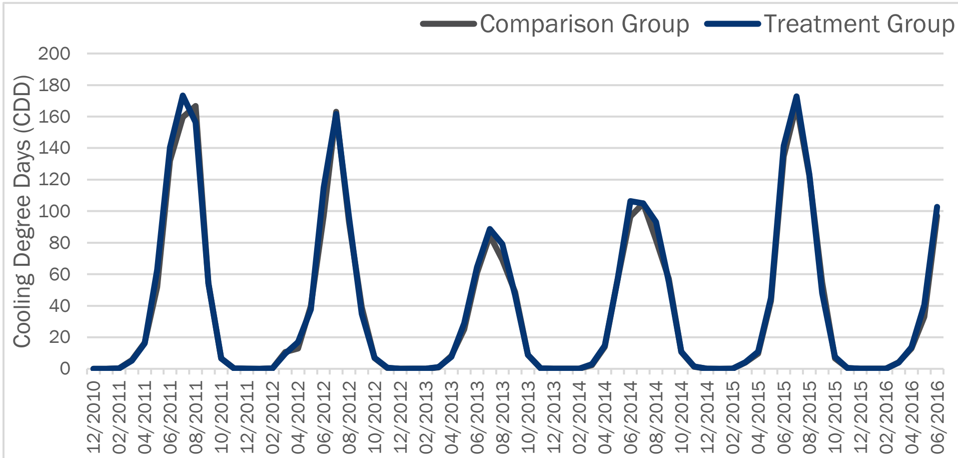
Figure B-2. Average Heating Degree Days of Customers Included in Billing Analysis



[24] *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.

[25] 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.

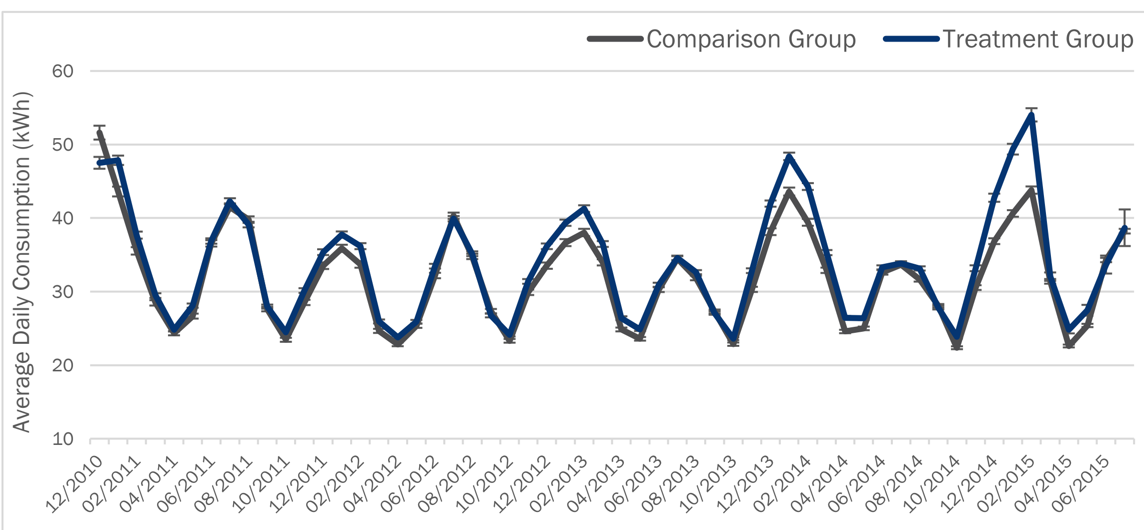
Figure B-3. Average Cooling Degree Days of Customers Included in Billing Analysis



Baseline Average Daily Energy Consumption

Opinion Dynamics examined the average daily electricity consumption for months during each participant's pre-participation period to compare energy consumption patterns. As shown in Figure B-4, pre-participation energy usage for the comparison group follows a nearly identical pattern as the treatment group, except for higher peaks in average usage during the coldest months. Differences in average energy consumption between the groups is cause for some concern. To account for these differences in pre-participation energy usage, the evaluation team incorporated several adjustments into our fixed effects models, including an interaction between the months and the treatment group.

Figure B-4. Comparison of Average Baseline Monthly kWh Consumption between Treatment and Comparison Customers



Our final dataset used in the billing analysis consists of all data mentioned above for all participants in the treatment and comparison groups. We start with a dataset of clean and unique participants from the program, including the date of participation, and their location. We combine this with the cleaned dataset of monthly bills, which brings in the customers usage (in kWh) over time. Into this combined dataset, we add HDD and CDD for each customer based on the nearest weather station. Customers who do not meet the criteria necessary for accurate modeling are dropped.

Model Specifications

To estimate savings for the RNP, Opinion Dynamics utilized a LFER model that incorporates weather, and monthly changes in energy usage. Our method utilizes a comparison group of future participants 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 process of determining the appropriate model for the analysis, we tested a multitude of possibilities, all of which utilized the comparison group.

Develop and Test Model Specifications

Our final model needed to fill a number of 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 data. The AIC provides a measure of relative quality between models; a lower value indicates a relatively more robust model.

As previously mentioned, we do not include customers who participated in other programs, with the exception of customers who only received a small number of CFLs from some other program. We considered not removing these customers, and entering indicator variables for each of the other utility programs. Doing this could lead to interference between the influences of each program on energy use, making it difficult to draw valid conclusions about the effects of RNP participation separate of the other programs. As such, we believe it is more appropriate to remove those customers from the analysis.

In the development of our model, we investigated average energy consumption before and after participation, how changes in weather affects 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.

To control for seasonal changes in energy use, the prior evaluation utilized month-year fixed effects (through the inclusion of indicator variables for every individual month in the analysis). While this method is common, it can be subject to misrepresentation of the treatment effect when a comparison group is not used. Even with a comparison group, there is potential for error with the use of month-year fixed effects without including appropriate and adequate corrects for potential changes to a customer's weather dependence, post participation. In lieu of monthly fix effects, our model includes terms for each month of the year (January-December). This allows a month to be present in both the pre-participation period and the post-participation period, thus capturing the change in usage during said month. Our use of these monthly terms in conjunction with a comparison group creates an improved counterfactual and increases the accuracy of program savings estimates.

Acknowledging differences in pre-participation period energy use between our treatment and comparison groups, we tested models that included the interactions of the treatment with monthly terms to control for those inconsistencies. We also tested models that included terms that interact the effects of each month with the post-participation period. Additionally, we checked the effect of adding interaction terms of weather and the post-participation period to account for the relationship between weather and consumption following treatment. Failing to account for non-program related changes that occur during the post-participation period, for example the warmer summers that have been experienced, could undervalue the treatment effect. We tested different combinations of these potential interaction terms in an effort to determine the most representative model corrections across participants.

Final Model for Residential Neighborhood Program Participants

Our testing revealed that the overall savings estimates were robust across a number of model specifications, but found the model in Equation B-1 to have the best overall fit. The model takes into account changes in weather (heating and cooling degree-days) for each bill, and includes an interaction term of weather and the post period to account for increasingly warmer summers. The model also utilizes dummy variables for each calendar month to help control for seasonal changes to energy use.

Interactions with monthly dummies are also included to account for differences that occur between our treatment and comparison groups. This approach allows the comparison group to more precisely represent the counterfactual. As shown in Figure B-4, pre-participation period usage differs slightly where participants in the treatment group appear to be more sensitive to some seasonal effects. By interacting the treatment group with monthly terms; we can control for the effect of that sensitivity on the treatment effect. This interaction term is present for records in both the pre and post period. To ensure that this correction does not adversely affect the effect of treatment in the post period, we include additional interactions of the post-participation period. These additional interactions control for non-program changes that occur during the post-participation period, which could otherwise undervalue the effect of program participation.

Equation B-1. Model Specification

$$ADC_{it} = B_h + B_1 Post_{it} + B_2 HDD_{it} + B_3 CDD_{it} + B_4 Post \cdot HDD_{it} + B_5 Post \cdot CDD_{it} + B_t Month + B_{t1} Month \cdot Post + B_{t2} Month \cdot Treat + \varepsilon_{it}$$

Where:

- ADC_{it} = Average daily consumption (in kWh) for the billing period
- $Post$ = Indicator for treatment group in post-participation period (coded "0" if treatment group in pre-participation period or comparison group in all periods, coded "1" in post-participation period for treatment group)
- HDD = Average daily heating degree days from NCDC
- CDD = Average daily cooling degree days from NCDC
- $Month$ = Month indicator
- $Treat$ = Indicator for treatment group participants
- B_h= Average household-specific constant
- B_1= Main program effect (change in ADC associated with being a participant in the post-program period)
- B_2= Increment in ADC associated with one unit increase in HDD
- B_3= Increment in ADC associated with one unit increase in CDD
- B_4= Increment in ADC associated with each increment increase of HDD for participants in the post-program period (the additional program effect due to HDD)
- B_5= Increment in ADC associated with each increment increase of CDD for participants in the post-program period (the additional program effect due to CDD)

B_t= Coefficients for each month
B_{t1}= Coefficients for each month in the post-participation period
B_{t2}= Coefficients for each month for treatment groups participants
ε_{it} = Error term

Comparison to Model Used in Past RNP Evaluation

There are several important methodological differences between the billing analysis model used in the 2013-2014 program evaluation and that used in the present 2015 evaluation. The use of a comparison group in the 2015 billing model is one important difference. Utilizing a comparison group of future participants, as we do, helps to construct a counterfactual baseline (what participants would have done during the post-participation period absent the RNP) for the treatment group in the post-participation period.

Beyond the use of comparison group, the largest difference rests in how each model accounts for normal time-related fluctuations in energy consumption. The 2013-2014 evaluation's model includes month-year fixed effects through the inclusion of indicator variables for every individual month in the analysis. This method can be subject to misrepresentation of the treatment effect, especially when no comparison group is present. Even with a comparison group, there is additional risk of error when month-year fixed effects are used because it is difficult to account for any change to a participant's sensitivity to changes of season. In lieu of monthly fixed effects, our model includes terms for each month of the year (January-December). This allows for a month to be present in both the pre-participation period and the post-participation period, thus capturing the change in usage during said month. With the use of a comparison group and monthly terms, we include additional terms in our model that control for differences in pre-participation period usage between the treatment and comparison group, and terms that ensure that the treatment effect is not adversely affected by these differences in the post-participation period. Failing to account for non-program changes that occur during the post-participation period, for example the warmer summers that have been experienced, could underestimate the treatment effect.

Another significant difference between the prior evaluation's billing analysis model and the model developed for the 2015 evaluation is how the model handles customers who also participated in other Duke programs. We do not include those customers in the 2015 evaluation, except for customers who only received a small number of CFLs from some other program. The prior model, however, attempts to control for potentially conflicting effects of those other programs by including a term like the treatment variable. Including variables in the model for each program essentially forces the model to determine a treatment effect for each additional program. This leads to interference in the model between each of the included programs, making it difficult to draw valid conclusions about the effects of RNP participation separate of the other programs.

Estimated Savings and Realization Rate

This section contains the observed net savings and realization rates resulting from the billing analysis of 2015 participants. The results account for free-ridership and reflect savings associated with installed measures, spillover, and potential behavioral changes from energy efficiency knowledge gained during the assessment.

Estimated Savings

The regression model results presented in Table B-22 show a reduction in electricity use after customers participate in the RNP, controlling for weather, time, and the household characteristics (reflected in the constant term).

Table B-22. Final Model

Variable	Coefficient
Post (RNP Participation)	-2.256***
Cooling Degree Days (CDD)	0.0827***
Heating Degree Days (HDD)	0.0292***
Post-participation period CDD	-0.00403
Post-participation period HDD	0.00168**
January	0.9505***
February	2.1288***
March	-0.8481***
April	-1.7517***
May	1.3098***
June	6.6247***
July	8.8546***
August	8.2910***
September	4.4743***
October	-1.1031***
November	-1.0499***
December	(omitted)
Constant	18.83***
Observations	493,512
R-squared	0.655
Monthly Effects Included	YES
Post-participation period Interacted with Months Included	YES
Treatment Group Interacted with Months Included	YES

* p<0.1, ** p<0.05, *** p<0.01.

Due to the weather and monthly interaction terms in the model, it is necessary to recalculate the coefficient of the treatment effect (Treatment) by combining the average value with the coefficient for each interaction term. The coefficient seen in the regression represents the reduction of daily consumption during the post-treatment period, including any reduction caused by milder temperatures. Utilizing a simple linear equation, shown in Equation B-2, which combines the coefficients of those interaction terms with the average post-participation period values for each, we can estimate the overall savings associated with the program itself.

Equation B-2. Model Specification

$$\Delta ADC = B_1 Post + AvgPostHDD_t \cdot (B_2 Post \cdot HDD) + AvgPostCDD_t \cdot (B_3 Post \cdot CDD) + B_t Month_t$$

ΔADC = Change in Average Daily Consumption
$AvgPostHDD_t$ = Average number of Heating Degree Days during month t of the post period
$AvgPostCDD_t$= Average number of Cooling Degree Days during month t of the post period

Table B-23. Adjusted Estimate of Daily Program Savings

RNP Estimate (ΔADC)	Standard Error	T	P>|t|	90% Confidence Interval	
				Lower	Upper
-0.945	0.106	-8.905	0.000	-1.12	-0.77

The value of the RNP estimate seen in Table B-23 represents 1.37 kWh reduction in ADC associated with moving from pre-treatment to post-treatment. There is a 90% probability, or confidence, that overall program savings range between 0.77 kWh and 1.12 kWh per day for RNP participants. These savings estimates are extrapolated to the overall net program savings for DEC RNP participants (Table B-24). We estimate that the average realized annual savings are 347 kWh for customers who participated in the RNP in 2015. 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 coefficient for RNP, representing the change in daily usage, by the mean baseline ADC to arrive at the percentage of savings.

Table B-24. Estimated Annual Savings from Billing Analysis

Baseline Energy Use		Energy Savings		
Daily (kWh)	Annual (kWh)	Daily (kWh)	Annual (kWh)	Savings (%)
32.2	11,768	0.95	347	2.9%

* Daily savings estimate is the inverse of the coefficient for RNP participation in each respective model.

Since the DEC territory includes portions of both North and South Carolina, we show the breakdown of participants and energy savings by state, in Table B-25.

Table B-25. Savings for 2015 RNP in Each State

State	2015 Participants	Annual Energy Savings (kWh)	
		Participant Savings	2015 RNP Savings
North Carolina	4,372	347	1,517,084
South Carolina	1,970	347	683,590
Total	**6,342**	**347**	**2,200,674**

Complete Model Results

Linear regression, absorbing indicators	Number of obs	493,512
	F(38, 9989)	630.35
	Prob > F	0.0000
	R-squared	0.6553
	Adj R-squared	0.6481
	Root MSE	13.4111

(Std. Err. Adjusted for 9,990 clusters in account)

ADC	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
Participation	-2.255586	0.480463	-4.69	0.000	-3.197390	-1.313782
HDD	0.029225	0.000498	58.67	0.000	0.028249	0.030201
CDD	0.082679	0.001757	47.05	0.000	0.079235	0.086124
Post-Period CDD	-0.004027	0.002922	-1.38	0.168	-0.009755	0.001702
Post-Period HDD	0.001684	0.000821	2.05	0.040	0.000074	0.003293
Months						
January	0.950464	0.100913	9.42	0.000	0.752654	1.148273
February	2.128776	0.116661	18.25	0.000	1.900097	2.357455
March	-0.848078	0.169181	-5.01	0.000	-1.179706	-0.516449
April	-1.751744	0.244439	-7.17	0.000	-2.230893	-1.272596
May	1.309768	0.290298	4.51	0.000	0.740725	1.878811
June	6.624667	0.322891	20.52	0.000	5.991735	7.257598
July	8.854615	0.342625	25.84	0.000	8.183000	9.526230
August	8.291049	0.328740	25.22	0.000	7.646654	8.935445
September	4.474252	0.310670	14.40	0.000	3.865276	5.083227
October	-1.103136	0.246062	-4.48	0.000	-1.585467	-0.620805
November	-1.049944	0.120421	-8.72	0.000	-1.285994	-0.813894
December	(omitted)					
Months * Treatment Group						
January	1.590735	0.155399	10.24	0.000	1.286122	1.895348
February	0.870612	0.178768	4.87	0.000	0.520190	1.221033
March	0.318356	0.242702	1.31	0.190	-0.157389	0.794101
April	-0.420834	0.363679	-1.16	0.247	-1.133719	0.292051
May	-1.140668	0.439920	-2.59	0.010	-2.002999	-0.278338
June	-1.975564	0.491339	-4.02	0.000	-2.938687	-1.012441
July	-2.002921	0.513349	-3.90	0.000	-3.009187	-0.996654
August	-1.988268	0.496443	-4.01	0.000	-2.961396	-1.015140
September	-2.355179	0.464967	-5.07	0.000	-3.266608	-1.443751
October	-1.864017	0.371244	-5.02	0.000	-2.591730	-1.136304
November	-0.398204	0.187932	-2.12	0.034	-0.766588	-0.029820
December	(omitted)					
Months * Post-Period						
January	0.658449	0.177760	3.70	0.000	0.310003	1.006896
February	1.254057	0.213290	5.88	0.000	0.835966	1.672148
March	0.969840	0.229528	4.23	0.000	0.519919	1.419761
April	1.139421	0.315398	3.61	0.000	0.521177	1.757665
May	1.883366	0.391168	4.81	0.000	1.116598	2.650134
June	0.198329	0.486738	0.41	0.684	-0.755775	1.152433
July	0.684825	0.545664	1.26	0.209	-0.384785	1.754436
August	1.459961	0.479769	3.04	0.002	0.519517	2.400404
September	1.795378	0.416351	4.31	0.000	0.979247	2.611510
October	1.856101	0.325027	5.71	0.000	1.218982	2.493220
November	0.406840	0.176643	2.30	0.021	0.060583	0.753097
December	(omitted)					
Constant	17.707100	0.310891	56.96	0.000	17.097690	18.316510

account absorbed (9,990 categories)

For more information, please contact:

Adam Burke
Managing Director

617 492 1400 x230 tel
617 497 7944 fax
aburke@opiniondynamics.com

1000 Winter St
Waltham, MA 02451

EM&V Report for the Duke Energy Multifamily Energy Efficiency Program

Prepared for:

Duke Energy Progress, Duke Energy Carolinas

October 4, 2016

Prepared for:
Duke Energy

Presented by
Stuart Schare
Managing Director

Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302
phone 303.728.2500
fax 303.728.2501

navigant.com

Primary contributing authors:
Mark Bielecki
Natasha Herring

TABLE OF CONTENTS

1. EVALUATION SUMMARY

1.1 Program Summary

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment to multifamily housing properties at no cost to the property managers or tenant end-users. The program is delivered through coordination with property managers and owners. Tenants are provided with notice and informational materials to inform them of the program and potential for reduction in their energy bills. The program consists of lighting and water measures.

- **Lighting measures:** Compact fluorescent light (CFL) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

For this evaluation cycle, Navigant assessed the following:

Duke Energy Progress: lighting and water measures installed between 1/1/15 and 2/29/16
Duke Energy Carolinas: lighting measures installed between 1/1/14 and 2/29/16[1]

Franklin Energy is the implementation contractor for the program. Customers (i.e., property managers) have the option to choose self-installation or direct installation through Franklin Energy. Duke Energy informed Navigant that most customers choose the direct install route by Franklin Energy. Duke Energy also informed Navigant that third-party quality control inspections are completed on 20 percent of properties in any given month. Within a selected property, the quantity of units to inspect is based on property size as defined by the number of housing units.

1.2 Evaluation Objectives and Program-Level Findings

Duke Energy selected Navigant to provide independent Evaluation, Measurement, and Verification (EM&V) for the Multifamily Energy Efficiency Program in the Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) jurisdictions. EM&V is a term used to describe the process of evaluating a program to assess the impacts as well as the program structure and delivery. For this EM&V effort, the evaluation approach and objectives can be described as follows:

- **Impact evaluation:** To quantify the net and gross energy and coincident demand savings associated with program activity at both the measure level and program level
- **Process evaluation:** To assess program delivery and customer satisfaction

By performing both components of the EM&V effort, Navigant is able to provide Duke Energy with verified energy and demand impacts, as well as a set of recommendations that are intended to aid Duke Energy with improving or maintaining the satisfaction with program delivery while meeting energy and demand reduction targets in a cost-effective manner.

[1] Navigant completed an evaluation report in November of 2015 for water measures in DEC.

Overall, Navigant found that the Multifamily Energy Efficiency Program is being delivered effectively, customer satisfaction is generally favorable, and the reported measure installations are accurate.

For the evaluation period covered by this report, there were a total of 26,492 housing units at 262 participating properties managed by 85 different property management companies in the DEP jurisdiction. There were 21,937 housing units at 210 properties managed by 99 different property management companies in the DEC jurisdiction. The program-level evaluation findings are presented in Table 1 though Table 4. For the DEP jurisdiction, Navigant found the realization rate for gross energy savings to be 101 percent, meaning that total verified gross energy savings were found to be slightly higher than claimed in the tracking database provided by Duke Energy. For DEC, the realization rate for gross energy savings was 103 percent. Navigant found the net-to-gross (NTG) ratio to be 0.94, meaning that for every 100 kWh of reported energy savings, 94 kWh can be attributed directly to the program. These findings will be discussed in greater detail throughout this report.

Table 1. Program Claimed and Evaluated Gross Energy Impacts

	Claimed	Evaluated	Realization Rate
DEP Gross Energy Impacts (MWh)	21,133	21,398	101%
DEC Gross Energy Impacts (MWh)	7,299	7,546	103%

Source: Navigant analysis, totals subject to rounding.

Table 2. Program Claimed and Evaluated Gross Peak Demand Impacts

	Claimed	Evaluated	Realization Rate
DEP Gross Summer Peak Demand Impacts (MW)	1.99	2.10	106%
DEP Gross Winter Peak Demand Impacts (MW)	3.32	3.72	112%
DEC Gross Summer Peak Demand Impacts (MW)	0.68	0.71	104%
DEC Gross Winter Peak Demand Impacts (MW)	0.68	0.90	132%

Source: Navigant analysis, totals subject to rounding.

Table 3. Program Net Energy Impacts

	MWh
DEP Net Energy Impacts	20,215
DEC Net Energy Impacts	7,129

Source: Navigant analysis, totals subject to rounding.

Table 4. Program Net Peak Demand Impacts

	MW
DEP Net Summer Peak Demand Impacts	1.98
DEP Net Winter Peak Demand Impacts	3.52
DEC Net Summer Peak Demand Impacts	0.67

DEC Net Winter Peak Demand Impacts	0.85

Source: Navigant analysis, totals subject to rounding.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Navigant performed an engineering review of measure savings algorithms, field verification to assess installed quantities and characteristics, as well as surveys with tenants and property managers to assess satisfaction and decision-making processes. The evaluated parameters are summarized in Table 5. For field verification, the expected sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 9 percent.

Table 5. Evaluated Parameters

Evaluated Parameter	Description	Details
Efficiency Characteristics	Inputs and assumptions used to estimate energy and demand savings	1. CFL wattage 2. CFL operating hours 3. Aerator flow rates (gpm) 4. Showerhead flow rates (gpm) 5. Water temperature (F) 6. Pipe wrap length (ft) 7. Baseline characteristics
In-Service Rates	The percentage of program measures in use as compared to reported	1. CFL, aerator, and showerhead quantities 2. Pipe wrap length
Satisfaction	Customer satisfaction	1. Satisfaction with program 2. Satisfaction with contractor 3. Satisfaction with program measures
Free Ridership	Fraction of reported savings that would have occurred anyway, even in the absence of the program	
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	

This evaluation covers program participation from January 1, 2015 through February 29, 2016 in DEP, and from January 1, 2014 through February 29, 2016 in DEC. Table 6 shows the start and end dates of Navigant's sample period for evaluation activities.

Table 6. Sample Period Start and End Dates

Activity	Start Date	End Date
Field Verification	April 4, 2016	April 15, 2016
Tenant Phone Surveys	April 21, 2016	April 30, 2016
Property Manager Interviews	April 30, 2016	May 18, 2016

1.4 Evaluation Recommendations

Navigant developed a series of recommendations during the EM&V effort. These recommendations are intended to assist Duke Energy with enhancing the program delivery and customer experience, as well as to support future EM&V activities and possibly increase program impacts. Further explanation for each recommendation can be found later in this report.

1. Navigant recommends that Duke Energy should adopt the ex post, per-unit energy and demand impacts from this evaluation and use them going forward (with the possible exception of making an appropriate adjustment for the lighting measure baseline as discussed in Section 4 of this report).
2. Navigant recommends that no more than the first three feet of cold water inlet pipes be insulated for the water heater pipe wrap measure.
3. Duke Energy should consider adding LEDs to the program.

2. PROGRAM DESCRIPTION

2.1 Design

The Multifamily Energy Efficiency Program is designed to provide energy efficiency to a sector that is often underserved or difficult to reach via traditional, incentive-based energy efficiency programs. This market can be difficult to penetrate because multifamily housing units are often tenant-occupied rather than owner-occupied, meaning that the benefits of participation may be realized by the tenant whereas the incremental costs of participating in the program are absorbed by the owner.

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment to multifamily housing properties at no cost to the property managers or tenant end-users. The program is delivered through coordination with property managers and owners. Tenants are provided with notice and informational materials to inform them of the program and potential for reduction in their energy bills. The program consists of lighting and water measures.

- **Lighting measures:** Compact fluorescent light (CFL) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

2.2 Implementation

Franklin Energy is the implementation contractor for the program. To recruit participants, Franklin Energy conducts onsite visits, in combination with internet searches, and SalesGenie[2] lists, to identify properties, property managers, or property management companies that it believes are likely to participate. Franklin Energy then sends an outreach team of energy advisors to coordinate with property managers and explain the program delivery and benefits. This is considered an Energy Assessment. This is also an opportunity for energy advisors to determine the type of measures along with associated quantities that can be installed. One potential delay in committing to the program is the need for the property manager to get approval to participate from their corporate office.

Once a property has been fully assessed and a service agreement has been signed, the project is handed over to a different group at Franklin Energy to schedule the installations. The installation crew performs the work as scheduled, while displaying Duke Energy branded clothing, badges, and vehicle decals as directed. The installation crews record the quantities and locations of installed measures for each housing unit via a tablet device, which are eventually entered into a tracking database.

When energy efficient program measures are installed, Franklin Energy removes the existing or baseline equipment and generally disposes of it onsite. If the property management previously requested to keep the existing equipment, Franklin Energy will package it up and leave it behind with property management or maintenance personnel. In general, Franklin Energy does not record specific information about the

[2] SalesGenie is a business and consumer lead generation tool that sales and marketing professionals can use to search for targeted leads, get contact names and phone numbers, and view detailed information. The tool also provides marketing and data solutions designed to help businesses reach their intended audiences more effectively.

efficiency characteristics of the equipment being removed, although Franklin Energy indicated they are experimenting with the idea of doing so.[3]

There can be logistical complications associated with performing these types of retrofits at multifamily housing properties. Franklin Energy indicated that some units may be skipped at a property due to safety issues, lack of access to equipment, pet barriers, or refusal from tenants.

Franklin Energy indicated that they have internal and external forms of quality control (QC) to ensure consistent measure installation. On the internal side, a Franklin Energy supervisor may accompany installation crews to ensure quality work. On the external side, a third-party inspector, High Performance Building Solutions, conducts inspections on a least five percent of participating housing units each year. The QC inspections are required to happen within 22 business days of installation. If a property is selected for a QC inspection, at least 20 percent of the units at the property are targeted for inspection.

During each month of QC inspections, Franklin Energy is provided with a discrepancy report that indicates when measures were missing, installed incorrectly, or if there were missed opportunities. Franklin Energy attempts to address the discrepancies, and subsequently updates the tracking data to reflect the QC findings. The tracking data is ultimately provided to Duke Energy, and subsequently to Navigant for EM&V.

[3] During the property assessment phase, Franklin Energy determines that housing units selected for participation contain lower efficiency light bulbs (incandescents) and standard aerators and showerheads.

3. KEY RESEARCH OBJECTIVES

As outlined in the Statement of Work, the key research objectives were to conduct impact and process evaluations, as well as a net-to-gross (NTG) analysis. The evaluation covers both lighting and water measures in DEP, and lighting measures only in DEC.

The primary purpose of the evaluation, measurement, and verification (EM&V) assessment is to estimate net annual energy and demand impacts associated with participation from January 1, 2015 through February 29, 2016 in DEP, and January 1, 2014 through February 29, 2016 for DEC. Secondary objectives include the following:

- Estimate net and gross impacts by measure
- Perform detailed review of deemed savings estimates for each measure, and provide updates if necessary
- Assess the installed quantities and efficiency characteristics of program measures
- Evaluate the strengths and weaknesses of current program processes and customer perceptions of the program offering and delivery
- Recommend improvements to program rules and processes that support greater savings, enhanced cost-effectiveness, and improved customer satisfaction
- Update measure life assumptions, if applicable

Key impact and process research questions to be explored include:

- Is the program achieving targeted energy and demand savings at the measure level?
- How do customers learn about the program, and can participation be increased?
- How is the persistence of savings impacted by participant removal of measures installed through the program?
- Are there opportunities for additional measure offerings through the program?
- Provide the effect on baseline lamp wattage from EISA, including some discussion on the projected degradation of baseline lamp wattage in future years.

4. IMPACT EVALUATION

4.1 Impact Results

Figure 1**Error! Reference source not found.** shows the program-level results for gross energy savings. Table 7 shows a more complete list of program-level findings. The evaluation team calculated the results in Table 7 by multiplying the measure quantities found in the tracking database by the verified energy and demand savings estimated during the EM&V process for each measure. The net impacts were found by multiplying the gross impacts by the NTG ratio of 0.94. The NTG methodology and results are discussed in detail in Section 5 of this report.

Figure 1. Reported and Verified Program-Level Impacts

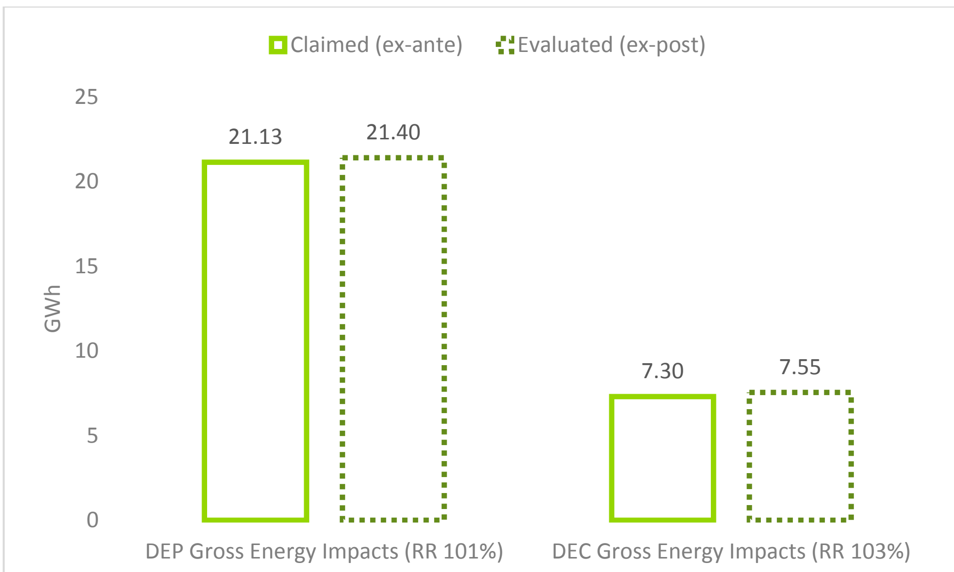


Table 7. Summary of Program Impacts

	Energy (MWh)	Summer Coincident Demand (MW)	Winter Coincident Demand (MW)
DEP Verified Gross Impacts	21,398	2.10	3.72
DEP Verified Net Impacts	20,215	1.98	3.52
DEC Verified Gross Impacts	7,546	0.71	0.90
DEC Verified Net Impacts	7,129	0.67	0.85

Source: Navigant analysis

A summary of each measure's contribution to program savings and realization rate between reported savings and verified savings is shown in Table 8 for DEP, and Table 9 for DEC. Compact Fluorescent Light (CFL) bulbs account for just under half of the energy savings for DEP. By dividing the total verified savings by the total reported savings in the tracking data in Table 8, Navigant calculates a gross realization rate of 101 percent for energy savings at the program level for DEP. The corresponding realization rate for DEC is 103 percent, as shown in Table 9.

Table 8. Distribution of Program Energy Savings by Measure (DEP)

Measure	Measure Count from Tracking Data	Total Ex Ante Savings from Tracking Data (MWh)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MWh)	Realization Rate
CFLs	238,783	9,718	46%	10,047	103%
Bathroom Faucet Aerators	28,710	1,239	6%	1,134	92%
Kitchen Faucet Aerators	18,862	1,715	8%	1,629	95%
Showerheads	24,743	5,741	27%	5,857	102%
Pipe Wrap (ft)	73,338	2,720	13%	2,731	100%
Total	384,436	21,133	100%	21,398	101%

Source: Navigant analysis

Table 9. Distribution of Program Energy Savings by Measure (DEC)

Measure	Measure Count from Tracking Data	Total Ex Ante Savings from Tracking Data (MWh)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MWh)	Realization Rate
CFLs	179,338	7,299	100%	7,546	103%

Source: Navigant analysis

The realization rate for summer coincident demand is 106 percent at the program level for DEP, as shown in Table 10. The realization rate for summer coincident demand is 104 percent at the program level for DEC, as shown in Table 11. The realization rate for winter coincident demand is 112 percent for DEP and 132 percent for DEC, as shown in Table 12 and Table 13, respectively. These realization rates include adjustments to the estimated savings for each measure which will be discussed during the remainder of this report. On a measure level, the largest adjustments were made to the energy savings for bathroom faucet aerators due to the in-service rates found during field verification.

Table 10. Distribution of Summer Coincident Demand Savings by Measure (DEP)

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MW)	Realization Rate
CFLs	0.907	46%	0.941	104%
Bathroom Faucet Aerators	0.163	8%	0.149	92%
Kitchen Faucet Aerators	0.226	11%	0.214	95%
Showerheads	0.472	24%	0.481	102%
Pipe Wrap (ft)	0.217	11%	0.312	143%
Total	1.99	100%	2.10	106%

Source: Navigant analysis

Table 11. Distribution of Summer Coincident Demand Savings by Measure (DEC)

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MW)	Realization Rate
CFLs	0.681	100%	0.707	104%

Table 12. Distribution of Winter Coincident Demand Savings by Measure (DEP)

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MW)	Realization Rate
CFLs	0.907	27%	1.199	132%
Bathroom Faucet Aerators	0.143	4%	0.131	92%
Kitchen Faucet Aerators	0.197	6%	0.187	95%
Showerheads	1.856	56%	1.893	102%
Pipe Wrap (ft)	0.217	7%	0.312	143%
Total	3.32	100%	3.72	112%

Source: Navigant analysis

Table 13. Distribution of Winter Coincident Demand Savings by Measure (DEC)

Measure	Total Savings from Tracking Data (MW)	Share of Total Savings from Tracking Data	Total Verified Ex Post Gross Savings (MW)	Realization Rate
CFLs	0.681	100%	0.901	132%

Source: Navigant analysis

4.2 Impact Evaluation Methodology

Navigant's methodology for evaluating the gross and net energy and demand impacts of the program included the following components:

1. Detailed review of deemed savings estimates including: engineering algorithms, key input parameters, and supporting assumptions.
2. Onsite field verification to assess measure characteristics and in-service rates (ISRs)
3. Net-to-gross (NTG) analysis
4. Incorporating supplemental impact findings from tenant surveys

4.2.1 Detailed Review of Ex Ante Deemed Savings

Navigant reviewed the ex-ante savings and supporting documentation used to estimate ex ante program impacts. For the compact fluorescent lighting measure in both DEP and DEC, Navigant believes the deemed savings are well-documented in the previous EM&V report and that the algorithms and assumptions used to estimate savings are reasonable.[4]

The deemed savings for the 13 watt CFLs are shown in Table 14 below. The baseline lamp is assumed to be a 60 watt incandescent.

Table 14. Ex Ante Savings and Parameters for CFLs

Program measure	kWh savings	Non-coincident kW savings	Coincident kW savings	Coincidence factor	Average baseline wattage	EE wattage	Average daily hours of use
13 watt CFL	40.7	0.0469	0.0038	0.081	55.33	13	2.89

Navigant was able to trace all of these findings to the previous EM&V report provided by Duke Energy. The impacts were calculated using the following algorithms:

Equation 1. Energy Savings Algorithm for CFLs

$$kWh\ savings = ISR\ x \left[\frac{(Watts_{base}\ x\ HOU_{base}) - (Watts_{EE}\ x\ HOU_{EE})}{1000}\right] x\ 365\ x\ (1 + HVAC_C)$$

Equation 2. Coincident Demand Savings Algorithm for CFLs

$$kW\ savings^{5} = ISR\ x \left[\frac{Watts_{base} - Watts_{EE}}{1000}\right] x\ CF\ x\ (1 + HVAC_d)$$

Where the parameters are defined as:

- ISR = in-service rate
- $Watts_{base}$ = wattage of baseline lamp removed
- $Watts_{EE}$ = wattage of CFL lamp installed
- HOU_{base} = daily operating hours of baseline lamp removed
- $HOUs_{EE}$ = daily operating hours of CFL lamp installed
- $HVAC_C$ = HVAC interaction factor for energy
- $HVAC_D$ = HVAC interaction factor for demand
- CF = coincidence factor

[4] *Process and Impact Evaluation of Duke Energy's Residential Smart $aver: Property Manager CFLs in the Carolinas*, TecMarket Works, 2013.

[5] To calculate winter coincident demand savings, the HVAC interaction factor, $HVAC_d$, is subtracted instead of added. This conservative assumption accounts for a mix participants who will have electric heat pumps for heating, as well as those who may use auxiliary electric heating to supplement gas during winter coincident peak periods.

For water measures, the deemed savings for DEP were based on Navigant's recent EM&V of water measures in the DEC, so little review was needed.[6]

4.2.2 Onsite Field Verification

Navigant performed onsite field verification at 123 housing units across 16 properties. Field verification efforts were designed to assess the measure characteristics as reported in the tracking data and to assess measure parameters that can be used to verify inputs and assumptions used to estimate energy and demand savings for individual measures. Table 15 shows a summary of the parameters assessed by Navigant during field verification, and Table 16 shows the field verification sample.

Table 15. Parameters Evaluated During Field Verification

	CFLs	Faucet Aerators	Water-saving Showerheads	Hot Water Pipe Wrap
Installed quantity	x	x	x	x
Installed wattage	x			
Flow rates (gpm)		x	x	
Water heating system characteristics		x	x	x
Water Temperatures		x	x	x
Pipe length				x
Measure location	x	x	x	x
Baseline information (where available)	x	x	x	x

Table 16. Field Verification Sample

Program Measure	Number of Housing Units in Sample[a]	Number of Measures Reported in Sample
CFLs	123	1,181
Bathroom Faucet Aerators	73	97
Kitchen Faucet Aerators	76	76
Showerheads	76	91
Pipe Wrap	31	162 ft

a. Totals exceed 123 because many sites had multiple measures

Source: Navigant analysis

A summary of findings from field verification is included in Section 4.3.

[6] Please refer to Navigant's report, titled "Multifamily Energy Efficiency Program, Evaluation, Measurement, and Verification for Duke Energy Carolinas", dated 11-3-15 for more information.

4.2.3 Tenant Surveys

Navigant incorporated supplemental findings from 150 tenant phone surveys to inform the impact analysis where applicable. The findings from the tenant surveys will be addressed later in this report.

4.3 Impact Evaluation Findings

The impact evaluation findings for lighting measures and water measures are discussed separately.

4.3.1 Compact Fluorescent Light Bulbs

Table 17 shows a summary of Navigant's ex-post, verified findings for CFLs. The energy savings per bulb increased slighted from the 40.7 kWh provided in the deemed savings to 42.1 kWh. To calculate verified energy and demand impacts, Navigant assessed the parameters that were used in the algorithms to estimate ex-ante savings. Table 18 lists all parameters used to calculate ex-post savings.

Table 17. Summary of CFL findings

	Ex-Post	Ex-Ante
In-Service Rate[1]	84.6%	94.7%
Daily Operating Hours	2.64	2.89
Gross Energy Savings Per Bulb (kWh)	42.1	40.7
Gross Summer Coincident Demand Savings Per Bulb (kW)	0.0039	0.0038
Gross Winter Coincident Demand Savings Per Bulb (kW)	0.0050	N/A

1. *Navigant did not account for vacant housing units, so the actual number of CFLs in use may be lower.*
Source: Navigant analysis

Table 18. Calculation parameters for ex post CFL impacts

Program measure	ISR	Average baseline wattage	EE wattage	Average daily hours of use for baseline lamps	Average daily hours of use for CFLs	Summer coincidence factor	Winter coincidence factor	Energy HVAC interaction factor[a]	Demand HVAC interaction factor[a,b]
13 watt CFL	84.6%	60	13	2.64	2.64	0.082	0.32[c]	1.1	1.21

a. Sourced from 2016 Mid-Atlantic TRM
b. The demand HVAC interaction factor is added for summer coincident demand impacts, and subtracted for winter. Navigant also adjusted the interaction factor for winter demand to account for 50% of participants having gas heating per the 2013 Duke Energy Residential Appliance Saturation Survey.
c. Source: *Coincidence Factor Study, Residential and Commercial & Industrial Lighting Measures*, prepared for: New England State Program Working Group

4.3.1.1 In-Service Rate

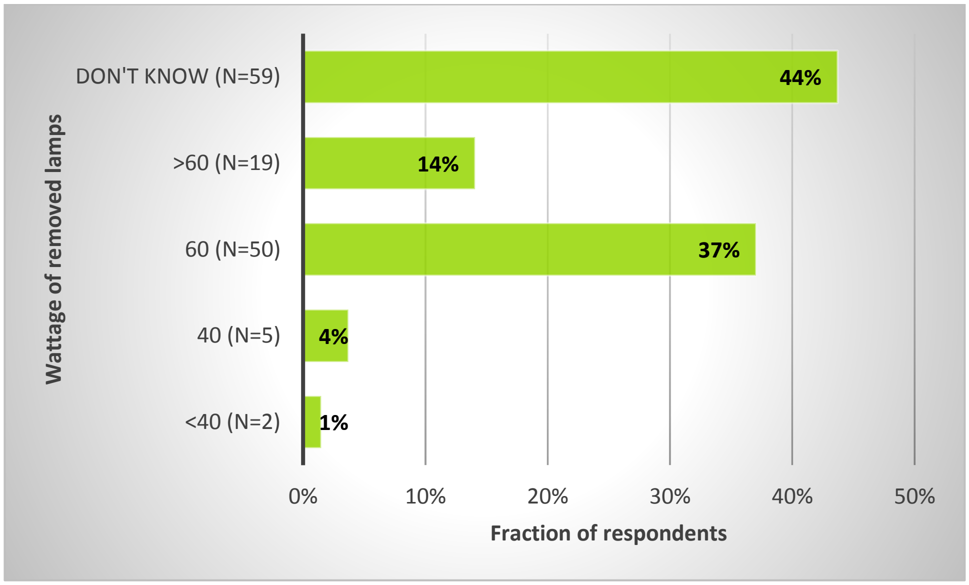
At the 123 housing units inspected by Navigant that had CFLs, there were a total of 1,181 reported program CFLs in the tracking database. During the inspections, Navigant found 844 CFLs. Additionally, during phone surveys with tenants, 13 respondents indicated they had removed a total of 41 CFLs. The predominant reason for removing CFLs was burnout. Navigant used a weighted average to combine the ISR from field verification with the ISR from phone surveys to calculate a final ISR.

4.3.1.2 Wattage

Navigant assessed the wattage of CFLs inspected during the onsite verification and found them to be 13 watts as reported. However, there is potential uncertainty in the wattages of lamps removed during the retrofit process, or at least whether that wattage should be the baseline going forward. The time period covered by this evaluation is January of 2014 through February of 2016. The Energy Independence and Security Act (EISA) of 2007 established that as of January 1st, 2014, 60 watt incandescent bulbs could no longer be manufactured or imported. The new, EISA compliant wattage was 43. However, Navigant's experience has shown that there was considerable lag between the EISA compliance schedule and actual market activity, and potential back stocking of incandescents by multifamily maintenance staff. Because Duke Energy's Multifamily Energy Efficiency Program is a retrofit program (rather than replace on burnout), it is important to consider the actual characteristics of the lamps removed because they likely had remaining useful life. Franklin Energy has indicated that they only remove incandescent lamps during the retrofit process.

Figure 2**Error! Reference source not found.** shows the results of customer self-reporting from tenant phone surveys with regards to the wattage of lamps removed during participation in the program. It can be seen that a large number of respondents were not sure, but more than half (51 percent) of respondents indicated that the lamps were 60 watts or higher. Additionally, during Navigant's field verification efforts, seven tenants were able to recall the lamps removed, and all seven indicated they were 60 watt incandescents. High rates of tenant turnover at multifamily housing units could explain why so many customers did not know what type of lamps were removed.

Figure 2. Customer self-reporting of wattage of lamps removed



Given that the period of time covered by this evaluation coincides with important EISA compliance dates that may have experienced a lag in market uptake, along with the results shown in Figure 2, Navigant believes that a baseline wattage assumption of 60 watts was appropriate for this evaluation cycle. However, as will be discussed later in this report, Navigant suggests further research be conducted to understand the lighting baseline for future evaluation cycles.

4.3.1.3 HVAC Interaction and Coincidence Factors

Navigant reviewed the ex-ante assumptions for HVAC interaction factors and summer coincidence factors and chose to replace them with updated values from the 2016 Mid-Atlantic TRM. For a winter coincidence factor, Navigant used a secondary literature source.[7]

4.3.1.4 Lighting Hours of Use

The hours of use for CFLs are an important parameter input to the energy savings algorithm, however the scope and budget of this evaluation did not support a full metering study to quantify operation hours. Navigant assessed the lighting operation hours via the following methods:

1. Collected self-report data from program participants during tenant phone surveys
2. Performed extensive review of the previous estimates for deemed savings
3. Performed a literature review to assess estimates from secondary sources

[7] RLW Coincidence Factor Study for New England State Program Working Group, https://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/116_RLW_CF%20Res%20C&I%20ltg.pdf

Navigant collected self-reported hours of use estimates from participants during the tenant phone surveys with 150 participants. The average self-reported estimate was 2.64 hours per day. Navigant recognizes that significant uncertainty exists in customer ability to estimate hours of use. For that reason, the evaluation team compared the self-report estimate of 2.64 with other sources.

Table 19 shows a comparison of estimated CFL operating hours from several sources. The previous assumptions used for ex-ante savings were based on a self-report results from customer phone surveys, which were then corrected for self-reporting bias by using the results of a different study.[8] The evaluation team also compared the self-report hours of use with other studies, and believes that the self-reported value of 2.64 is appropriate for this evaluation.

Table 19. Comparison of CFL Operating Hours

Estimated Daily CFL Usage Hours	Method	Source
2.89	Customer self-report, bias corrected	TecMarket Works, previous EM&V study for Property Manager CFL Program for Duke Energy[8]
2.21	Metering study	Navigant metering study for similar multifamily program in Southwestern U.S.
1.5-1.6	Meta data analysis	U.S. Department of Energy *Residential Lighting End-Use Consumption Study: Estimation Framework and Initial Estimates* (2012)[9]

Source: Navigant analysis

4.3.1.5 Effect of Baseline Wattage Requirements for EISA

It is important to address the topic of CFL baseline in more detail. The Energy Independence and Security Act (EISA) was enacted to increase the availability of reduced wattage lighting options, and hence shift the lighting market toward higher efficiency. In theory, this would eventually cause the program CFL baseline to eventually shift to a lower wattage as 60 watt incandescents become less-prominent. There is still uncertainty around what the exact baseline is in Duke Energy's service territories.

Navigant believes that EISA standards should be applied to new construction applications or replace-on-burnout scenarios. However, the Multifamily Energy Efficiency Program is primarily a direct install retrofit program targeting existing homes where the existing lamps likely have remaining useful life. The program implementer requires that all lamps being removed are incandescents. Furthermore, some program participants have reported that the lamps removed were higher than 60 watts. Due to the changing market for residential lighting, Navigant suggests that further research be conducted in future evaluation years to assess the baseline.

[8] *Process and Impact Evaluation of Duke Energy's Residential Smart $aver: Property Manager CFLs in the Carolinas*, TecMarket Works, 2013.

[9] http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf

4.3.2 Water Flow Regulation Measures

For field verification of program water measures, Navigant collected information to validate the efficiency characteristics of the equipment. This included verifying the reported number of measures and measuring actual flow rates of the retrofit equipment.

4.3.2.1 In-Service Rate

The ISRs for water measures are shown in Table 20. These were calculated using a weighted average of results from the onsite field verification inspections and the tenant phone surveys.

Table 20. In-Service Rates for Water Measures

Measure	ISR
Kitchen aerators	94%
Bathroom aerators	92%
Showerheads	95%
Pipe wrap	93%

Source: Navigant analysis

4.3.2.2 Energy Savings

The deemed savings for water measures in DEP are based on a recent EM&V report by Navigant for DEC, which was completed in November of 2015. The evaluation team used a similar approach for DEP, but supplemented or replaced inputs with data gathered during field verification. To calculate verified savings for aerators and showerheads, Navigant used a standard engineering equation taken shown in Equation 3, Equation 4, and Equation 5. Navigant subsequently applied inputs collected during field verification or assumptions as listed below in Table 21. The resulting estimates for impacts of aerators and showerheads are presented in Table 22.

Equation 3. Algorithm for Estimating Energy Savings for Faucet Aerators

$$kWh\ savings\ for\ faucet\ aerators = ISR \times \left[\frac{(GPM_{base} - GPM_{low}) \times T_{home/day} \times 365\frac{days}{yr} \times DF \times (T_{out} - T_{in}) \times 8.3\frac{Btu}{gal \cdot ^{\circ}F}}{\#_{faucets} \times 3412\frac{Btu}{kWh} \times RE}\right]$$

Equation 4. Algorithm for Estimating Energy Savings for Low Flow Showerheads

$$kWh\ savings\ for\ low\ flow\ showerheads = ISR \times \left[\frac{(GPM_{base} - GPM_{low}) \times T_{home/day} \times N_{showers/day} \times 365\frac{days}{yr} \times (T_{out} - T_{in}) \times 8.3\frac{Btu}{gal \cdot ^{\circ}F}}{\#_{showers} \times 3412\frac{Btu}{kWh} \times RE}\right]$$

Equation 5. Algorithm for Estimating Coincident Demand Savings for Aerators and Showerheads

$$\Delta kW_{peak} = \Delta kWh/yr \times CF/365$$

Table 21. Input Parameters and Assumptions for Aerator Savings Calculations

Input	Definition	Value	Source
ISR	In-service rate	Refer to Table 20	Navigant field verification and phone surveys
GPM_{base}	Baseline flow rate	Aerators 2.2 Shower 2.5	Deemed savings assumptions from Duke Energy
GPM_{low}	Retrofit flow rate	Aerators 1 Shower 1.5	Deemed savings assumptions from Duke Energy[a]
$T_{home/day}$	Avg hot water use per day per home (minutes)	Kitchen 4.7 Bath 2.4 Shower 8.4	Building America Benchmark
$N_{showers/day}$	Number of showers per person per day	1	Navigant assumption
DF	Percent of water going down drain	Kitchen 75% Bath 90%	Navigant assumption
T_{out}	Temp of water flowing from faucets (F) Temp of water flowing from showerheads (F)	90[b] 105	Navigant field verification 2016 Mid-Atlantic TRM
T_{in}	Temp of water entering water heater (F)	66	Navigant field verification
#faucets/showers	Number of faucets in home (used to distribute minutes of use between different faucets)	Kitchen 1 Bathroom 1.33 Shower 1.2	Navigant field verification
RE	Recovery efficiency of water heater	0.98	Ohio TRM
CF (aerators)	Coincidence Factor	Summer 0.048 Winter 0.042	Building America Benchmark
CF (showerheads)	Coincidence Factor	Summer 0.03 Winter 0.118	Building America Benchmark

a. *Navigant measured flow rates during onsite field verification and they were lower than the reported flow rates for the measures installed. However, this was likely due to calcification or water pressure characteristics and suggests that baseline flow rates may also have been lower. Because we did not measure flow rates for baseline units, we chose to use the reported flow rates in both cases.*

b. *The actual measured hot water temperature was 109F. For analysis purposes, Navigant assumed that customers use water at a temperature of 90 degrees, or the average of 109F and 70F.*

Table 22. Verified Estimates of per Unit Impacts for Aerators and Showerheads[10]

Measure	Annual Energy Savings per Unit (kWh)		Annual Summer Coincident Demand Savings per Unit (kW)		Annual Winter Coincident Demand Savings per Unit (kW)	
	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante
Kitchen aerator (1.0 GPM)	86	91	0.0114	0.0120	0.0099	0.010
Bathroom aerator (1.0 GPM)	40	43	0.0052	0.006	0.0045	0.005
Low flow showerhead (1.5 GPM)	237	232	0.0195	0.0190	0.0765	0.0750

Source: Navigant analysis

4.3.3 Water Heater Pipe Wrap

During field verification, Navigant found that some of the water heater pipe wrap was installed on the cold water inlet pipe to the water heater. Industry standards are to install pipe wrap on all hot water pipes, and only the first three feet of the cold water pipe because savings are minimal from insulating cold water pipes.[11] Therefore, when calculating the ISR, Navigant did not count savings from pipe wrap of greater than three feet installed on cold water pipes.

To estimate impacts from the pipe wrap measure, Navigant used algorithms from the 2016 Mid-Atlantic TRM shown in Equation 6 and Equation 7 below.[12] The ex-post impacts are shown in Table 23.

Equation 6. Energy savings for water heater pipe wrap

$$\Delta kWh = \left(\frac{1}{R_e} - \frac{1}{R_n}\right) \times (L \times C) \times \Delta T \times 8760 \div nDHW \div 3413$$

Equation 7. Demand savings from water heater pipe wrap

$$\Delta kW = \Delta kWh \div 8760$$

The following list defines the parameters used in the equations above:

R_e = R-value of existing, uninsulated pipe (R = 1)
R_n = insulation R-value of pipe after retrofit (R = 1.5)
L = length of pipe (per foot)
C = circumference of pipe (Navigant assumed average of 0.5” and 0.75” diameter pipe)
ΔT = temperature difference between water in pipe and ambient air (65F)
nDHW = heat recovery efficiency (0.98)
3413 = conversion from Btu to kWh

[10] The program offers aerators and showerheads at other flow rates. However, the tracking data indicated that 100 percent of the water measures installed during the period covered by this evaluation cycle were the flow rates shown in Table 22, so a verified savings are shown here for only those measures. A full list of savings is shown in Section 9

[11] http://www.energy.gov/energysaver/projects/savings-project-insulate-hot-water-pipes-energy-savings

[12] http://www.neep.org/mid-atlantic-technical-reference-manual-v6

Table 23. Verified Impacts for Water Heater Pipe Wrap

Measure	Annual Energy Savings per Unit (kWh)	Annual Summer Coincident Demand Savings per Linear Foot (kW)	Annual Winter Coincident Demand Savings per Linear Foot (kW)
Ex Post	37	0.0043	0.0043
Ex Ante	37	0.0030	0.0030

Source: Navigant analysis

4.3.4 Measure Life

Navigant reviewed the measure life assumptions for all program measures and compared them to other sources from secondary literature research. The evaluation team believes all program measure lives are appropriate and not in need of an update.

5. NET-TO-GROSS ANALYSIS

Navigant conducted an NTG analysis to estimate the share of program savings that can be attributed to participation in or influence from the program. Table 24 shows the results of Navigant's NTG analysis. Navigant anticipated low free ridership and spillover given that the program is structured to offer energy efficient equipment at no cost to multifamily housing units, which are typically not owner-occupied. The results shown here are in line with expectations. Navigant chose to present a program-level NTG ratio rather than measure level due to the limited sample size of property managers and the fact that it is difficult to estimate spillover by measure. Navigant believes it is more appropriate to present the NTG ratio in aggregate.

Table 24. NTG Results

Estimated Free Ridership	7.5%
Estimated Spillover	2.0%
Estimated NTG	0.94

Source: Navigant analysis

5.1 Overview of Net-to-Gross Methodology

As indicated in the evaluation plan, Navigant used a survey-based, self-report methodology to estimate free ridership and spillover for the Multifamily Energy Efficiency Program. A self-report approach is outlined in the Universal Methods Protocol (UMP), and Navigant has previously used this method to estimate a NTG ratio for several other Duke Energy programs in the Carolinas. Navigant primarily targeted property managers for the NTG surveys, because they are the decision makers for participation in the program.[13] Navigant also incorporated supplemental data gathered during tenant phone surveys into the analysis.

5.1.1 Definitions of Free Ridership, Spillover, and NTG 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 anyway (i.e., actions that were not induced by the program). This is meant to account for naturally occurring adoption of energy efficiency measures. The Multifamily Energy Efficiency Program and most other Duke Energy programs cover a wide range of energy efficiency measures and are designed to advance the overall energy efficiency market. However, it is likely that, for various reasons, some participants would have wanted to install some high-efficiency measures even if they had not participated in the program or been influenced by the program in any way.

[13] Navigant recognizes that some property managers may have been instructed to participate by higher-level decision makers at the corporate level. Although we do not think this was the case very often, we do think that the local property managers were still privy to the decision making process.

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.

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 NTG formula is shown in Equation 8:

Equation 8. Net-to-Gross Formula

NTG = 1 – free ridership + spillover

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

5.1.2 Estimating Free Ridership

Data to assess free ridership was gathered through the self-report method using a series of survey questions asked to the property managers at participating properties. The survey assessed free ridership using both direct questions, which aimed to obtain respondent estimates of the appropriate free ridership rate that should be applied to them, and supporting or influencing questions, which could be used to verify whether the direct responses were consistent with participants' views of the program's influence.

Each respondent to the survey provided perspectives on the measures that they had installed through the program. The core set of questions addressed the following three categories:

- **Likelihood:** To estimate the likelihood that they would have incorporated measures "of the same high level of efficiency," if not for the assistance of the 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 energy efficient measure prior to participating in the program. The general approach holds that if customers were not definitively planning to install all of the efficiency measures prior to participation then the program can reasonably be credited with at least a portion of the energy savings resulting from the high-efficiency measures. Strong free ridership is reflected by those participants who indicated they had already allocated funds for the purchase and selected the equipment 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 the three categories.[14] Navigant then calculated a weighted average from each respondent based on their share of sample energy savings, and divided by 10 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 when they would have installed the equipment without the program. Respondents who indicated that they would not have installed the equipment for at least two years were not considered free riders and received a timing multiplier of 0. If they would have installed at the same time as they did, they received a timing multiplier of 1; within one year, a multiplier of 0.67; and between one and two years, a multiplier of 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 received a timing multiplier of 1.

5.1.3 Estimating Spillover

The basic method for assessing participant spillover was an approach that asked a set of questions to determine the following:

- **Whether spillover exists at all.** These were yes-or-no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records and did not receive any rebates from Duke Energy.
- **The savings that could be attributed to the influence of the program.** Participants were asked to list the extra measures they installed, and the evaluation team assigned a savings value. See below for the method of assigning savings.
- **Program attribution**. 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.

[14] 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).

If respondents said no, they did not install additional measures, they were assigned a 0 score for spillover. If they said yes, then Navigant estimated the energy spillover savings on a case-by-case basis. It is important to note that although free ridership questions were only asked of property managers, Navigant surveyed both property managers and tenants for spillover.[15]

5.1.4 Combining Results Across Respondents

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

- Individual respondents, by evaluating the responses to the relevant questions and applying the rules-based approach discussed above.
- The program as a whole, by taking a weighted average of the individual results based on each respondent's share of reported energy savings.

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

5.2.1 Review of Data Collection Efforts for Attribution Analysis

Surveys were conducted with decision makers to provide the information to estimate free ridership, and thus, NTG ratios. A total of 21 property managers were surveyed. These 21 property managers managed 39 total properties in the program. This sample represents about 10 percent of the total reported energy savings, as shown in Table 25.

Table 25. Property Manager Sample Representation

	Program Total	Sample Total	% of Program
Properties	449	39	9%
CFLs	418,121	39,942	10%
Bathroom faucet aerators	28,710	2,737	10%
Kitchen faucet aerators	18,862	1,948	10%
Showerheads	24,743	1,964	8%
Pipe wrap (ft)	73,338	10,189	14%
Total Energy Savings			**10%**

Source: Navigant analysis

5.2.2 Free Ridership Results

[15] The reason for not assessing free ridership at the tenant level is because tenants generally participated in the program via their property managers rather than personal choice. It is possible that tenants would have installed the same measures themselves, but Navigant does not believe they should be considered free riders to the program because the timing of those installations would have been difficult to evaluate and tenants would still have the ability to install CFLs in non-retrofitted fixtures. If a tenant already had equivalent measures in place, it is unlikely that the implementer would have replaced them with program measures.

As described above, surveyed participants responded to a series of questions intended to elicit explicit estimates of free ridership, as well as ratings of program influence. Estimates are based on questions regarding the likelihood, scope, and timing of the investments in energy efficiency if the respondent had not participated in the program. For the Multifamily Energy Efficiency Program, free ridership was estimated at 7.5 percent, which is a relatively low value as anticipated by Navigant.

Navigant developed the free ridership estimate presented above based on responses to a variety of questions that related to survey respondents' intentions prior to participating in the program and to the influence of the program itself. Below are summaries by scoring component.

Prior Planning: Fourteen of the respondents did not have any prior plans for installing any of the energy efficient measures. The other seven respondents indicated that they did have plans, but for the most part, their plans were not very far along. These results indicate low free ridership.

Program Importance: Respondents stated that the program was very important in having the measures installed. Several property managers noted that their decision to participate was influenced by helping their tenants save energy and money.

Likelihood: Respondents were asked in the absence of the program, if they would have had at least some of the work done. Twelve respondents stated they "definitely would not have" installed the measures in the absence of the program, and six said they "may have".

Timing: 11 of 21 respondents stated they would have done the installation within two years or less in the absence of the program. The other 10 stated they would have done the installation after two years or never if not for the program. These findings are suggestive of low free ridership.

In summary, respondents indicated that the program was very important in their decisions to have the energy efficient measures installed. Some indicated that they did have some prior plans to install the measures, but their plans were not very far along.

5.2.3 Spillover Results

Three of the 21 surveyed property managers indicated that the program influenced him/her to install additional, non-incentivized energy efficiency measures at the property. The additional measures included LEDs in outdoor or common spaces, attic insulation, and water heater insulation wraps. In addition to the three property managers reporting spillover, eight tenants reported installing a small number of LEDs and other efficient lights after participating in the program.

Navigant estimated spillover from the equipment reported by property managers and tenants by applying simple engineering equations along with the self-reported measure quantities and characteristics. Navigant calculated the total spillover to be 2.0 percent.

5.2.4 NTG Results

The NTG ratio was calculated as written in Equation 9:

Equation 9. Net-to-Gross Ratio

$$NTG = 1 - free\ ridership + spillover = 1 - 0.075 + 0.0197 = 0.9447$$

This suggests that for every one kWh reduced from program measures, about 0.94 kWh of savings can be directly attributed to the program.

6. PROCESS EVALUATION

Navigant conducted a process evaluation of the Multifamily Energy Efficiency Program to assess program delivery and customer satisfaction. The process findings summarized in this section are based on the results of customer surveys with 150 program participants, detailed surveys with 21 property managers representing 39 properties, an interview with the Duke Energy Program Manager, and a high level review of the program documents and functionality. The property manager interviews and tenant surveys were also used to inform the NTG analysis.

6.1 Key Findings

- The program appears to be effectively addressing many key challenges that are inherent to delivering energy efficiency programs to non-owner-occupied multifamily housing facilities.
- Over half of the property managers learned about this program through outreach by a program representative. This onsite marketing approach seems to be a successful way of gaining participants. Most tenants learned of this program through their property managers.
- Property managers indicated they chose to participate in the program to provide a service and save money for their tenants and owners as well as to capitalize on the free installation to save on internal labor costs
- 75 percent of DEP tenants and 83 percent of DEC tenants noticed savings on their energy bills since the installation of the measures.
- 55 percent of tenants stated that the program CFLs were installed in the light fixtures used most in the home. Incandescent bulbs were listed as the most commonly removed type of bulb.
- A majority of program participants were satisfied with the program. On a scale of 0 to 10, where 0 indicates “not satisfied at all” and 10 indicates “extremely satisfied”:
    - Over 65 percent of participants indicated 8-10 for satisfaction with the overall program
    - Over 80 percent of participants indicated 8-10 for satisfaction with the installer’s quality of work
    - Over 70 percent of participants indicated 8-10 for satisfaction with Duke Energy
- High satisfaction ratings by tenants were often associated with money savings as the primary benefit. Low satisfaction ratings were often associated with complaints about the equipment.
- Satisfaction was higher for CFLs than for showerheads and aerators.
- During the tenant phone surveys, several participants expressed dissatisfaction with the low water pressure in their showers and sinks. Additionally, some property managers indicated that they had received tenant complaints about low water pressure.

6.2 Documentation Review

Navigant requested program documentation and tracking data to conduct a complete review of current processes. The program tracking data was sufficient to identify the measure characteristics and quantities of installed measures for each tenant at the participating properties.

6.3 Property Manager Interviews

The evaluation team conducted interviews with property managers from the participating properties to assess decision-making (which will ultimately feed into the NTG analysis) and overall satisfaction with the program. The evaluation team interviewed twenty-one property managers who were responsible for 39 properties representing over 56,000 measures or 10% of the program measures.

Overall, property managers indicated that their experience with the program was very favorable. Some key findings from the property manager interviews are listed below:

- Property managers expressed high satisfaction with the free program measures and free installation by an external contractor. Property manager's noted the contractor's quality of work as "well done and professional" and "impressive."
- Over 60% of property managers responsible for their energy bills noticed a decrease in the property energy bills since participating in the program.
- Over 95% of property managers are very likely to recommend this program to other property managers. Provided are a subset of property manager responses on how the program influenced their decision to install the energy efficient measures:
  - "The program made it happen, otherwise it never would have."
  - "The program made it easy, so why not do it."
  - "[Duke Energy] did all the work and we just made the appointments available to get the efficient measures installed. Overall the cost and the work was done quickly."
  - "I didn't have to do anything. We just scheduled the appointment and they just came and did the installs."
  - "[I] saw that it would save move – just the electricity costs and everything it just made sense."
- One property's maintenance staff communicated that after 90 days, over 40% of the installed showerheads started leaking due to dirt buildup. The maintenance staff was able to clean the showerheads after discovering the root problem.
- One property's maintenance staff indicated that some tenants are confiscating program lightbulbs, showerheads, and aerators upon apartment turnover.
- A small number of property managers stated that they were not satisfied with the responsiveness of program staff if any rescheduling or additional follow-up work was needed.
- General suggestions for program improvement from property managers and maintenance staff include adding the following measures/material to the program: window weather stripping, outside or porch lights, and a reminder sticker below the thermostat to display a suggested air conditioner temperature.

6.4 Overall Marketing and Outreach

Customer outreach is a key driver to program participation. Navigant recognizes the importance of marketing and outreach with regards to continued participation and satisfaction, so several questions in the tenant survey and property manager interviews were included to address this.

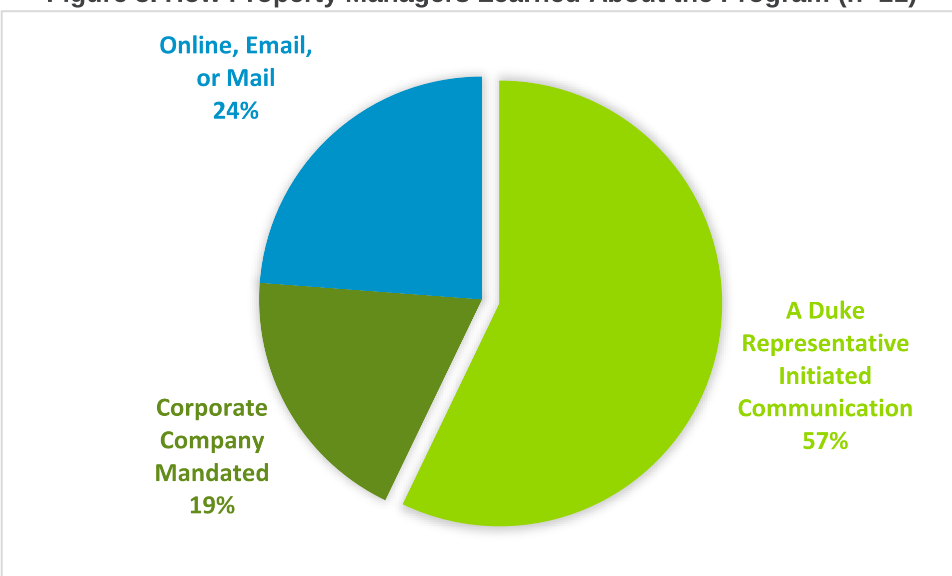
Table 26 and Figure 3 show how tenants and property managers learned about the program, respectively. Tenant participants were asked to indicate all of the sources through which they learned about the program, and about 70 percent indicated they had learned about the program through property managers as would be expected given the program model. Tenants also indicated having received notice via a Duke Energy mailing or bill stuffer. Property managers indicated that they were approached in-person by a program representative, or received a mail or email with program details.

Table 26. How Tenants Learned About the Program

How Tenants Learned About the Program (n=150)	
Through property manager	70%
Duke Energy mailing or bill stuffer	13%
Duke Energy website	5%
Through family, friend or neighbor	4%
Marketing by trade ally, vendor or contractor	1%
Duke Energy email	1%
Don't Know	6%

Source: Navigant analysis

Figure 3. How Property Managers Learned About the Program (n=21)



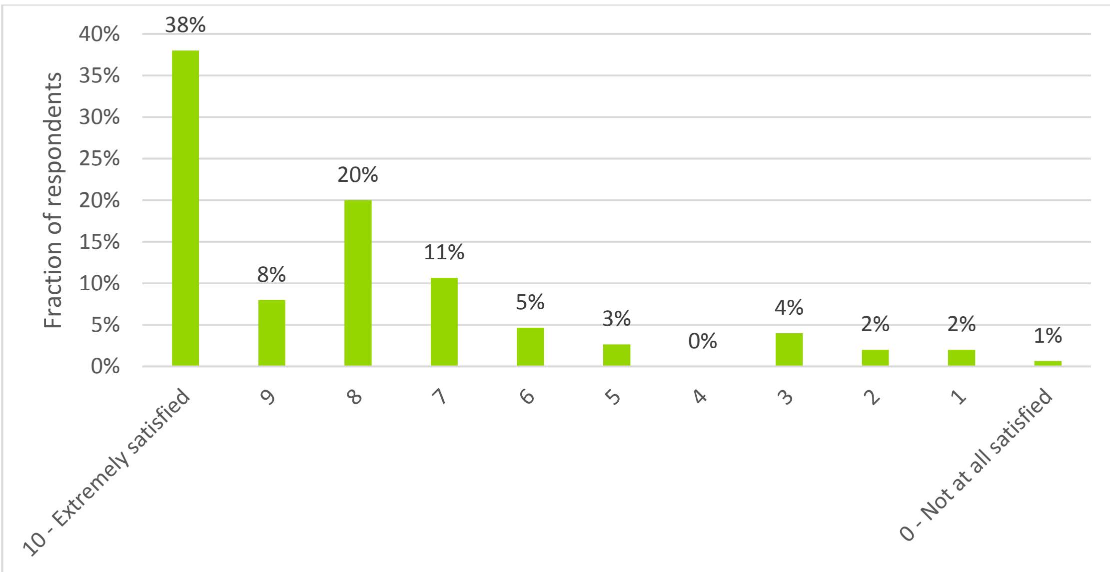
Source: Navigant analysis

6.5 Tenant Surveys

Navigant conducted phone surveys with 150 residential tenants to assess program satisfaction. The surveys contained a number of questions to assess satisfaction with program participation, satisfaction with new equipment, as well as questions to assess measure baseline and any measures removed by the tenant after participation.

Customer satisfaction with the program is high. On a scale of 0 to 10, where 0 indicates "not satisfied at all" and 10 indicates "extremely satisfied," two-thirds of customers rated satisfaction with the program as an 8-10 as shown in Figure 4. Participants who ranked their overall satisfaction low did so because they disliked the products or did not experience any energy savings. This chart includes data from both DEP and DEC territories as there were no significant satisfaction differences.

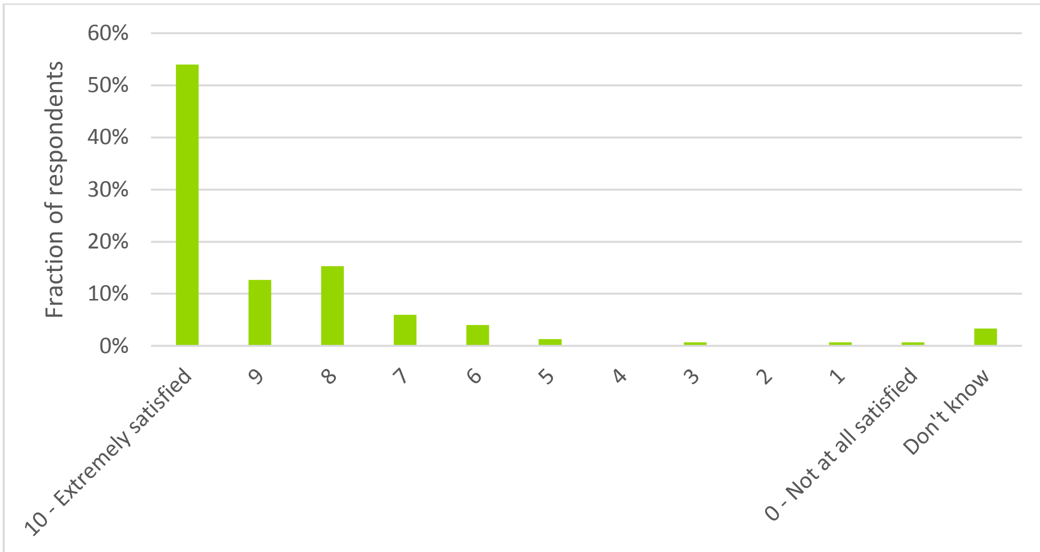
Figure 4. Tenant Satisfaction with Overall Program Experience (n=150)



Source: Navigant analysis

Customer satisfaction with the contractor quality of work was also high, as shown by Figure 5.

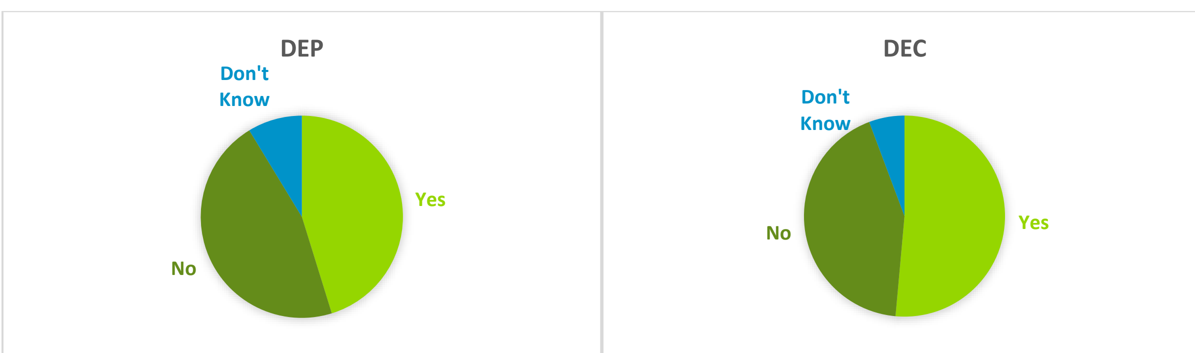
Figure 5. Tenant Satisfaction with Contractor's Quality of Work (n=150)



Source: Navigant analysis

As shown in Figure 6, about half of participants noticed a decrease in their energy bills after the new measures were installed.

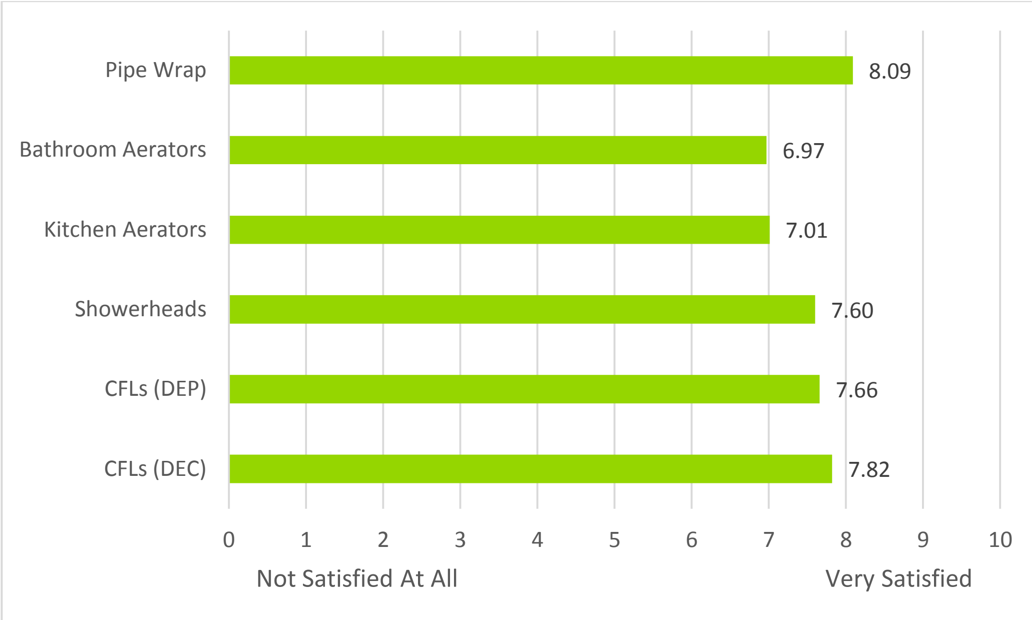
Figure 6. Participants Who Noticed a Decrease in Their Energy Bill After Installing Program Measures (n=150)



Source: Navigant analysis

While a majority of participants were satisfied with the new measures, some were not. Navigant asked the participants to rate their satisfaction for each measure installed at their home. Average satisfaction ratings ranged from as high as 8.09 out of 10 for Pipe Wrap, to as low as 6.97 out of 10 for bathroom faucet aerators as shown in Figure 7.

Figure 7. Tenant Satisfaction Rating for Each Measure (n=150)



Source: Navigant analysis

A small percentage of tenants removed the installed measure as shown in Figure 8. In the DEC territory, 100 percent of the CFLs removed by tenants were bulbs that had burned out. In the DEP territory, 57 percent of the CFLs removed by tenants were due to burnout, and the remainder were removed due to poor product quality. Participants indicated they removed bathroom faucet areators because of poor water pressure. Showerheads and kitchen faucet areators were removed because of leakage or excess water spray.

Figure 8. Participants Who Removed Any Installed Measures

Source: Navigant analysis

6.5.1.1 Participant Suggestions

Navigant also included a question in the tenant satisfaction survey that allowed respondents to offer suggestions for improving the program. One-fourth of the respondents offered suggestions, which were as follows:

- Several respondents asked for a better quality of equipment, including the quality of CFLs, showerheads, and aerators
- Several participants asked for better notification of installation date and time
- Two participants requested LEDs instead of CFLs
- One respondent requested offering motion sensors

7. SUMMARY FORM

Multifamily Energy Efficiency Program

Completed EMV Fact Sheet

Description of program

Duke Energy's Multifamily Energy Efficiency Program provides energy efficient equipment to multifamily housing properties at no cost to the property managers or tenant end-users. The program is delivered through coordination with property managers and owners. Tenants are provided with notice and informational materials to inform them of the program and potential for reduction in their energy bills. Typically, measures are installed directly by the implementation contractor rather than tenants or onsite maintenance staff.

The program consists of lighting and water measures.

- **Lighting measures:** Compact fluorescent light (CFL) bulbs installed in permanent fixtures
- **Water measures:** Bathroom and kitchen faucet aerators, water-saving showerheads, hot water pipe wrap

Date:	October 4, 2016
Region:	Duke Energy Progress Duke Energy Carolinas
Evaluation Period	DEP 1/1/15 – 2/29/16 DEC 1/1/14 – 2/29/16
Annual kWh Savings	DEP 21,398,188 DEC 7,546,028
Per Participant kWh Savings	DEP 808 DEC 344
Net-to-Gross Ratio	0.94

Evaluation Methods

The evaluation team used engineering analysis and onsite field inspections as the primary basis for estimating program impacts. Additionally, telephone surveys were conducted with tenants and multifamily housing units to assess customer satisfaction and spillover. Detailed interviews were conducted with property managers to assess their decision-making process, and ultimately to estimate a net-to-gross ratio.

Impact Evaluation Details

- **Field inspections were conducted at 123 housing units.** The evaluation team inspected program equipment at 123 housing units to assess measure quantities and characteristics to be compared with the program tracking database.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 85% for CFLs to 95% for low flow showerheads.
- **Participants achieved an average of 808 kWh of energy savings per year in DEP, and 344 kWh in DEC.** The evaluation for DEC only included lighting measures, whereas the evaluation for DEP included lighting and water measures. Therefore, the two should not be compared directly.
- **The type of lamp removed during retrofit that was most commonly reported by participants was 60W incandescents.** Of the tenants who could recall what type of lamps were removed during lighting retrofits, the majority reported 60W incandescents. The evaluation team believes that evaluation periods covering dates beyond the end of this cycle will include a lower baseline wattage for retrofitted lamps.

8. CONCLUSIONS AND RECOMMENDATIONS

Navigant's findings in this report suggest that Duke Energy's Multifamily Energy Efficiency Program is being delivered and tracked effectively in the DEC and DEP jurisdiction. Customer satisfaction is generally high, and the program measure installations appear to be tracked appropriately. Navigant presents the following list of recommendations that may help improve program delivery and impacts:

1. **Navigant recommends that Duke Energy should adopt the per-unit energy and demand impacts from this evaluation and use them going forward.** The engineering analysis and data collection described in this report provide support for updating the estimated impacts for each program measure. Duke Energy should consider additional research to investigate the baseline for CFLs for future evaluation cycles.
2. **Navigant recommends that no more than the first three feet of cold water inlet pipes be insulated for the water heater pipe wrap measure.** The U.S. Department of Energy recommends only insulating the first three feet of cold water inlet pipes. Beyond that, savings are likely negligible. During field verification, Navigant found that over half of the reported water heater pipe wrap was installed on cold water pipes (with just under 10 percent of those installations greater than three feet on the cold water heater pipes).
3. **Duke Energy should consider adding LEDs to the program.** Because of EISA, the baseline for the 13 watt CFL measure will eventually reach 40 watts instead of 60 watts. This will diminish the cost-effectiveness of program CFLs. LED options may provide increased savings and improved customer satisfaction.

9. MEASURE-LEVEL INPUTS FOR DUKE ENERGY ANALYTICS

Navigant used the findings from field verification, surveys, and review of Duke Energy's deemed savings to estimate an updated set of deemed savings for Duke Energy to use for tracking program activity. Table 27 provides the measure-level inputs that can be used by Duke Energy Analytics for estimates of future program savings. Impacts for water measures apply to the DEP jurisdiction only, whereas impacts from CFLs apply to both DEP and DEC.

Table 27. Gross Measure-Level Impacts

Measure	Annual Energy Savings Per Unit (kWh)	Annual Summer Coincident Demand Savings Per Unit (kW)[1]	Annual Winter Coincident Demand Savings Per Unit (kW)[2]
Faucet Aerators MF Direct 0.5 GPM - bath	55.99	0.153	0.007
Faucet Aerators MF Direct 1.0 GPM - bath	39.52	0.108	0.005
Faucet Aerators MF Direct 1.0 GPM - kitchen	86.40	0.237	0.011
Faucet Aerators MF DIY 0.5 GPM - bath	45.46	0.125	0.006
Faucet Aerators MF DIY 1.0 GPM - bath	32.09	0.088	0.004
Faucet Aerators MF DIY 1.0 GPM - kitchen	68.98	0.189	0.009
LF Showerhead MF Direct 0.5 GPM	473.56	1.297	0.039
LF Showerhead MF Direct 1.0 GPM	355.17	0.973	0.029
LF Showerhead MF Direct 1.5 GPM	236.78	0.649	0.019
LF Showerhead MF DIY 0.5 GPM	374.70	1.027	0.031
LF Showerhead MF DIY 1.0 GPM	281.03	0.770	0.023
LF Showerhead MF DIY 1.5 GPM	187.35	0.513	0.015
Pipe Wrap MF Direct	37.24	0.004	0.004
Pipe Wrap MF DIY	30.05	0.003	0.003
13W CFLs	42.10	0.048	0.004

1. *The summer coincident period for DEP and DEC is defined as weekdays in July, hour ending 17.*
2. *The winter coincident period for DEP and DEC is defined as weekdays in January, hour ending 8.*

APPENDIX A. DETAILED SURVEY RESULTS

This appendix contains additional results from the property manager interviews and tenant surveys. It is meant as a supplement to other sections of the report.

A.1 Property Manager Interviews

Navigant conducted in-depth interviews with 21 property managers. As shown in Table 25, the sample of 21 property managers represented 39 properties. This section presents details of the interviews. The responses to each question shown are paraphrased to maintain confidentiality and summarize the key points.

Table 28. How did you learn about the Duke Energy Multifamily Energy Efficiency Program?

Respondent(s)	Response
1,2,5,7,10-12,14,16-18,21	Duke Energy online, mail or email
3,4,6,9	Corporate company mandated
8,13,15,19,20	Approached by a program representative

Source: Navigant analysis

Table 29. What were the primary reasons to participate in the program?

Respondent(s)	Response
1,7,10,	Energy Efficiency
3,4,14	Corporate mandated
5,8,9,12,13,15,18,21	To save money
2,6,11,16,17,19,20	To savings water cost for tenants

Source: Navigant analysis

Table 30. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied are you with your overall program experience?

Respondent(s)	Response
1-4,7,9-12,14,18,20	10
5,20	9
13,16,17,19	8
8	7
6	5

Source: Navigant analysis

Table 31. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied are you with the tenant notification and program materials?

Respondent(s)	Response
3,4,6,10-12,14,16,18,21	10
1,2,5,7,15,20	9
8,9,13	8
19	7
17	5

Source: Navigant analysis

Table 32. On a scale of 0 to 10, with 0 being "not satisfied at all" and 10 being "extremely satisfied", how satisfied would you say your tenants are with the new energy efficient equipment?

Respondent(s)	Response
1,3,12	10
2,10,14	9
5-7,9,11,16,17,21	8 – because some of the tenants prefer the incandescent light bulbs because of look and color, but most really like the CFLs
8,15,19	7 – the kitchen aerators and showerheads are leaking and breaking, requiring equipment repairs
4,13,20	6
18	5 – water measures cut down water pressure noticeably

Source: Navigant analysis

Table 33. On a scale of 0 to 10, with 0 being "not likely at all" and 10 being "very likely", how likely are you to recommend the Multifamily Energy Efficiency Program to other property managers?

Respondent(s)	Response
1,7,9-12,14, 16,18,20,21	10
2,15,19	9
4,5	8
3,6,8,13,17,	7

Source: Navigant analysis

Table 34. Prior to participating in the program, had you considered installing the same energy efficient equipment at your facility?

Respondent(s)	Response
1-6,8,10-15,19	No
7, 16-18,20	Yes

9	Yes – for lighting measures, not the water measures
21	Yes, they considered installing CFLs and the water measures to save on energy bills

Source: Navigant analysis

Table 35. Did your experience with the program influence you to incorporate any additional energy efficiency equipment for which you did not receive a Duke Energy program rebate?

Respondent(s)	Response
1-4,6,9,11-20	No
5	Yes, installing LED
7	Yes, remodeling apartments
8	Yes, installed more energy efficiency exterior lighting
21	Yes, insulation blankets on water heaters, insulation on attic, and caulked windows at multiple properties

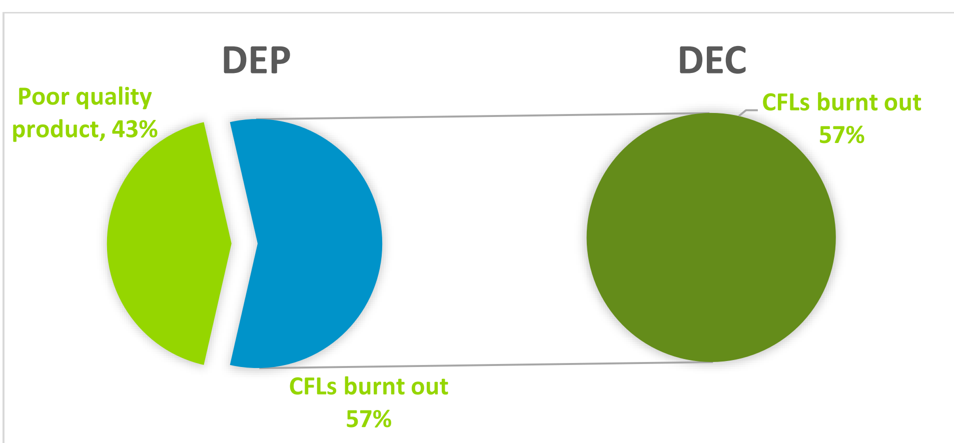
Source: Navigant analysis

A.2 Tenant Satisfaction Surveys

Satisfaction surveys were conducted with 150 program participants. Many of the results are presented in Section 6.5 of the main report, and this section serves as a supplement.

Figure 9 shows the reasons why tenants removed CFLs, the most common being burnout. For water measures, the most common reason for removal was low water pressure and leakage, although fewer measures had been removed.

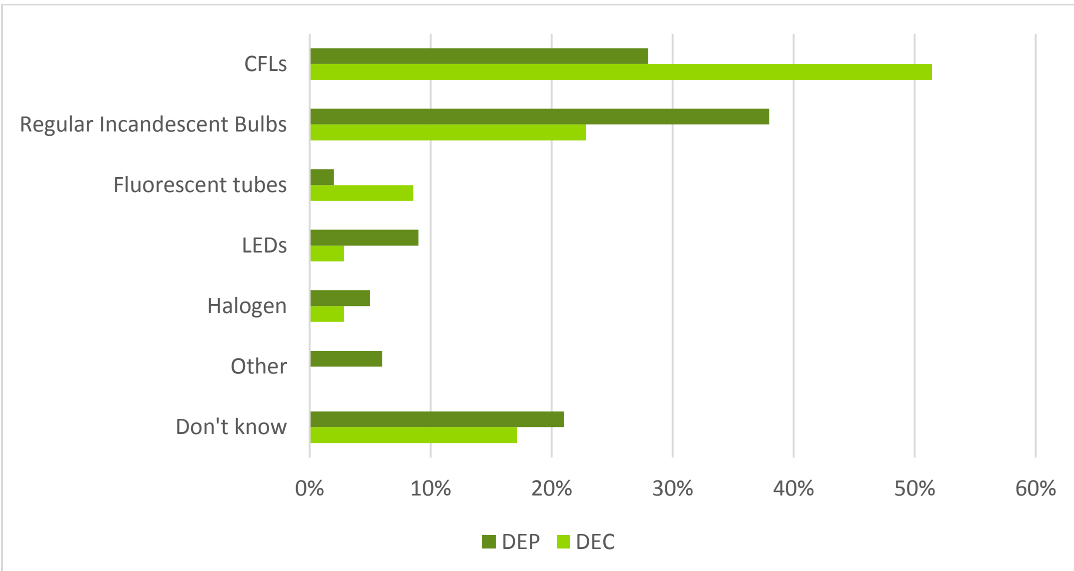
Figure 9. Reasons Why Tenants Removed CFLs (DEP = 7; DEC=3)



Source: Navigant analysis

Figure 10 shows the types of light bulbs that tenants reported as being installed in the non-retrofitted fixtures in their homes. For the DEC territory, an important supplement to this figure is that just under 90 percent of tenants reported that program CFLs were installed in the fixtures used most in their homes, which demonstrates that the program is effective in reaching the fixtures with greatest savings potential. For the DEP territory, just under 50% of tenants reported that CFLs were installed in fixtures that are used most in the home. Additionally, for the DEP jurisdiction 60 percent of tenants reported that they were very likely to install CFLs in their home in the future; for the DEC jurisdiction 77 percent of tenants indicated they were very likely to purchase CFLs in the future.

Figure 10. Type of Bulbs Found in Non-Retrofitted Fixtures



Source: Navigant analysis

As noted earlier, overall tenant satisfaction with the program was very high for DEP and DEC jurisdictions, with an average rating of 8.05 on a scale of 0 to 10 with 10 as very satisfied. However, ten of the 150 tenants reported a satisfaction of five or less with the program for the following reasons:

- No money savings (n=7)
- Dislike products (n=1)
- Mandated program participation by property management (n=1)

Tenants also reported a few suggestions for improving the program:

- Improve the kitchen faucet aerator (n=4)
- Improve the quality of products (n=3)
- Improve the quality of CFLs (n=3)
- Provide LEDs instead of CFLs (n=2)
- Provide participants a discount (n=1)
- Offer motion sensors (n=1)

Impact and Process Evaluation of the 2015 Power Manager Program® Duke Energy Carolinas

Final, April 26, 2016

Duke Energy Carolinas
400 S. Tryon St
Charlotte, NC 28202

CADMUS

Prepared by:

Cadmus

CADMUS

Table of Contents

CADMUS

Executive Summary

Duke Energy engaged Cadmus to perform a process evaluation and assess the results of Duke Energy Carolinas' (DEC) impact evaluation of its Power Manager Program in North Carolina and South Carolina. This report outlines the Program Year 2015 (PY2015) impact and process evaluation findings for the evaluation period of June 1, 2015, through May 31, 2016.

Cadmus' process evaluation included interviews with Duke Energy program managers and two sets of surveys with program participants. We fielded event/non-event surveys in the summer, immediately following curtailment events (event) and high temperature days without events (non-event), that were focused on customer response to events. We fielded a participant survey after the end of the cooling season that was focused on the overall participant experience, including topics such as awareness, enrollment, and household demographics.

For the PY2015 impact evaluation, DEC used a variety of commonly accepted, utility industry statistical practices and applications to measure and report program results. These included sample selection and validation, air conditioner duty cycle modeling, model simulations, switch device operability analysis, weather normalization, and monthly capability weighting of expected capacity. As an independent, third-party evaluator, Cadmus reviewed DEC's approaches commensurate with standard evaluation, measurement, and verification (EM&V) industry practice.

Program Description

Power Manager is a voluntary residential load control program available to DEC homeowners with qualified central air conditioning. Each year, program customers receive a monthly bill credit for participating during the summer months of June through September. Participants agree to allow DEC to cycle their air conditioning units during peak periods of energy demand, when energy costs are high, or for emergency purposes when a program-induced full-shed period would aid in the reliability of delivering energy to the region. As shown in Table 1, 172,338 customers in North Carolina and South Carolina participated in PY2015.

Table 1. PY2015 Program Participation as of September 30th, 2015

Enrolled Customers	Enrolled Switches
172,338 total North Carolina: 126,327 South Carolina: 46,011	206,267 total North Carolina: 150,066 South Carolina: 56,201

High-Level Process Findings

Awareness and Response to Curtailment Events

Only 51% (event/non-event survey n=276) of surveyed participants were aware that their Power Manager devices have been activated since they joined the program. Among respondents surveyed following a curtailment event, only 17% (n=113) of those who were at home at the time were aware that their device had been activated, which is statistically significantly more than 4% (n=81) of those at home on high temperature days without events who believed there had been an event when there was not. Survey respondents who were not home during the event time period were also significantly less likely to believe that there had been an event (2%, n=47 events and 3%, n=35 non-events).

Similar numbers of respondents who were surveyed after events (17%, n=101) and after high temperature days without events (11%, n=71) reported that comfort levels in their home declined on the afternoon of the event or high temperature day, respectively. Among those that reported a decline in comfort (event/non-event survey n=25), the average comfort ratings declined from 8.4 before the event time period to 5.4 during the event time period, and most respondents blamed rising temperatures for their decline in comfort. Among respondents surveyed during the cooling season, only 5% (event/non-event survey n=109) of event respondents reported that the activation of their Power Manager device had caused a decline in their comfort; this is significantly different from the 0% (event/non-event survey n=51) of full shed test event respondents and 1% (event/non-event survey n=116) of non-event respondents surveyed following high temperature days without events who reported that activation of their Power Manager device had caused a decline in their comfort. There are no statistically significant differences in awareness of events, declines in comfort during event time periods, or associating Power Manager device activation with a decline in comfort between PY2015 and PY2014 event/non-event surveys.

About half of respondents surveyed in the fall after the end of cooling season (participant survey 46%, n=72) report that they have electric fans running in their home “always” or “most of the time” on weekday afternoons when the outdoor temperature is over 90 degrees. This is similar to the actual rate of electric fan use measured by surveys conducted on hot days during the cooling season (event/non-event surveys 57%, combined n=193 respondents at home during surveyed time period).

Only 5% (event/non-event survey n=194) adjusted their thermostats downward during the event time period, and 16% (n=193) turned on electric fans during the event time period. Non-event respondents (event/non-event survey 24%; n=80) were significantly more likely than those surveyed following events (10%; n=113) to turn on fans during the event time period.

Air Conditioner Use and Maintenance

Three-quarters of respondents (participant survey 77%, n=71) report that they use air conditioning on “most days” or “every day” during the cooling season, and 83% (n=72) report that their home is typically occupied on weekday afternoons before 6:00 p.m. This is similar to the actual the summertime event/non-event survey result that 70% (n=276) of surveyed households were occupied during the time period surveyed.

Only 35% (participant survey n=71) of respondents make manual adjustments to their thermostats, while the majority either have programmed their settings or leave the thermostat at the same setting all the time. Respondents' median thermostat set point for every time period during the week was 73 to 75 degrees.

Three-quarters of respondents (participant survey 75%, n=71) have had maintenance performed on their air conditioning units since they joined Power Manager. None of these respondents (n=53) reported that their Power Manager device had been disconnected during maintenance and not re-connected afterwards, although 74% were not sure if their device had been disconnected or not.

Motivation for Enrollment and Understanding of the Program

The most common main reason given by participants for enrolling in Power Manager was to save money through lower utility bills (participant survey 39%, n=57), followed by bill credits (32%).

Only 17% (participant survey n=70) indicated something was unclear to them about how the program works, and 6% (participant survey n=72) contacted Duke Energy to find out more about the program. However, 67% (participant survey n=72) could not estimate how much they receive in bill credits from Power Manager, 46% did not know if they had received any bill credits during 2015, and 78% did not know how many events to expect per year.

Program and Utility Satisfaction

Participant satisfaction ratings measured during PY2015 are similar to past years. The average rating for satisfaction with Power Manager was 8.8 (n=62) in the participant survey and 8.7 (n=254) in the event/non-event survey. Participants' average rating for their likelihood of recommending the program were 8.1 (n=67) in the participant survey and 8.5 (n=250) in the event/non-event survey. Survey respondents gave Duke Energy an overall satisfaction rating of 8.2 (n=72) in the participant survey and 8.5 (n=267) in the event/non-event survey.

There were no statistically significant differences in satisfaction or recommendation ratings for participants surveyed following curtailment events and those surveyed following high temperature days without events.

High-Level Impact Findings

DEC conducted the impact analysis of the Power Manager Program. Cadmus reviewed the results presented in this report as well as a spreadsheet with a sample of impact figures to ensure proper methodology.

The section summarizes DEC's key findings for the evaluation period.

- There were 206,267 active switches installed at the end of September 2015 (see Table 3)
- For PY2015, the operability study conducted in DEC revealed that Power Manager switch devices were operational at a 93.9% rate (see Table 2)

- For PY2015, the total summer Power Manager Program capacity at the plant—adjusted for peak normal weather and de-rated for operability—was 455.21 MW
- During PY2015, there were four (4) Power Manager events and four (4) test events in DEC

Table 2. PY2015 Program Summary Table

Program Year	Active Switches as of September 30th, 2015	Summer Capacity	Operability Rate
PY2015	206,267	455.21 MW	93.9%

- In 2012, a project was begun to replace the older PLC and Comverge switches with new Cannon switches. As of the end of PY2015, this project was nearing completion.

Table 3. Power Manager Program Participation Summary

Program Year	Cannon Switches	Comverge & PLC Switches
PY2015	199,868	6,399
PY2014	170,254	12,863
PY2013	106,927	76,475
PY2012	73,807	111,735

Conclusions and Recommendations

The Power Manager Program is successful as measured by multiple metrics. Participants report they are satisfied with the program, are generally not aware of curtailment events, and that events do not have a significant effect on their home comfort or on their satisfaction with the program. Additionally, participants who experience an event are not more likely to take counter-actions such as lowering thermostat temperatures, turning on secondary window or wall units, or turning on electric fans than they were on days of equivalent high temperature but no curtailment event.

While the program is functioning well overall, the evaluations revealed potential areas Duke Energy could explore to further refine program operations or expand program benefits. Following are the conclusions and recommendations resulting from Cadmus' process evaluation and DEC's impact evaluation activities.

***Conclusion:* Monitoring customer experience through annual event/non-event surveys enhances understanding of program affects during specific summer conditions.** Compared to PY2014, PY2015 customers experienced higher temperatures (including five 100 degree days), although high temperature days were clustered in June and July while August and September temperatures were relatively mild. Different summer weather may affect participants differently, so results for a given year's surveys may not be predictive of other years. Since the scope of summer weather cannot be predicted in advance, event/non-event surveys should be fielded every year.

Recommendation: **Continue fielding event/non-event surveys to gauge customer response to curtailment events.**

Introduction

Power Manager is a voluntary residential load control program available to DEC homeowners with qualified central air conditioning. Each year, program customers receive a monthly bill credit for participating during the summer months of June through September. Participants agree to allow DEC to cycle their air conditioning units during peak periods of energy demand, when energy costs are high, or for emergency purposes when a program-induced full-shed period would aid in the reliability of delivering energy to the region.

Two types of Power Manager events may be called. First, economic events can be called on days when energy demand and/or energy costs are expected to be high, but there is not necessarily significant concern about system reliability. Second, emergency events can be called when high energy usage on hot days or other conditions threaten the reliability of the transmission system. DEC would cycle participants' units off for the duration of such a Power Manager emergency event. The emergency demand response capability is critical because DEC is a self-balancing utility. Power Manager was initiated as an emergency-only demand response program, but was expanded to include economic events following Duke Energy's merger with Cinergy in 2006.

During an economic event, DEC cycles air conditioners off for a few minutes per hour with a targeted average load reduction of 1.3 kW per unit controlled. Customers with more than one central air conditioner must have all units controlled in order to participate.

CADMUS

Process Evaluation

Methodology

The intent of our process evaluation was to document how well the program worked in practice, in order to identify and understand important influences on program operations and overall performance. Cadmus assessed the program strengths, weaknesses, areas for improvement, and use of best practices. As part of the process evaluation, we interviewed Duke Energy program staff and surveyed participants/customers (Table 5 lists the sample populations).

Program Manager Interviews

Cadmus interviewed Duke Energy staff that lead the Power Manager Program for North Carolina and South Carolina, to discuss the following research areas:

- Program design and implementation;
- Marketing;
- Enrollment processes;
- Event Calls;
- Quality control.

Participant and Event/Non-Event Surveys

Cadmus fielded two surveys to capture customer feedback; the first was an online participant survey (participant survey) about program participation fielded in the fall, at the end of the cooling season. For the second survey, we conducted telephone calls during the cooling season immediately following curtailment events and hot days without events (event/non-event surveys).

Participant Survey and Sample Design

Cadmus developed a customer survey for Power Manager Program participants, and lauched this via an online platform, Qualtrics, between November 12 and November 30, 2015. The survey timing was after participants had experienced control events during the summer of 2015. We randomly selected 2,000 program participants from the population of 125,215 contactable[1] participants in DEC territory, and

[1] A participant was considered contactable if all of the following were true: (1) the program record included a person’s name (not a business or organization), (2) the program record included a telephone number, (3) the customer was not enrolled in the Power Manager Research Group,(4) the customer was not on Duke Energy’s do-not-call list, and (5) the customer had not been contacted for any other evaluation surveys in the previous six months.

invited 693 of those customers with a valid email address to take the survey. Cadmus closed the online survey after three weeks, when we had a sample large enough to meet the targeted precision level.[2]

Event/Non-Event Survey and Sample Design

Cadmus conducted telephone surveys immediately after program control events to collect participant information. We maintained these surveys in a “ready-to-launch” status until being notified of an event affecting switches used by Duke Energy. Then we launched the surveys following the end of the event, and continued them just over 24 hours, attempting all calls during regular surveying hours (10:00 a.m. to 8:00 p.m. Eastern Standard Time [EST], Monday through Saturday). For example, if a control event occurred on a Monday and ended at 5:00 p.m., survey calling hours for that particular event would be:

- Monday 5:00 p.m. – 8:00 p.m. and
- Tuesday 10:00 a.m. – 8:00 p.m.

Cadmus made event survey calls following regular curtailment events (i.e., economic cycling events) on June 16, June 23, July 20, and August 5, 2015, and following full shed test events on July 13 and August 3, 2015. We surveyed 160 participants in DEC territory (51 following the full shed test events and 109 following regular events), exceeding the target needed to meet a minimum ±10% precision with 90% confidence for event respondents.

Cadmus also surveyed Power Manager participants on hot days without events. Since there was no activation period for these non-event surveys, we asked respondents about their activities and comfort level between 2:00 p.m. and 5:00 p.m. on the day of high temperature, a time period that is similar to the normal curtailment event time periods. We conducted the non-event surveys following non-event days when the outdoor high temperature was at least 93°F (June 18, June 19, June 22, June 24-26, June 30, July 7-9, July 21, July 27, and July 30, 2015). Cadmus surveyed 116 participants in DEC territory, exceeding the target needed to meet a minimum ±10% precision with 90% confidence for non-event respondents.

The schedule of Power Manager event/non-event surveys for DEC are shown in Table 4, along with the high temperatures on those dates.[3]

[2] Based on the size of the population being surveyed, a sample of at least 68 respondents was necessary to achieve a precision of ±10% or better with 90% confidence. Although the survey achieved the sampling goal of 90/10, precision estimates vary for individual survey questions depending on the number of respondents who answered the individual question and the distribution of their responses.

[3] These high temperatures were recorded at the Charlotte/Douglas International airport (airport code CLT) for those dates, as reported in the historical temperature data archive at http://www.wunderground.com/.

Table 4. Schedule of PY2015 DEC Events and Non-Event High Temperature Days

Event ID	Type	2015 Event or Non-Event Date	Event Hours	2015 Survey Dates	Completed Surveys	High Temp-erature
SE-event1	Regular Event	June 16	2:30 – 6:00 p.m.	June 16-17	13	99°F
SE-nonevent1	Non-event	June 18	N/A	June 18-19	9	100°F
SE-nonevent2	Non-event	June 19	N/A	June 20	5	96°F
SE-nonevent3	Non-event	June 22	N/A	June 18-19	4	100°F
SE-event2	Regular Event	June 23	2:30 – 5:00 p.m.	June 23-24	16	100°F
SE-nonevent4	Non-event	June 24	N/A	June 25	2	100°F
SE-nonevent5	Non-event	June 25	N/A	June 25-26	15	98°F
SE-nonevent6	Non-event	June 26	N/A	June 27	12	100°F
SE-nonevent7	Non-event	June 30	N/A	July 1	7	94°F
SE-nonevent8	Non-event	July 7	N/A	July 8	7	93°F
SE-nonevent9	Non-event	July 8	N/A	July 8-9	14	97°F
SE-nonevent10	Non-event	July 9	N/A	July 10	9	99°F
SE-event3	Full Shed Test Event	July 13	4:00 – 4:15 p.m.**	July 13-14	29	96°F
SE-event4*	Regular Event	July 20	3:30 – 6:00 p.m.	July 20-21	33	98°F
SE-nonevent11	Non-event	July 21	N/A	July 22	12	98°F
SE-nonevent12	Non-event	July 27	N/A	July 27-28	15	95°F
SE-nonevent13	Non-event	July 30	N/A	July 31	5	97°F
SE-event5	Full Shed Test Event	August 3	4:00 – 4:30 p.m.**	August 3	22	95°F
SE-event6	Regular Event	August 5	2:30 – 6:00 p.m.	August 5-6	47	99°F

* Duke Energy did not activate switches in South Carolina during the curtailment event on July 20, 2015. Cadmus only surveyed North Carolina participants following this event.
** For full shed test event survey questions that refer to the event time period, Cadmus mentioned the entire hour from 4:00 p.m. to 5:00 p.m.

Survey Response Rates and Precision

Table 5 summarizes the response rates and achieved precision levels for the participant surveys and event/non-event surveys. Cadmus exceded the targeted number of completed surveys for all respondent groups.

CADMUS

Table 5. Process Evaluation Data Collection and Analysis

Evaluation Component	Population	Attempted Contacts	Achieved Completes	Response Rate	Precision at 90% Confidence
Program Managment Staff	N/A	1	1	1	N/A
Participating Customers (Participant Surveys)	176,828	693	72	10%	±9.7%
Participating Customers (Event/Non-Event Surveys)	176,828	3,006	276 (109 regular event, 51 full shed test event, 116 non-events)	9%	±4.9% all surveys ±6.5% all event ±7.9% regular event ±11.5% full shed test event ±7.6% non-event

Program Manger Interviews

Program Operations

Cadmus interviewed the program manager to gain an in-depth understanding of the program and to identify its successes and challenges. Results of these discussions follow below, presented by topic.

Program Design and Implementation

DEC calls Power Manager events in order to reduce load when there is peak demand. The program manager oversees Duke Energy's North Carolina and South Carolina service territories, and program operations usually coincide between states.

The program manager reports that GoodCents is the contractor that installs, removes, and maintains switches for Power Manager in the Carolinas System. GoodCents is scheduled to completed a three-year process of upgrading all Power Manager switches in DEC territory to a newer model manufactured by Eaton Cooper during CY2016. Duke Energy maintains the paging system which transmits control signals to switches, rather than using a contractor for this service.

The program manager reported that Duke Energy is seeking to increase Power Manager's load reduction capacity, and has already made significant progress toward this goal due to upgrading switches to improve the program's operability factor, and increasing marketing outreach to recruit more participants.

Marketing

The program manager reported that during PY2015, most outreach for the Power Manager Program was conducted through outbound calling using vendor CustomerLink. The program manager reported that telephone contact has increased the recruitment rate because customers are able to pose questions directly to a representative.

At this time, Duke Energy does not co-brand or co-market Power Manager with other energy efficiency programs.

Historically, mailings from Duke Energy were the most important channel for recruiting customers to enroll in the program, and most of the current participants recalled learning about the program through the mail (see Figure 1 in the Program Awareness section below).

Enrollment Process

Customers may enroll in Power Manager over the phone, by mail, e-mail, or online. During PY2015, DEC focused on recruiting new participants using telephone and e-mail channels. Once the customer provides their enrollment information, installation vendor GoodCents is able to transmit the information automatically to their work management system.

The current participant dropout rate is very low accoding to the Duke Energy program manager, and recruitment has accelerated since the previous evaluation due to increased marketing activity. There were 154,959 customers enrolled in Power Manager according to the PY2014 evaluation, and there were 176,828 participating customers in PY2015, for a net increase of 14% in one year.

Duke Energy pays customers who enroll in Power Manager four monthly bill credits of $8.00, and all household units must be controlled for a customer to qualify for the program.[4] The monthly bill credit is applied to the July through October bills. Unlike Duke Energy Midwest, there are no enrollment options, and Duke Energy Carolinas does not pay an additional incentive upon enrollment.

Event Calls

Duke Energy program managers meet weekly with their Demand Response Team and company market price planners to determine whether to call an economic curtailment event. Key inputs for this decision include the wholesale price of generation capacity, local weather forecasts (including high temperatures, humidity, and storm activity), as well as Duke Energy's capacity needs and any extraneous considerations such as local outages or maintenance on transmission lines. The program manager reports that the customer experience is a key consideration, and close attention is paid to the length and frequency of events so as to minimize any inconvenience to participants. Events are timed to maximize their impact by activating switches during peak demand hours for the service territory, which is most often between 2:30 p.m. to 6:00 p.m. EST in the DEC territory.

If necessary, program management will adjust planned event periods; during PY2015 an event that was planned to last three and a half hours was ended an hour earlier when actual demand during the time period was lower than what had been predicted. There was also one curtailment event where DEC

[4] Many customers in DEC territory have more than one air conditioning unit. The average number of switches installed per participant is 1.2 (see Table 1).

activated switches in North Carolina but not South Carolina, due to ongoing restoration work being performed after power outages in South Carolina the previous weekend.

For the PY2015 cooling season, Duke Energy called three curtailment events for the general population of participants in North Carolina and South Carolina (June 16, June 23, and August 5, 2015), one curtailment event that only affected customers in North Carolina (July 20, 2015), and two full shed test events lasting 30 minutes or less (July 13 and August 3, 2015). Duke Energy also called three curtailment events for their logger research group, which did not affect most program participants.[5]

Quality Control

DEC assures quality for all aspects of the program through internal monitoring and study, and through implementer activities.

Duke Energy staff is able to monitor the load reduction impact of curtailment events in nearly real-time, by observing internal load shapes provided by the utility's system operating center.

Duke Energy performed switch operability and air conditioner duty cycle studies in PY2015 and earlier years, but operability studies will be performed by Nexant beginning in PY2016. The program manager reports that maintaining and improving the operability factor is a priority for program operations for DEC, and these studies will measure progress and inform the process for improvement.

The scope of work for program implementer GoodCents was revised effective January 1, 2016, to provide additional checks and balances to improve data entry, verification and reporting. These changes include a new work order management system.

In response to past disruptions in the supply chain affecting the availability of Eaton Cooper switches, Duke Energy maintains an inventory of switches sufficient to supply the program for at least three months. The program manager reports that this was done because they cannot control extraneous events that affect the global supply chain, and also that the switch availability has improved in PY2015.

Participant Surveys

Cadmus analyzed feedback from online surveys completed by 72 Duke Energy customers who participated in the Power Manager Program in PY2015. These participant surveys were designed to cover program-level topics such as awareness, enrollment, and household demographics that are not related to specific curtailment events. Power Manager event/non-event surveys are summarized separately, in the Event/Non-Event Surveys section of this report.

This section presents the results of our analysis by topic. Except where noted, we excluded "don't know" and "refused" responses, which is reflected in accompanying n-values.

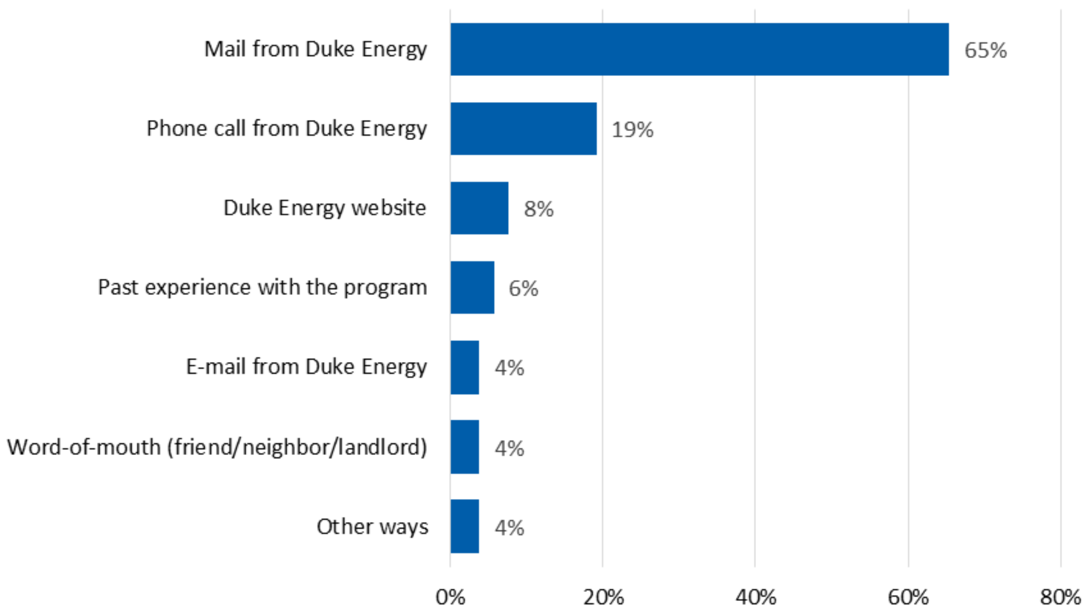
[5] Cadmus removed these research group participants from the survey sample.

CADMUS

Program Awareness

In order to qualify for the survey, respondents had to confirm that they were aware of their household's participation in the Power Manager Program. Most survey respondents (84%; n=68) were involved in their household's decision to participate in the program, while 3% were not involved and 13% joined the program by moving into a home that already had a Power Manager device installed by a previous occupant. Figure 1 shows that most participants who were involved in the decision to join the program first learned about Power Manager through mailings from Duke Energy (65%; n=69), with the next most common channels being phone calls (19%) and the Duke Energy website (8%).

Figure 1. Source of Power Manager Program Awareness

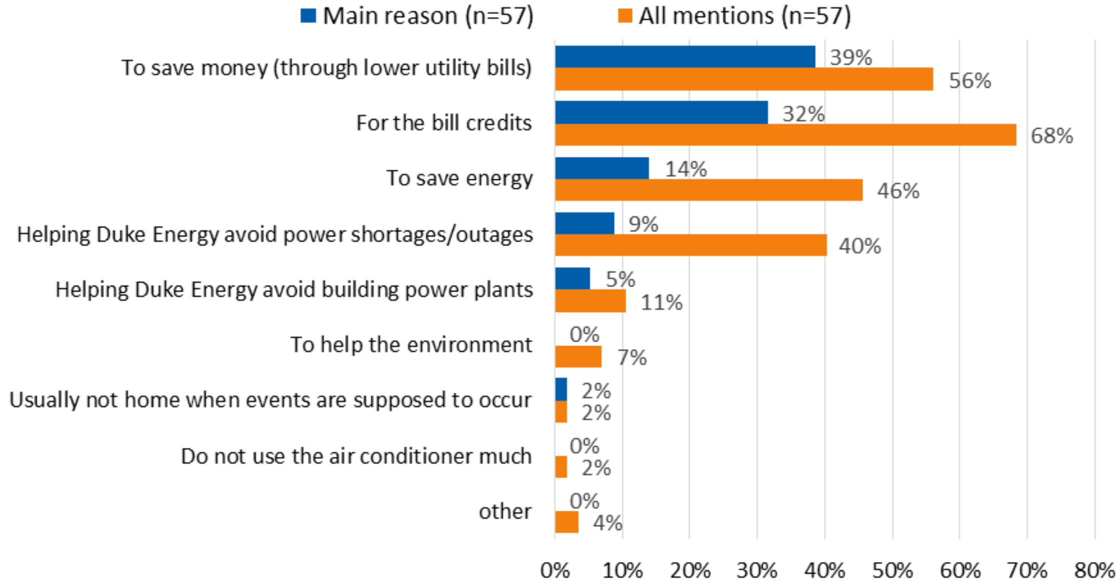


Source: Participant Survey Question B2. How did you hear about the Power Manager Program? Multiple responses permitted (n=52 respondents involved in household decision to join program).

Program Enrollment

Cadmus asked participants who were involved in the decision to join the program for the reasons they joined the program, first giving a single main reason, then any additional reasons (shown in Figure 2). More than one-third (39%; n=57) of respondents mentioned saving money through lower utility bills as their main reason for joining the program, and 32% specifically mentioned the bill credits. Respondents also mentioned saving energy (14%) and avoiding power shortages (9%). When all reasons are combined, saving money (56%) and bill credits (68%) were mentioned by a majority of survey respondents, followed by 46% who mentioned saving energy and 40% who mentioned avoiding power shortages. Eleven percent mentioned building fewer power plants, and only 7% mentioned helping the environment as a reason for their participation.

Figure 2. Reasons for Joining the Power Manager Program



Source: Participant Survey Questions B3 and B4. What was the main reason why you chose to participate in the program? (single response) and Were there any other reasons why you chose to participate in this program? (multiple response permitted; n=57 respondents involved in household decision to join program).

Cadmus asked the four respondents who mentioned helping the environment as a reason for their participation what they meant by this response, and three provided explanations, saying: “less wasted energy reduces my environmental footprint,” “any reduction is a help,” and “we do what we can.”

We asked respondents who were involved in their household’s enrollment to rate their satisfaction with the enrollment process on a 10-point scale, where 10 is very satisfied and 0 is very dissatisfied. Most (78%; n=55) gave a high rating of 9 or 10, and the overall mean rating was 9.3. No respondents rated their satisfaction with enrollment lower than 5.

Understanding of the Program

During the time of program enrollment, Duke Energy provides new participants with information about how the program works. When asked if they recalled this information, 82% (n=56) of respondents confirmed that they did.[6]

For respondents who recalled receiving information about the program, we asked them to rate their satisfaction with the information they received on a 10-point scale, where 10 is very satisfied and 0 is

[6] We did not ask this question of participants who joined the program by moving into a home that already had a device installed by a previous occupant.

very dissatisfied. Sixty-seven percent (n=46) gave a high rating of 9 or 10, and the overall mean rating was 9.1. No respondents rated their satisfaction with the information they received lower than 6.

When asked, 17% of respondents (n=70) indicated that something was unclear to them about how the program works. Four of these 12 respondents merely expressed a general lack of knowledge of "how the program works," while five specifically wanted to know when or how often their devices are activated, and two wanted to know how they were benefiting from the program. The last of these 12 respondents said they did not know when their device had been activated without looking at the light on the switch outside.

Only 6% (n=72) of respondents reported having contacted Duke Energy to find out more about the Power Manager Program. All four of these respondents used the telephone to reach a Duke Energy representative, and all four gave a rating of 10 on a 0-to-10 scale where 10 is very satisfied with the ease of reaching a Duke Energy representative.

Bill Credits

Cadmus asked all survey respondents to estimate the total annual amount of bill credit they receive for participating in Power Manager, and 67% (n=72) did not know. Among the 33% who provided estimates, responses ranged from zero to $100, with an average estimate of $47.79 and median of $34.00. The median response is close to the actual amount of annual bill credit paid to most program participants ($32.00).[7]

Only 40% (n=72) of respondents said they received bill credits during PY2015, while 14% said they did not receive any credit for the program[8], and 46% did not know if they had received any credit. Among those who recalled receiving bill credits, 21% (n=29) could not recall how many times they noticed a credit for Power Manager on their bill, while 45% recalled credits on four bills or "every bill this summer," 28% recalled seeing a credit on two or three bills, and 7% recalled seeing a credit on one bill.

Awareness of Device Activation

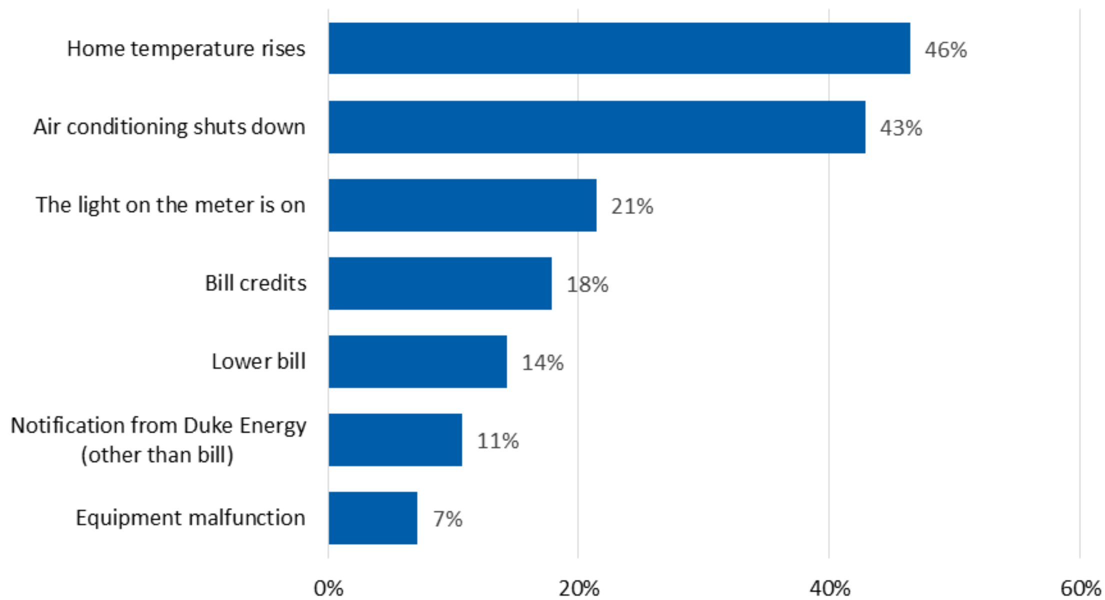
Cadmus asked respondents how many times per year Duke Energy said they would activate the Power Manager device (i.e., call an event). Only 22% (n=72) of respondents were able to answer this question, while the rest did not know. Among those who answered, the number of expected events ranged from zero to four, with one being the most common response (27%; n=11). The mean number of expected events was 1.9 per year and the median was two per year.

7 Power Manager Program participants in North Carolina and South Carolina receive $8 per device per month, which is credited on their bills for the four months of the cooling season, for an annual total credit of $32 per year. Most participants have one Power Manager device.

8 Duke Energy confirmed that the appropriate credits were provided to all accounts associated with the participant addresses on record.

Only 39% (n=71) of surveyed participants were aware of any times their devices have been activated since they joined the program. Figure 3 shows that 46% of these respondents (n=28) reported that they could tell an event occurred because their home temperature rises, 43% mentioned that air conditioning “shuts down” temporarily, while 21% mentioned the light on the meter and 18% noticed credits for events on their bills. Two respondents (7%) said they became aware of an event due to equipment failure, one explaining “my meter went bad” and the other saying “my temperature control mechanism had to be reset.”

Figure 3. Reasons for Awareness of Device Activation



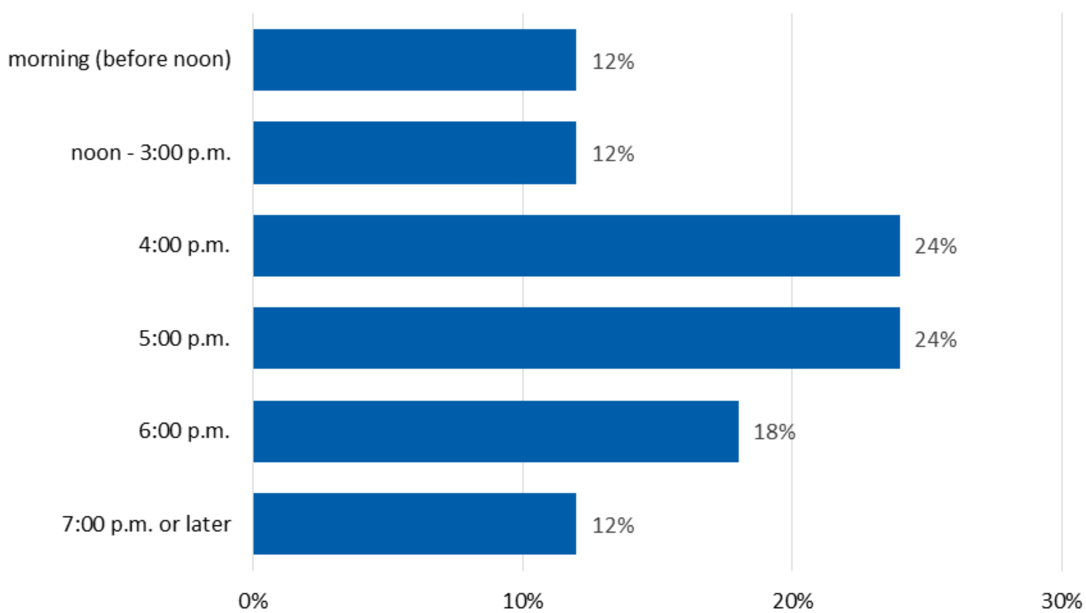
Source: Participant Survey Question D2. What happened that made you believe that the device had been activated? Multiple responses permitted (n=28 who were aware their device was activated).

Cadmus asked respondents who were aware of their devices being activated since joining the program how many times Duke Energy had activated their devices during the summer of 2015. Half of these respondents (54%; n=28) were able to provide a number, with estimates ranging from zero to 10 events, and an average estimate of 3.5 events with median estimate of three events. Duke Energy called six curtailment events that affected the entire population of program participants in North Carolina during PY2015, and five events that affected those in South Carolina (two of these events in both states were full shed test events).

We then asked these same respondents how long Duke Energy is controlling the air conditioning when devices are activated. Most (64%; n=28) were able to answer the question, with responses ranging from one to eight hours. The mean estimate was that events last 2.8 hours and the median estimate was two hours, which closely matches the actual event lengths in PY2015 of 2.5 hours and 3.5 hours.[9]

Cadmus also asked these same respondents who were aware of device activation what time of day events generally end. Most (61%; n=28) were able to answer the question, and their responses ranged from 9:00 a.m. to 7:00 p.m. Figure 4 shows the complete distribution of responses from those who were able to answer. The median response was 5:00 p.m., which corresponds to the PY2015 event end times that occurred in North and South Carolina (5:00 p.m. and 6:00 p.m. for regular events, with the full shed test event ending by 4:30 p.m.)

Figure 4. Respondents' Perception of When Events Typically End



Source: Participant Survey Question E7. On a day when Duke Energy activates your Power Manager device, at what time of day do you think that they usually de-activate the control devices and stop controlling your air conditioner? (n=17 who were aware of device activation).

Response to Device Activation

We asked respondents who were aware that their device has ever been activated if they were at home during any events that occurred during 2015, and 15 said they were. These respondents rated the comfort level in their home before and during the period when they believe their devices were activated, using a scale of 0 to 10 where 0 means very uncomfortable and 10 means very comfortable. The average rating for comfort before the perceived event was 9.5, and the average comfort rating

[9] These times are for regular general population events; for the ffull shed test events in PY2015, Duke Energy cycled air conditioners for 30 minutes or less.

CADMUS

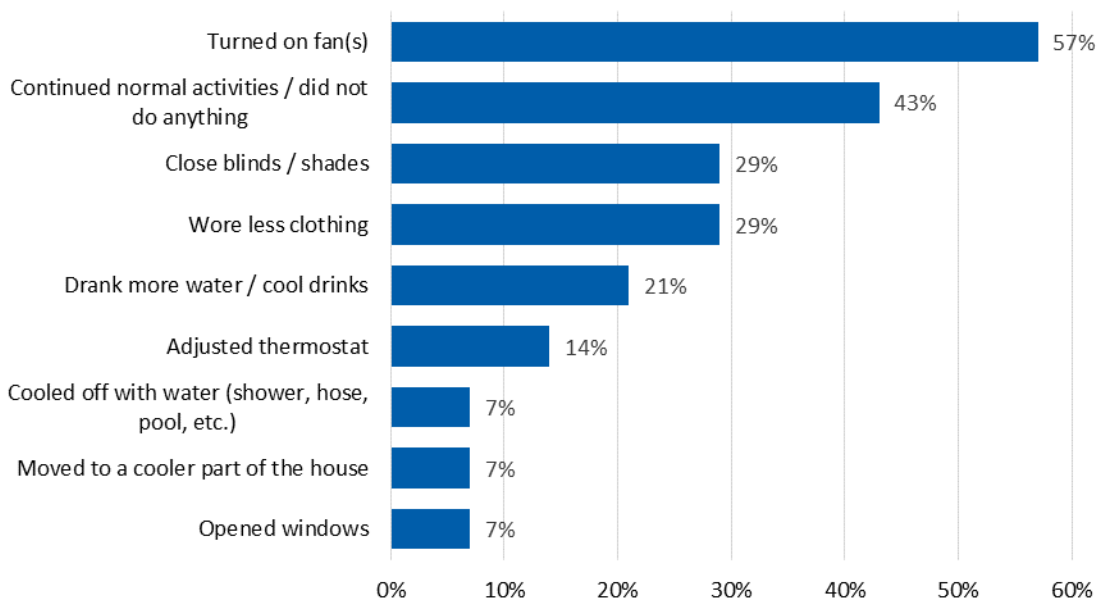
during the event was 5.9. Thirteen of the 15 respondents reported that their comfort declined during the event, with the largest decline being 8 points on the 10-point rating scale.

Cadmus asked the 13 respondents who reported a decline in comfort during a PY2015 event what they thought had caused this decline, and ten cited rising indoor temperatures while four said their air conditioning temporarily shut down (one respondent mentioned both of these responses). We also asked these respondents how long it took for their comfort level to return to normal after they believe their device had been activated; six reported that it took less than one hour, three said it took one to two hours, and three said it took two to four hours (one respondent did not answer this question).

We asked all 16 respondents who believe they were at home during an event in 2015 how many times device activation may have affected their comfort during the summer. Responses ranged from “once” up to “six to eight times,” with a mean of being affected 2.6 times and a median of two times.

Most respondents who believe they were at home during a PY2015 event (57%; n=14 who could recall what they were doing at the time) said they turned on fans in response to device activation, while another 43% did not do anything (Figure 5). Closing blinds and shades and wearing less clothing were mentioned by 29% apiece, and 21% drank cool beverages. Two respondents (14%) made thermostat adjustments during the event time period, but none turned on window or room air conditioners.

Figure 5. Respondent Actions During Perceived Device Activation



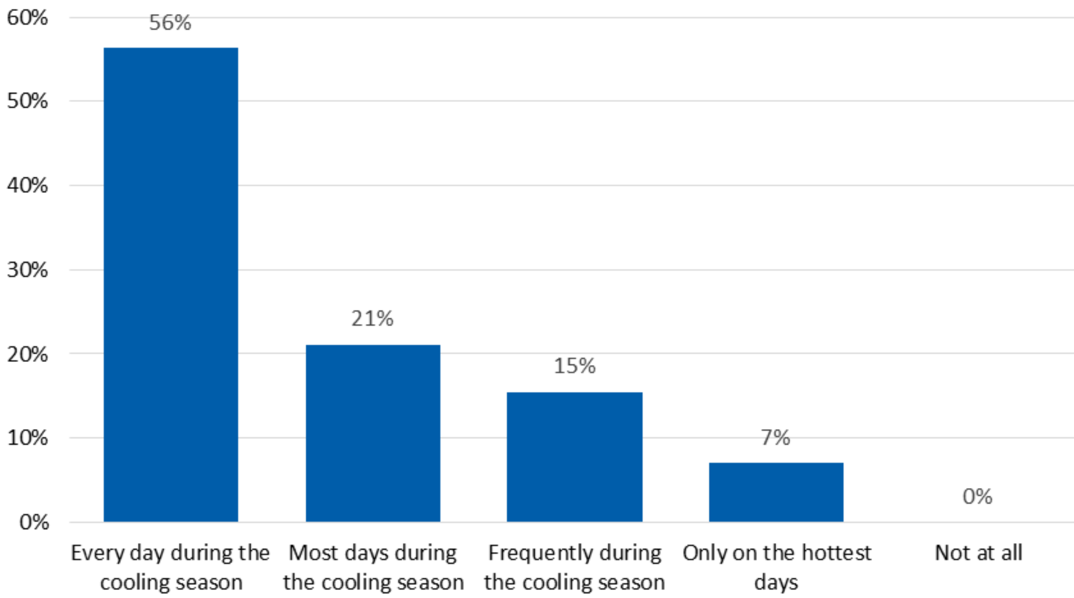
Source: Participant Survey Questions E8 and E10. When Duke Energy activated your Power Manager device, did you or any other members of your household adjust the settings on your thermostat? and Did you or other members of your household do anything else to keep cool? Multiple responses permitted (n=14 who believed they were at home during a PY2015 event).

CADMUS

Air Conditioner Use

Respondents routinely use their air conditioners throughout the cooling season, and are therefore more likely to be affected by curtailment events. Figure 6 shows that 56% (n=71) of respondents use their air conditioning every day during the cooling season, and none said they do not use their air conditioning at all.

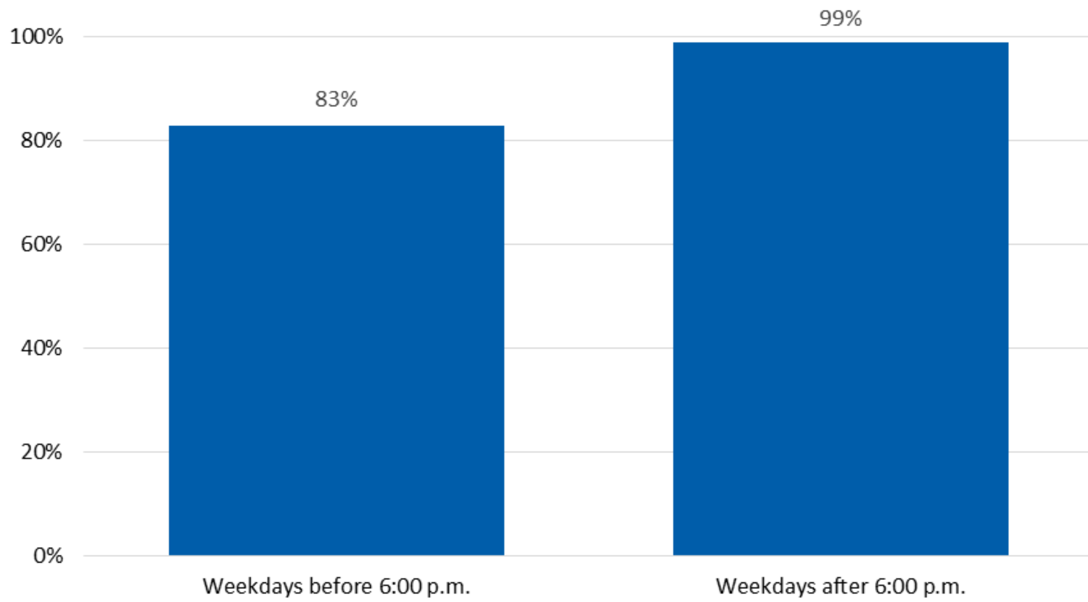
Figure 6. Respondents' Air Conditioner Use



Source: Participant Survey Question G1. How often do you use your central air conditioner? Would you say you use it ...? (n=71).

Figure 7 shows that 83% of surveyed participants (n=72) reported typically using their air conditioning to keep someone comfortable in the home on summer weekday afternoons before 6:00 p.m., and virtually all (99%; n=72) typically use air conditioning in the evenings after 6:00 p.m.

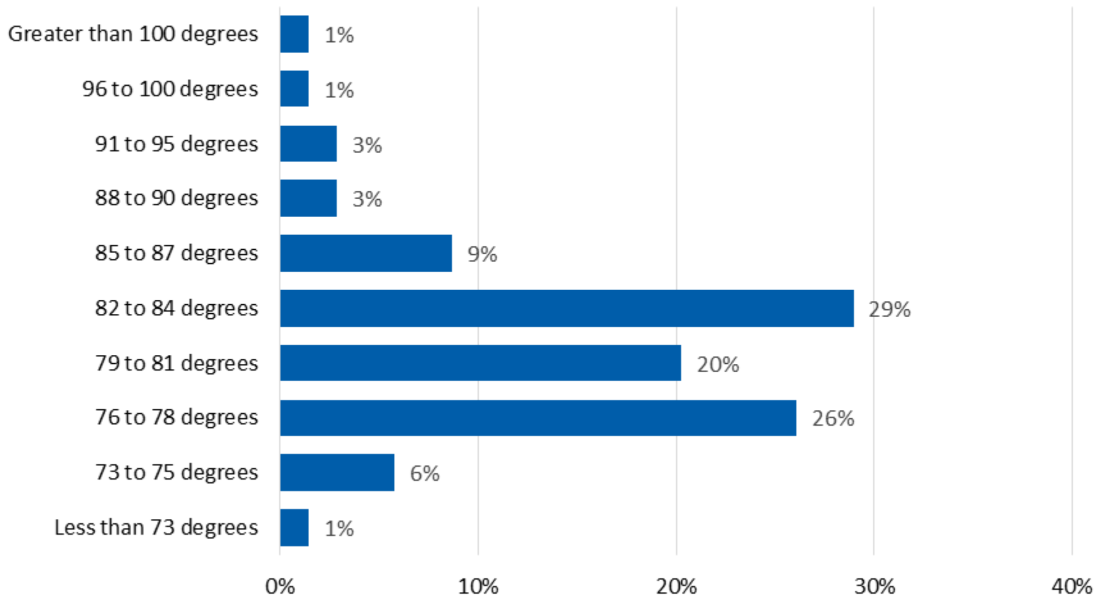
Figure 7. Air Conditioner Use by Time of Day



Source: Participant Survey Questions G6 and G7. Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons before 6:00 p.m.? (n=82) and Is the air conditioner typically used to keep someone at home comfortable during weekday summer afternoons after 6:00 p.m.? (n=72).

Personal comfort levels vary, so Cadmus asked respondents at what outdoor temperature they start to feel uncomfortable in their home, and at what outdoor temperature they tend to turn on their air conditioner. Figure 8 indicates that the median outdoor temperature at which respondents start to become uncomfortable is around 80°F, and 94% (n=69) say they are uncomfortable when the outdoor temperatures reaches 88°F to 90°F.

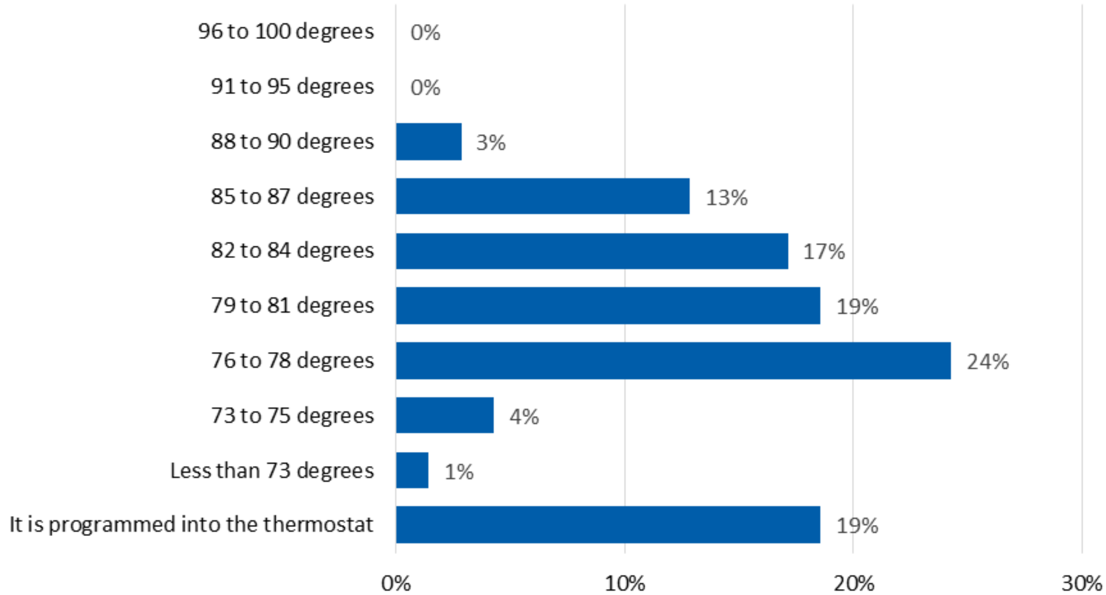
Figure 8. Outdoor Temperature at which Respondents Start to Feel Uncomfortable in their Home



Source: Participant Survey Question G8. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm in your home? (n=69).

Only one respondent (1%; n=70) turns on their air conditioner when the outdoor temperature is less than 73°F, while all respondents tend to turn on their unit before the outdoor temperature has reached 91°F (Figure 9). Some respondents (19%; n=70) did not respond with a specific temperature, but said their air conditioner is programmed to turn itself on when the indoor temperature reaches a set point. Among those who answered with a specific temperature, the median response was around 80°F, matching the median response for the outdoor temperature at which they tend to become uncomfortable in their home.

Figure 9. Outdoor Temperature at which Respondents Turn on Air Conditioners

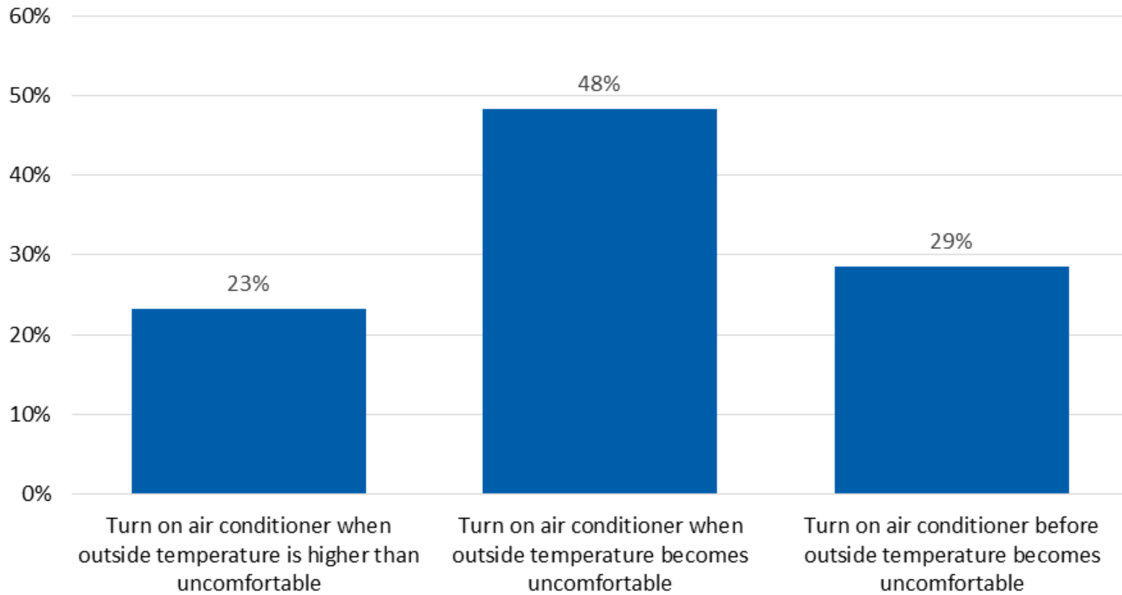


Source: Participant Survey Question G9. At what outside temperature do you tend to turn on the air conditioner? (n=70).

Of respondents who said their thermostat is programmed, rather than providing a temperature at which they turn their unit on, most reported that they program their thermostat based on when the weather gets hot (69%, n=13) rather than based on the season or time of year (23%). One respondent (8%) said they set their thermostat based on their personal “finances.”

Cadmus cross-tabulated the survey responses to questions about the outdoor temperature at which a respondent becomes uncomfortable with the temperature at which they turn on their air conditioning (Figure 10). The largest percentage of respondents tend to turn on their air conditioner at the same temperature they tend to become uncomfortable (48%; n=56), while 23% turn on their air conditioner when the outdoor temperature is higher than the temperature at which they become uncomfortable, and 29% turn on their air conditioning before the temperature becomes uncomfortable.

Figure 10. Uncomfortable Outdoor Temperature Compared to Temperature at which Air Conditioners are Turned on

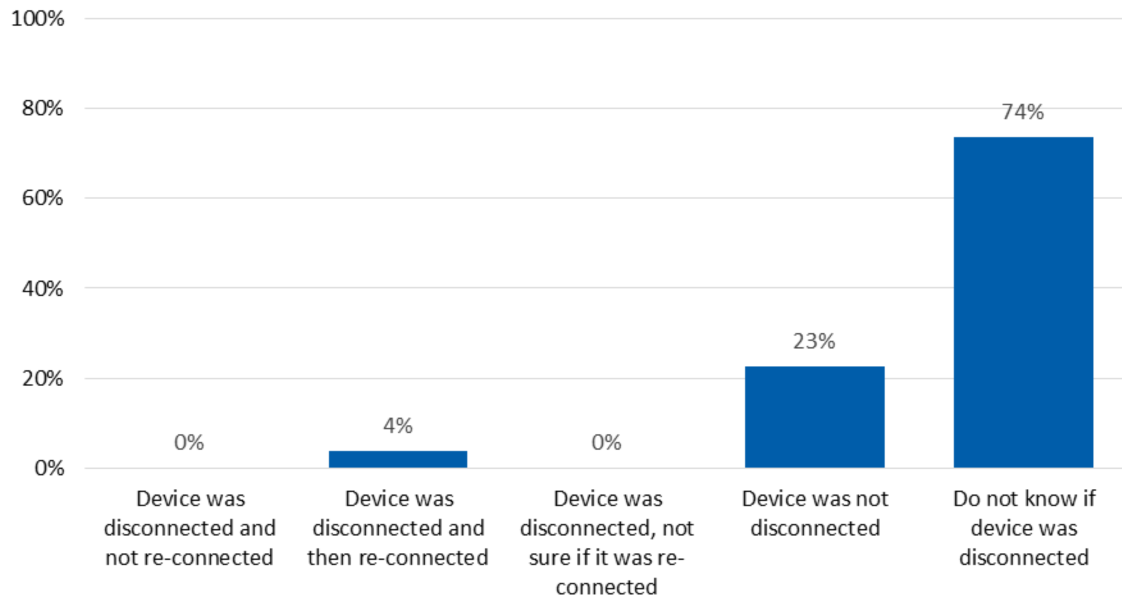


Source: Participant Survey Questions G8 and G9. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm in your home? and At what outside temperature do you tend to turn on the air conditioner? (n=56 who gave a numeric response to both questions).

Air Conditioner Maintenance

Three-quarters of respondents (75%; n=71) reported they have had maintenance performed on their central air conditioning since joining the Power Manager Program. As shown in Figure 11, most of the participants who had their units serviced (74%; n=53) did not know if their Power Manager device was disconnected during maintainence, while 4% reported that their devices were disconnected and 23% reported they were not. None of these survey respondents said their Power Manager device was disconnected during maintenance then not reconnected afterwards.

Figure 11. Disconnecting Power Manager Devices for Air Conditioner Maintenance

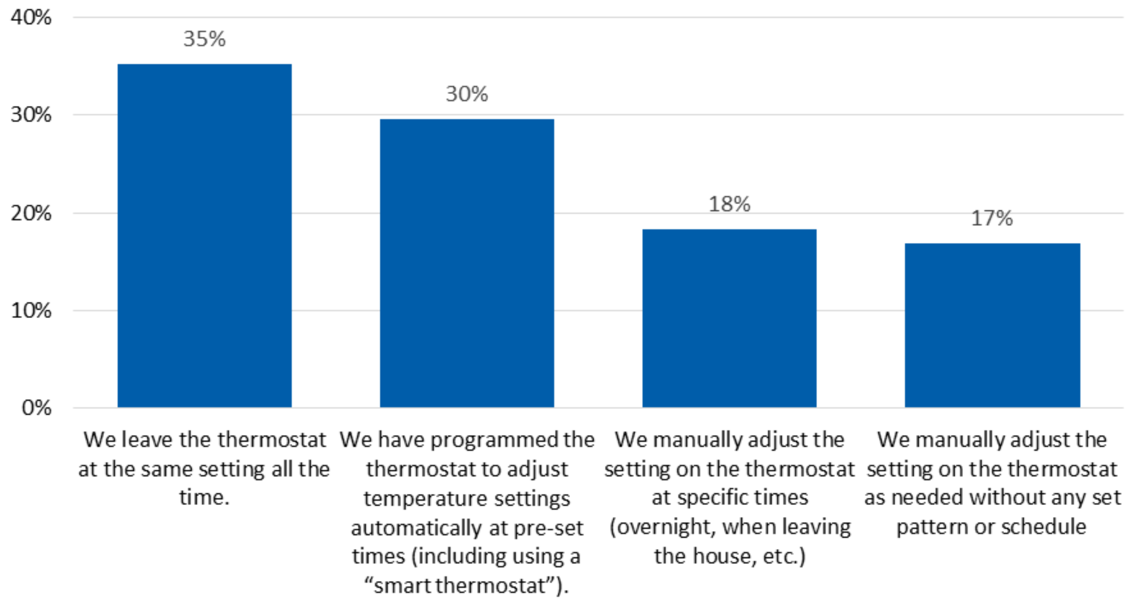


Source: Participant Survey Questions G3 and G4. Was the Power Manager device disconnected while your air conditioner was being serviced? (n=53) and Was the Power Manager device re-connected after completing service on the air conditioner? (n=2 who said yes to G3).

Thermostat Settings and Electric Fan Use

Cadmus asked respondents how they make adjustments to their thermostat, and 35% (n=71) said they leave their thermostat on the same temperature setting all the time (Figure 12). Another 30% programmed their thermostat to make adjustments automatically (including the use of smart thermostats), while the remaining 35% make manual adjustments. Participants who make manual adjustments are about equally split between those who make adjustments at specific times (18%) and those who make adjustments “as needed” without a pattern or schedule (17%).

Figure 12. How Respondents Adjust their Thermostat



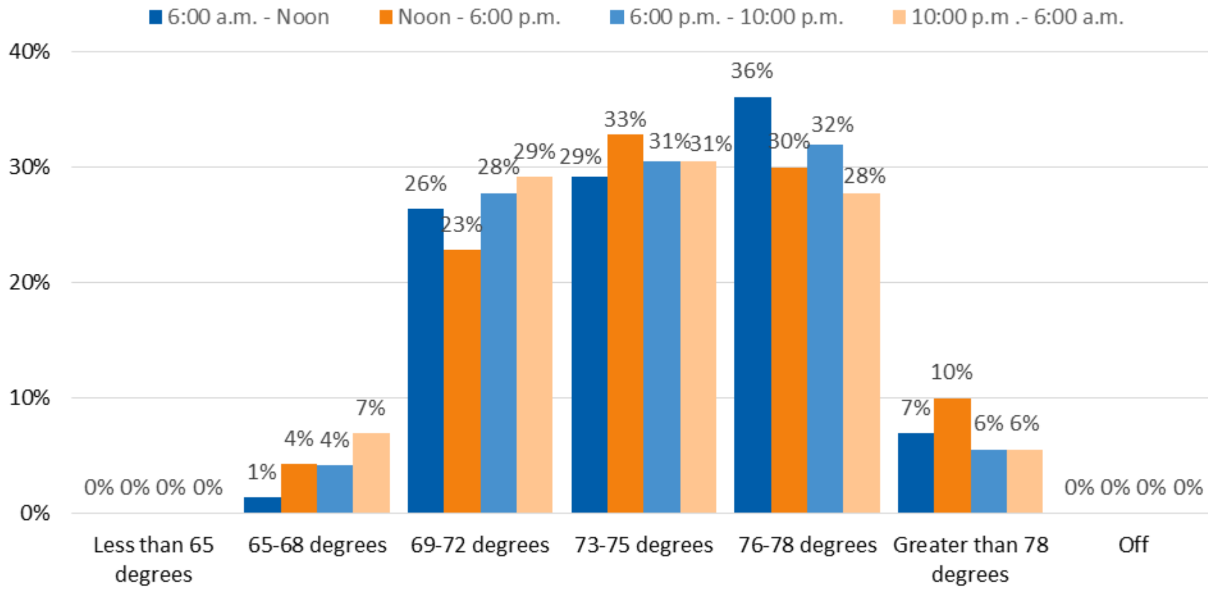
Source: Participant Survey Questions G11. Which of the following best describes how you control the temperature in your home during the summer? (n=71).

Cadmus asked respondents a series of follow-up questions to determine thermostat settings throughout the week. Figure 13 shows that no more than 10% normally have their thermostats set higher than 78°F, and none normally have their thermostats turned off on summer weekdays. For every set of times we asked about during the weekday, a large majority of respondents (86% to 92%) set their thermostat between 69°F and 78°F. Although many respondents keep consistent thermostat settings throughout the week, the overall pattern shows a clear shift toward higher thermostat set points before noon, and lower thermostat set points during the 10:00 p.m. to 6:00 a.m. time period.

Cadmus also asked respondents about their weekend thermostat set points, and the distribution of responses was almost identical to their weekday set points.

CADMUS

Figure 13. Respondent Thermostat Settings by Time of Day on Weekdays

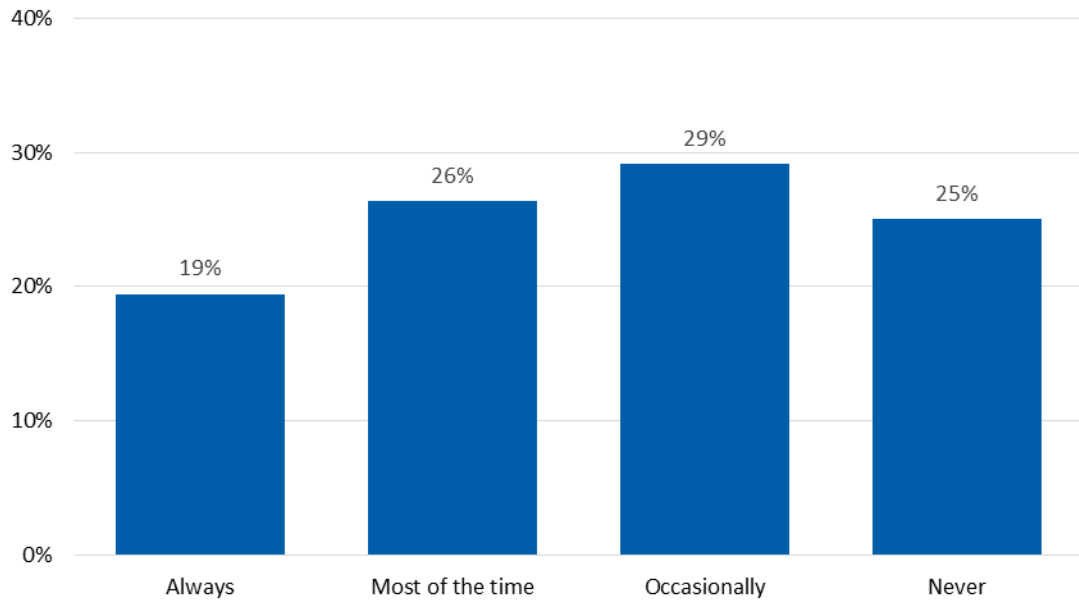


Source: Participant Survey Questions G12-G16 combined (n=70 to 72 per question).

Figure 14 shows that respondents commonly use electric fans on hot weekday afternoons. Nearly half (46%; n=72) reported that they run electric fans at least “most of the time” in the afternoon when the outdoor temperature is in the 90s, including 19% who “always” have fans running at such times.[10] Only 25% said they “never” use electric fans in their home.

[10] Forty-five percent (19% plus 26%) shown in table due to rounding.

Figure 14. Electric Fan Use on High Temperature Weekday Afternoons



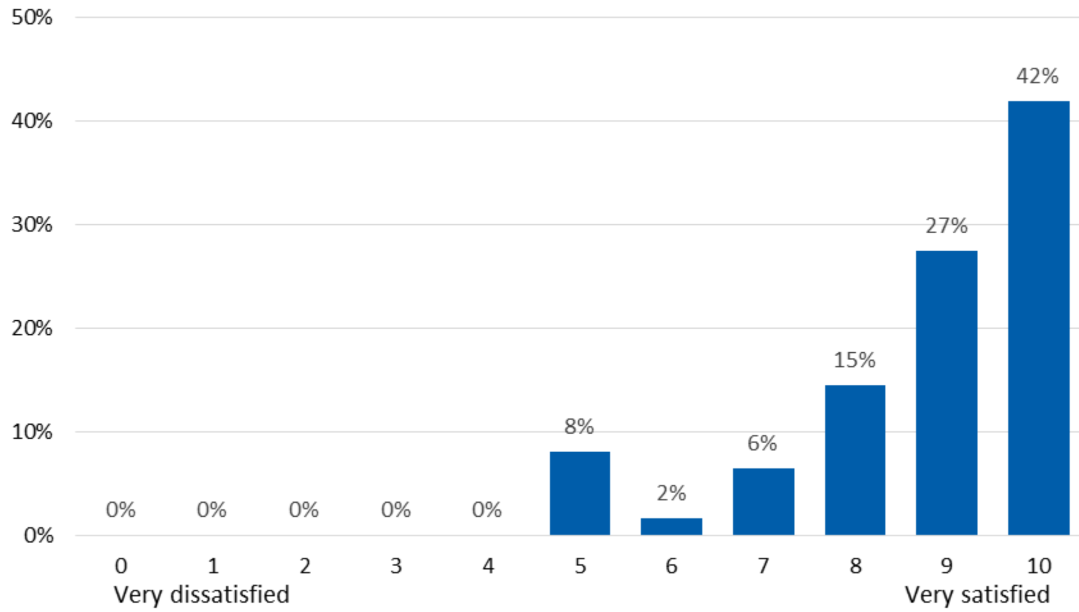
Source: Participant Survey Question G22. On a weekday afternoon when the outdoor temperature is in the 90s, how often do you use electric fans to keep cool in your home? Would you say that you have fans on... (n=72).

Satisfaction with the Program

Cadmus asked respondents to rate their overall satisfaction with the Power Manager Program on a scale from 0 to 10, where 10 indicates being "very satisfied." Figure 15 shows that 42% of respondents (n=62) gave the highest possible rating of 10. The average satisfaction rating was 8.8, while the median rating was 9. No respondents gave the program a satisfaction rating lower than 5.

CADMUS

Figure 15. Power Manager Program Satisfaction Ratings

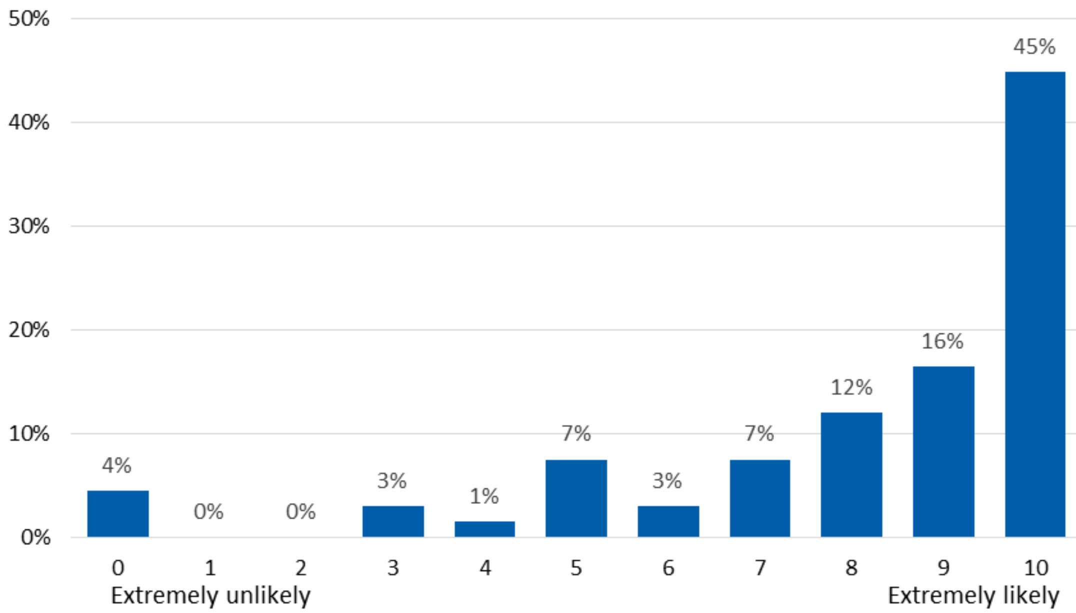


Source: Participant Survey Question F3. How would you rate your overall satisfaction with the Power Manager Program, would you say you were…? (n=62).

Cadmus also analyzed program satisfaction scores for different subgroups of respondents in order to identify contributing factors. Participant survey respondents did not give significantly different satisfaction ratings if they were aware of their devices being activated, aware of receiving bill credits in 2015, or if they reported a decline in comfort ratings during a perceived event. Some factors that were associated with lower satisfaction ratings include moving into a home where a Power Manager device was already installed (7.6; n=10), being unclear about how the program works (8.1; n=7) and not being able to answer the survey question about how much to expect in annual bill credits (8.5; n=38). All of these groups of respondents gave average satisfaction ratings that were at least 0.5 points lower than the average ratings given by other respondents.

Cadmus also asked respondents how likely they would be to recommend the Power Manager Program to others, also using a scale from 0 to 10 where 10 is most likely to recommend. As shown in Figure 16, 45% (n=67) gave the highest possible rating of 10. The average recommendation rating was 8.1, and the median rating was 9.

Figure 16. Likelihood of Recommending Power Manager

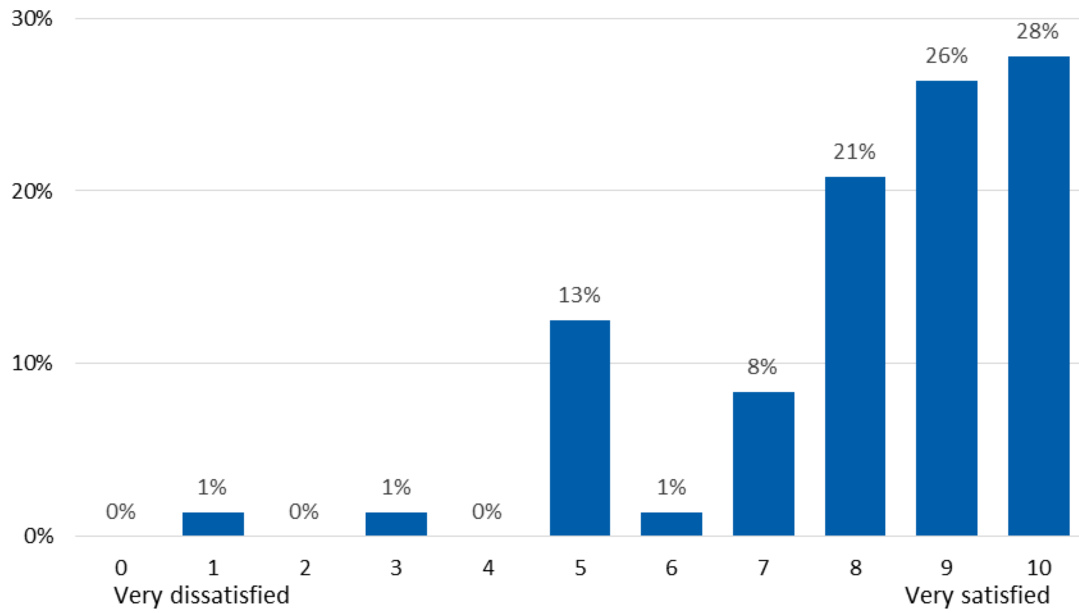


Source: Participant Survey Question F5. Using a scale of 0 to 10, where 0 means "extremely unlikely and 10 means "extremely likely," how likely is it that you would recommend this program to a friend, neighbor, or co-worker? (n=67).

Satisfaction with Duke Energy

Cadmus asked respondents to rate their overall satisfaction with Duke Energy on a scale from 0 to 10, where 10 means "very satisfied." As shown in Figure 17, 28% of respondents (n=72) gave Duke Energy the highest possible rating of 10. The average satisfaction rating was 8.2, while the median rating was 9.

Figure 17. Satisfaction with Duke Energy Overall



Source: Participant Survey Question I3. How would you rate your overall satisfaction with Duke Energy, would you say you were…? (n=72).

Two respondents rated their satisfaction with Duke Energy as 4 or less on a 10-point scale, and we asked them to explain the reasons for their low ratings. One respondent who gave Duke Energy a rating of 3 had issues with automatic billing, customer service, and pollution. The other respondent gave a rating of 1 and was dissatisfied with high energy prices.

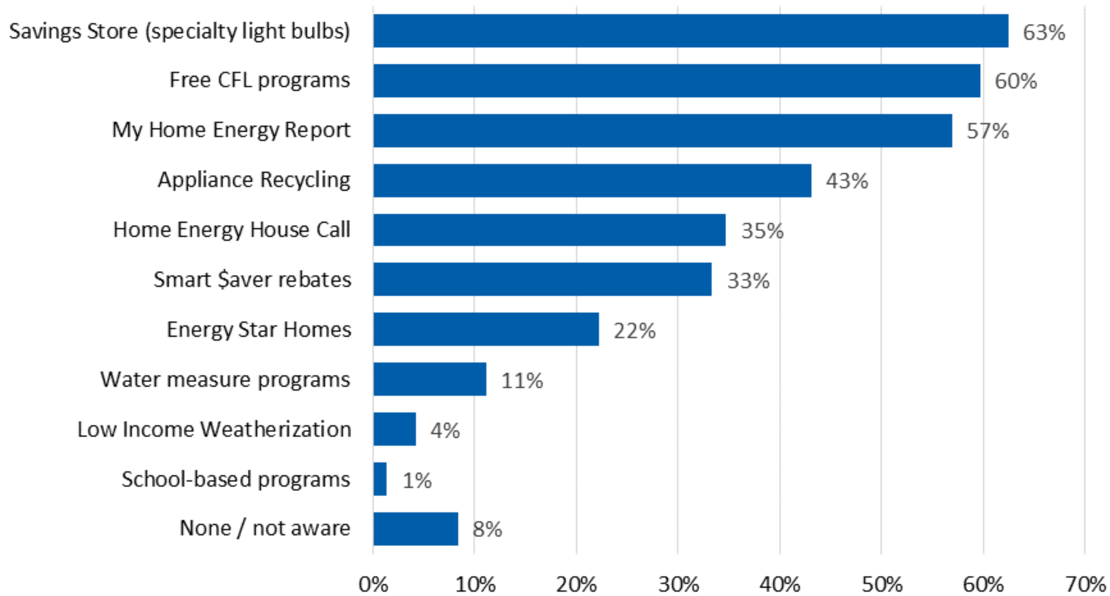
Cadmus also analyzed utility satisfaction scores for different subgroups of respondents in order to identify contributing factors. Participant survey respondents did not give significantly different satisfaction ratings if they were aware of their devices being activated, aware of receiving bill credits in 2015, or if they reported a decline in comfort ratings during a perceived event. Some factors that were associated with lower satisfaction ratings include being unclear about how the program works (7.3; n=12) and not being able to answer the survey question about how much to expect in annual bill credits (7.9; n=48). Both of these groups of respondents gave average satisfaction ratings that were about one point lower than the average ratings given by other respondents.

Awareness and Interest in Other Utility Programs

Cadmus asked respondents if they were aware of any other Duke Energy programs to help them save energy. Figure 18 shows that the Savings Store (specialty light bulb program), free CFL programs, and My Home Energy Report (MyHER) are the most well-known Duke Energy programs, each mentioned by between 57% and 63% of surveyed Power Manager participants (n=72). Only 8% of respondents were not aware of any other Duke Energy programs.

CADMUS

Figure 18. Awareness of Other Duke Energy Programs



Source: Participant Survey Question H1. What, if any, Duke Energy programs or services have you heard of that help customers save energy? Multiple response permitted (n=72).

Cadmus asked respondents if they would be interested in participating in programs to cycle other types of equipment, such as electric water heaters. A majority of 54% (n=72) expressed interest in such a program, while 22% said they would not participate in such a program, and 24% said they were not sure.

Participant Demographics and Household Characteristics

Cadmus asked survey respondents a number of questions about their household, including questions about demographics and cooling systems. These responses are summarized in Appendix B. Participant Household Characteristics and Demographics.

Event/Non-Event Surveys

Cadmus surveyed current Power Manager participants during the cooling season in order to better gauge their awareness of Power Manager events and their perception of discomfort caused by Power Manager curtailment events.

This section outlines the results of Cadmus' analysis of the difference in responses between participants who were surveyed immediately following curtailment events, and those who were surveyed immediately following equivalent high temperature days without events. This is a quasi-experimental study design, where the event surveys constitute the experimental group (those experiencing an event) and the non-event surveys constitute a control group (those not experiencing at event).

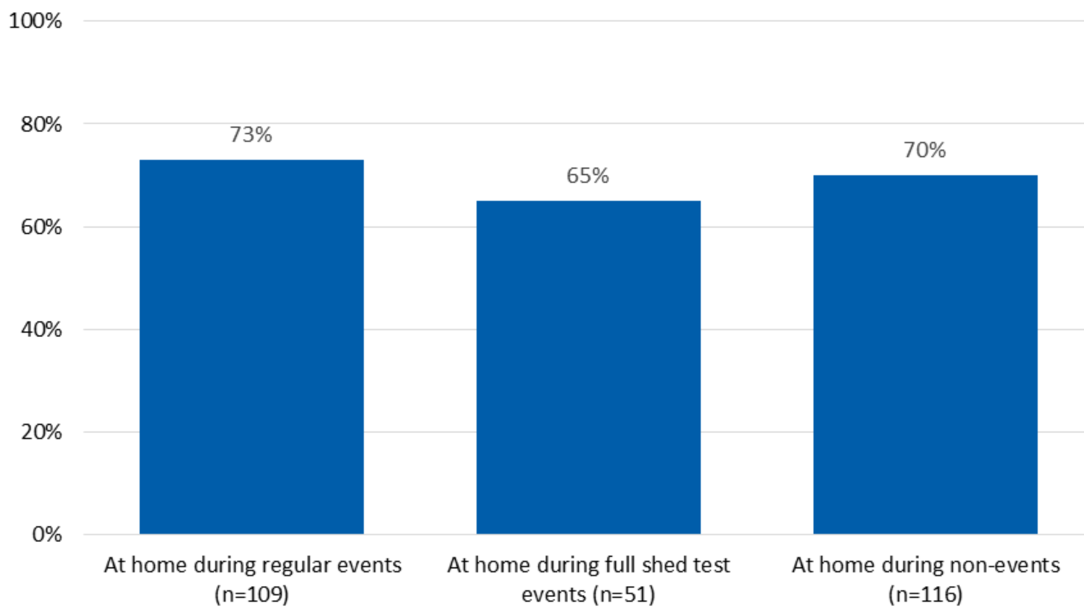
Although the study design controls for the presence of an event, there are many factors which cannot be controlled, such as the range and distribution of temperatures over the summer, other weather events (such as high humidity and storms), and extraneous events that could affect program operations (such as power outages or transmission issues). The opportunities to conduct these surveys were limited by program activities and the weather, thus the results of surveys during a particular summer may not be predictive of other years under different conditions. The number of Power Manager curtailment events and high temperature days in North Carolina and South Carolina during the summer of 2015 was similar to the summer of 2014 (four regular events in each state), less than in 2013 (five to seven regular events per state), and slightly more than in the summer of 2012 (three regular events per state) .

Except where noted, Cadmus excluded “don’t know” and “refused” responses, which is reflected in accompanying n-values.

Home Occupancy During Events

Cadmus asked respondents if there was anybody at home during the actual time period when an event occurred, and during the equivalent hours of 2:00 p.m. to 5:00 p.m. for non-event surveys. Most surveyed households (70%; n=276 combined event and non-event) had someone at home during the afternoon in question (Figure 19).

Figure 19. Home Occupancy During Event Time Period

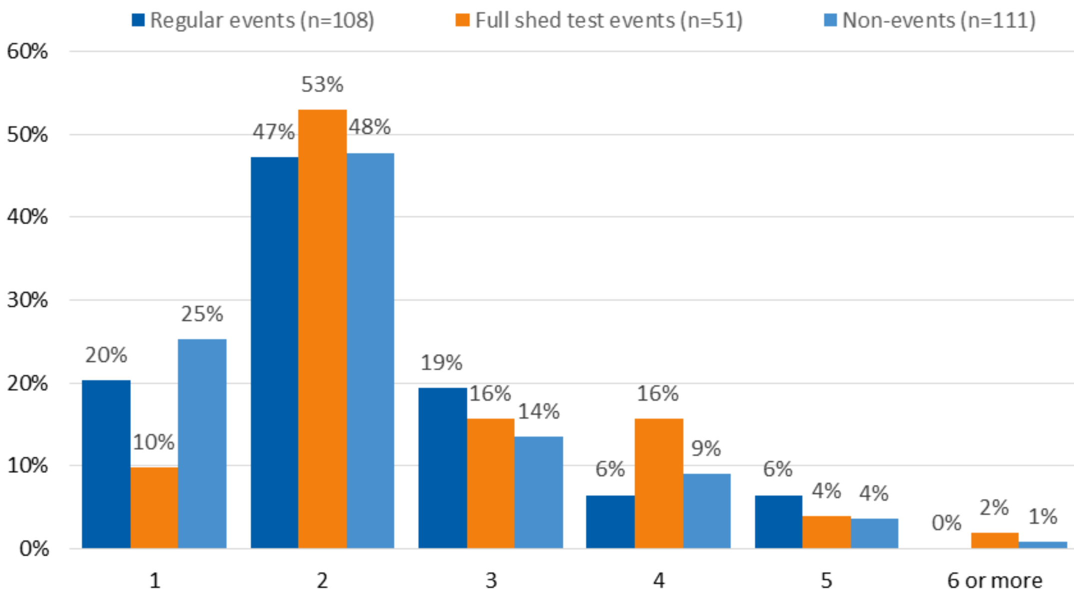


Source: Event/Non-Event Survey Question B5. Were you or any members of your household home at that time?

Cadmus asked respondents how many people live in their home. Figure 20 shows that respondents surveyed for events and non-events had similar numbers of people living in their home. The overall average number of residents per household for event and non-event surveys was 2.3. In the participant survey, the average number of residents per surveyed household was also 2.3 (see Appendix B. Participant Household Characteristics and Demographics).

CADMUS

Figure 20. Number of People Living in Respondent Households



Source: Event/Non-Event Survey Question G1. Including you, how many people live in this home?

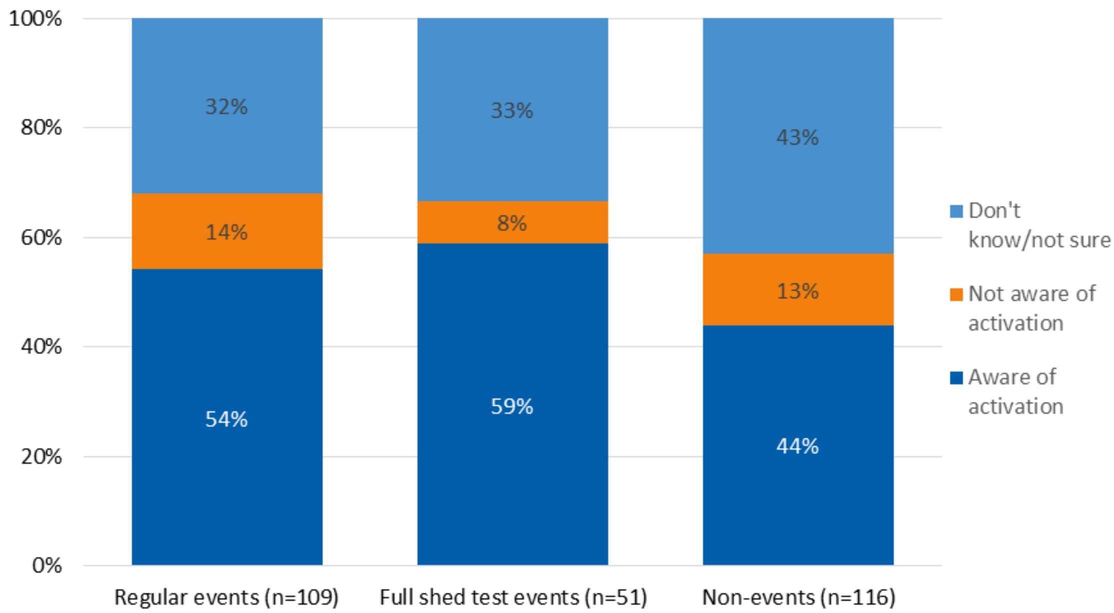
Awareness of Device Activation

In order to gauge awareness of the Power Manager device activation, Cadmus first asked event and non-event respondents if they were aware of any device activations occurring since they had joined the program. Most event respondents said they were aware that their devices have been activated (56%, n=160), while this was true for only 44% (n=116) of the non-event respondents (Figure 21). This difference between event and non-event respondents is statistically significant.[11]

[11] This difference is statistically significant at $p<0.05$ using a binomial t-test.

CADMUS

Figure 21. General Awareness of Device Activation

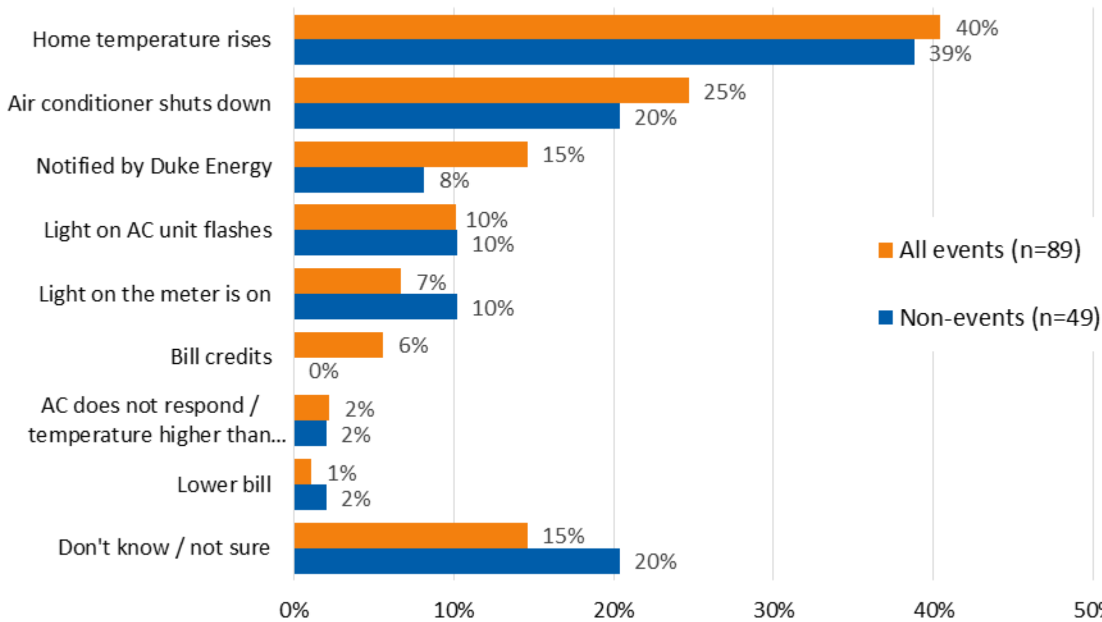


Source: Event Survey/Non-Event Question B1. Has Duke Energy activated the Power Manager device since you joined the program?

Cadmus asked all respondents how they know when their Power Manager device has been activated. Figure 22 shows the distribution of reasons given by respondents who were aware that their devices had been activated. Most event and non-event respondents were able to give reasons why they were aware of device activation (83%; n=138 combined). The most frequently mentioned reasons for both groups are a rising home temperature and air conditioning shutting down, followed by notifications from Duke Energy (including email, mail, and directly from Duke Energy employees), and noticing the activation light on the device or meter.

CADMUS

Figure 22. Reasons for Awareness of Device Activation



Source: Event/Non-Event Survey Question B2. How can you tell when the device has been activated?

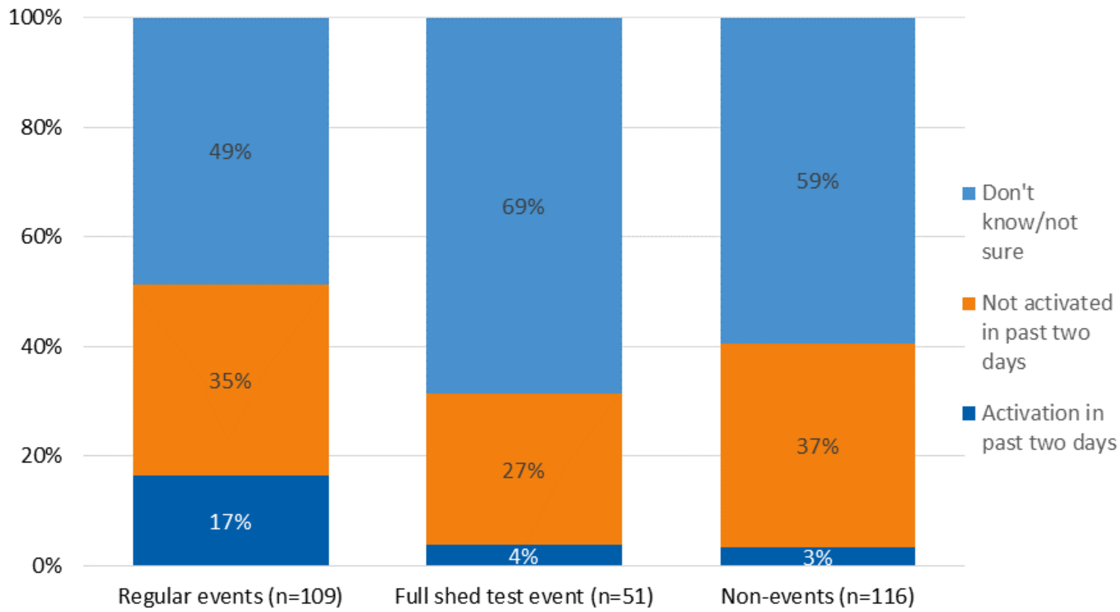
Most respondents who were not aware that their devices have been activated were unable to state how they would know if the devices had been activated (69%; n=136 combined event and non-event group respondents who were not aware of their devices having been activated since joining the program). The most common reasons given by respondents who were able to answer this question is that the air conditioner shuts down (21%) and home temperature rises (9%).

Cadmus asked respondents if Duke Energy had activated their Power Manager device in the past two days (i.e., the day of the survey call or the day before). For event respondents, there had been device activation (a curtailment event) during this time period, while for non-event respondents there had been no device activation in the past two days. Only 17% (n=109) of regular event and 4% (n=51) of full shed test event respondents answered correctly that their device had been activated, compared to 3% (n=116) of non-event respondents who incorrectly believed their device had been activated (Figure 23). Regular event respondents were significantly more likely than full shed test event respondents or non-event respondents to be aware of device activation.[12] However, 49% to 69% of the respondents in each survey group did not know if their devices had been activated or not.

[12] These differences are statistically significant at $p<0.05$ or better using binomial t-tests.

CADMUS

Figure 23. Awareness of Recent Device Activation



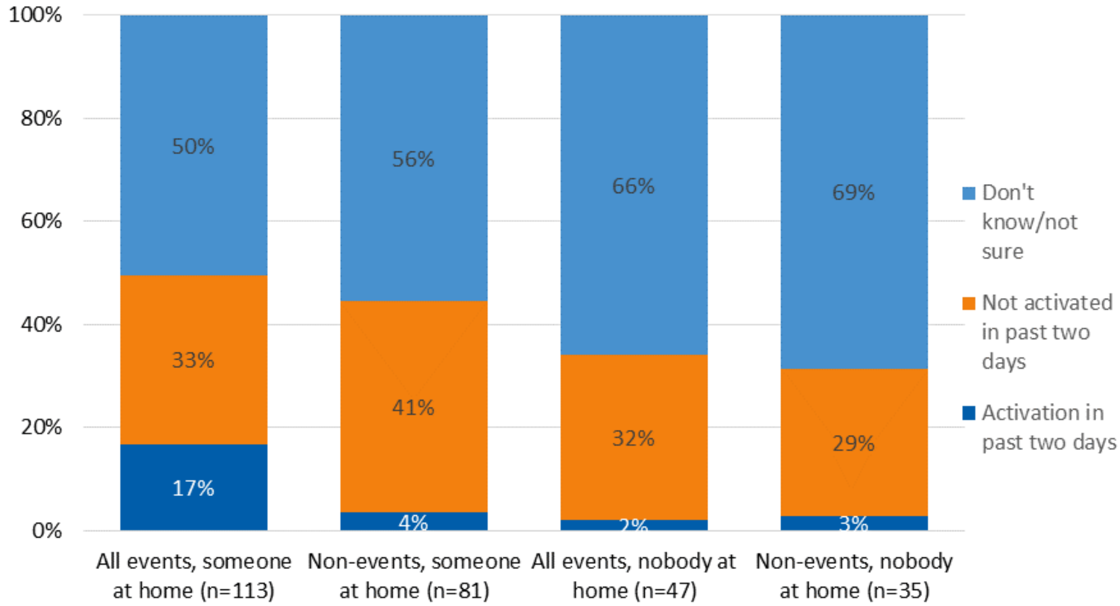
Source: Event/Non-Event Survey Question B3. Has your device been activated in the last two days? [IF NEEDED: Was your device activated yesterday or today?]

Figure 24 shows that respondents in households where people were home during the event period were significantly more likely to be aware of an event (17%; n=113) compared to event respondents who were not at home, as well as compared to non-event respondents (whether at home or not).[13]

[13] The difference between event group respondents who were home during the event period and the other three groups shown in Figure 24 are all statistically significant at $p<0.05$ using binomial t-tests.

CADMUS

Figure 24. Awareness of Recent Device Activation for Occupied Homes and Unoccupied Homes



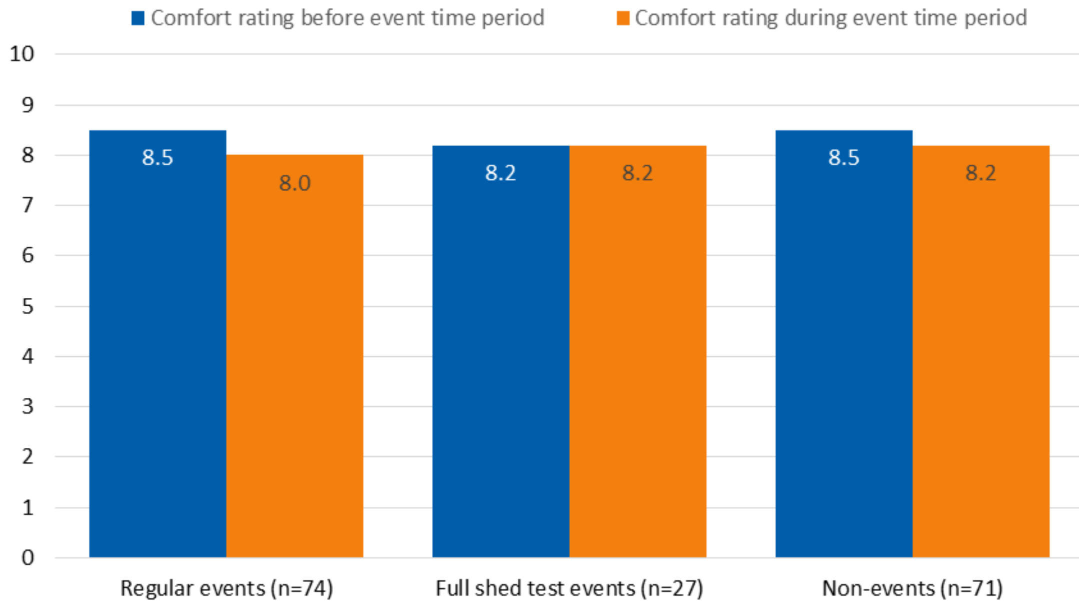
Source: Event/Non-Event Survey Question B3. Has your device been activated in the last two days? [IF NEEDED: Was your device activated yesterday or today?]

Response to Device Activation

Cadmus asked respondents who were at home during the event time period (when events would occur, whether they did or not) to rate the comfort level of their home before and during the time period on a scale from 0 to 10, where 0 means very uncomfortable and 10 means very comfortable Cadmus defined the before time period using the actual start time of a curtailment event for event respondents, or 2:00 p.m. for non-event respondents. We defined the event time period as the actual start and end times of an event for event respondents, or from 2:00 p.m. to 5:00 p.m. for the non-event respondents.. Figure 25 shows that there was a small, statistically significant decline in comfort ratings from before the event time period to during the event time period for the regular event (from 8.5 to 8.0) and non-event (8.5 to 8.2) respondents.[14] However, when comparing event respondents to non-event respondents, the ratings are not significantly different.

[14] These differences are statistically significant at $p<0.05$ using paired-samples t-tests.

Figure 25. Comfort Ratings Before and During Event Time Period

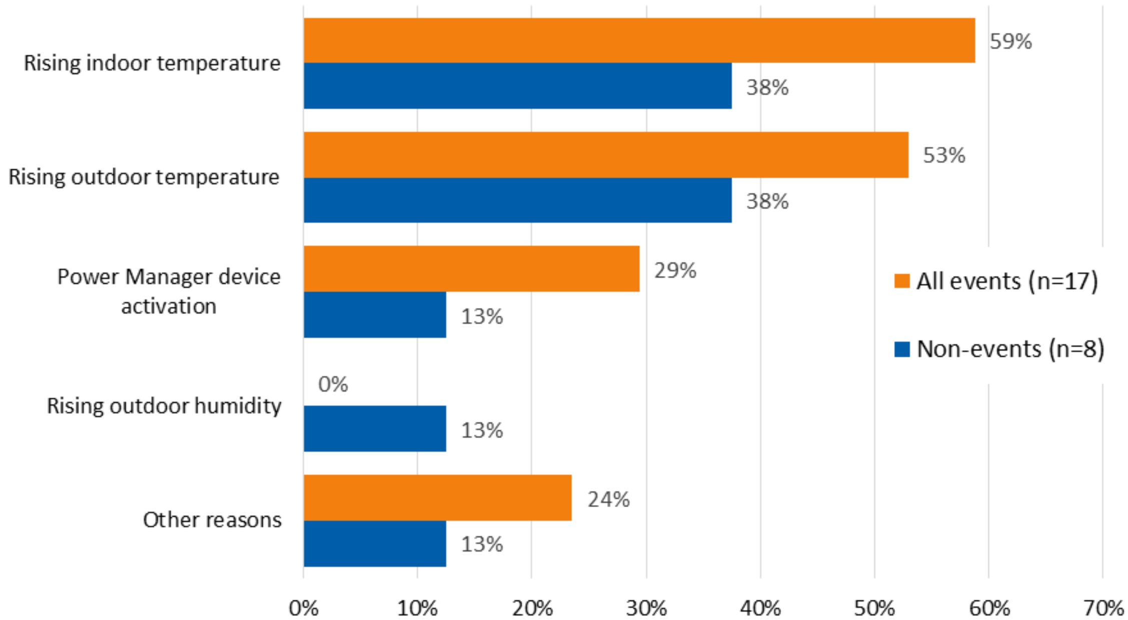


Source: Event/Non-Event Survey Questions C1 and C2. Using a scale of 0 to 10 where 0 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort before [START TIME] on [DATE]? and Using the same scale of 0 to 10 where 0 means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort between [START TIME] and [END TIME] on [DATE]?

Slightly more event respondents (17%; n=101) than non-event respondents (11%; n=71) reported a decline in comfort ratings during the event time period, though this difference is not statistically significant. Respondents who reported a decline in comfort provided an overall average comfort rating of 8.4 before the event time period and 5.4 during the event time period (n=25 combined).

Cadmus asked the 25 respondents who reported a decline in comfort during the event period what had caused their decline in comfort. Figure 26 shows that rising indoor and outdoor temperatures were the most frequent responses for event and non-event respondents, and a minority associated the activation of their Power Manager device with their decline in comfort.

Figure 26. Reasons Given for Decline in Comfort



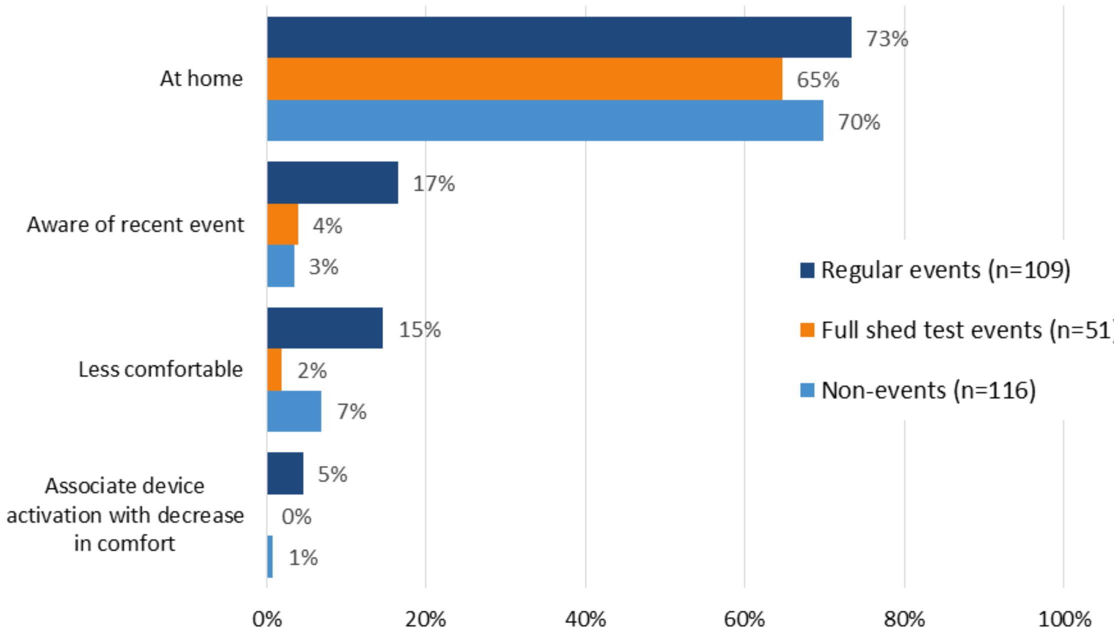
Source: Event/Non-Event Survey Questions C3. What do you feel caused your decrease in comfort? (Multiple response permitted).

Summary of Awareness and Response to Events

Figure 27 summarizes respondents' awareness and response to events using the total survey sample as a base. There were no significant differences between event and non-event respondents in terms of someone being at home during the event time period. Regular event respondents were significantly more likely to be aware of events (17%; n=109), report a decline in comfort during events (15%), and associate Power Manager device activation with their decline in comfort (5%) compared to both full shed test event and non-event respondents.[15] There were no significant differences between full shed test event and non-event respondents.

[15] These differences are all statistically significant at p<0.10 or better using a binomial t-test.

Figure 27. Summary of Awareness and Response to Events



Source: Event/Non-Event Survey Questions B5, B3, C1, C2, and C3. (See Figure 19, Figure 23, Figure 25, and Figure 26 for question wording).

Figure 28 shows a comparison of PY2015 event/non-event survey results to previous evaluations of the Power Manager Program in North and South Carolina.[16]

There are some notable statistically significant differences in these key metrics between the PY2015 surveys and previous years, although the overall results are more similar than different between years.

- Between 62% and 71% of survey respondents said they were at home during the event time period for both survey groups in every year, except for event respondents in PY2013 (48%; n=228), who were significantly less likely to be at home during the event time period.[17]
- For the last three program years, awareness of recent device activation has ranged from 8% to 13%, with no significant differences between years; however, in PY2012, significantly more event respondents (20%; n=147) noticed events. However, non-event respondents in PY2012

[16] TecMarket Works. *Process Evaluation of the 2012 Power Manager Program in the Carolinas System*. March 21, 2013.; TecMarket Works. *Process Evaluation of the 2013 Power Manager Program in the Carolinas System*. March 18, 2014. TecMarket Works. *Process Evaluation of the 2014 Power Manager Proram in the Carolinas System*. February 17, 2015.

[17] This difference between the PY2013 event group and all all other years' event groups is statistically significant at p<0.05 using a binomial t-test.

were also significantly more likely to (falsely) be aware of events on high temperature days compared to the most recent three years' event respondents.[18]

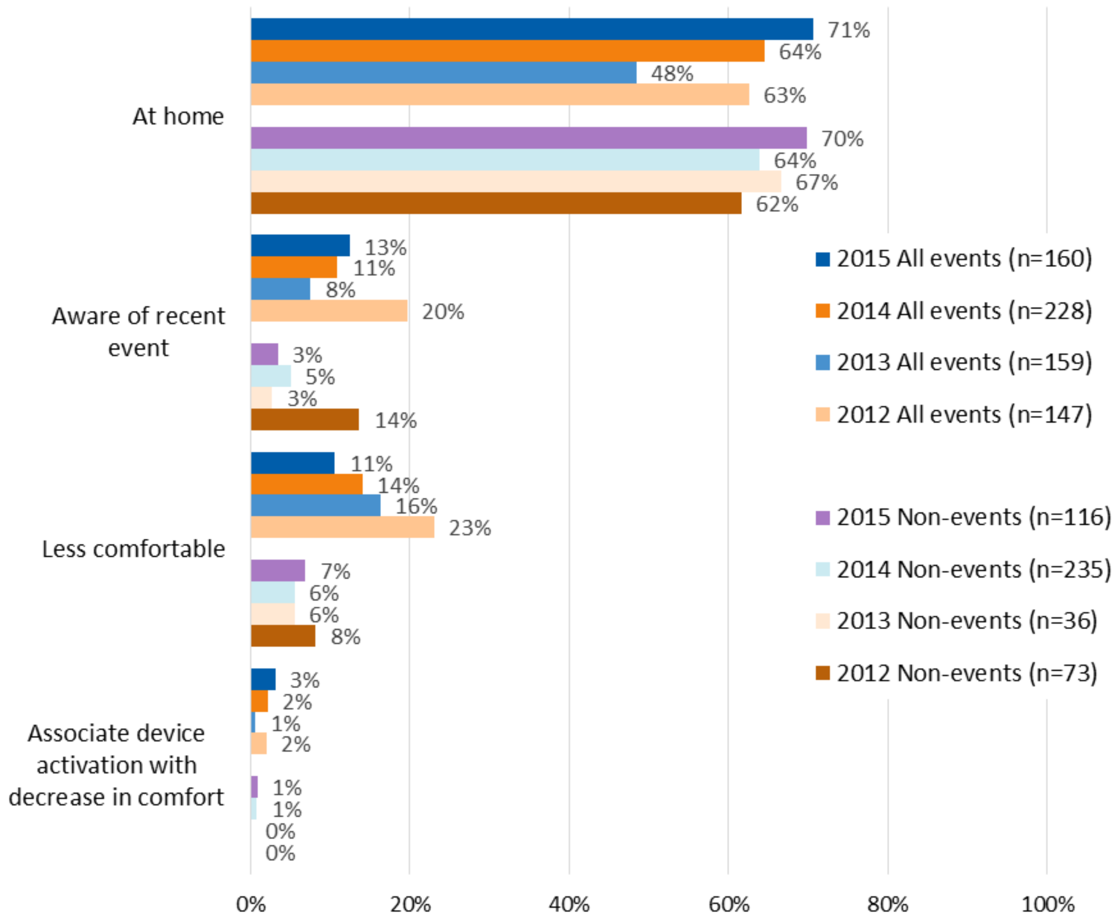
- Between 6% and 8% of non-event respondents over the years surveyed have said they experienced a decline in comfort in their home on a high temperature day without an event. Every year, event respondents have reported a higher rate of comfort decline, though the difference from non-event respondents is often not significant. There appears to be a downward trend in the rate of event respondents reporting a decline in comfort (declining every year from 23% in PY2012 to 11% in PY2015); however, the only statistically significant difference between years' of event respondents is comparing PY2015 to PY2012.[19]
- In the PY2015 survey, 3% (n=160) of event respondents associated a Power Manager device activation with their decline in comfort, which is not significantly different from the 1% to 2% who associated device activation with discomfort in previous event surveys.

[18] These differences between PY2012 and PY2013-PY2015 survey results are statistically significant at p<0.10 or better using binomial t-tests.

[19] This difference between PY2012 and PY2015 event survey results is statistically significant at p<0.05 using a binomial t-test.

CADMUS

Figure 28. Summary of Awareness and Response to Events Compared to Previous Evaluations

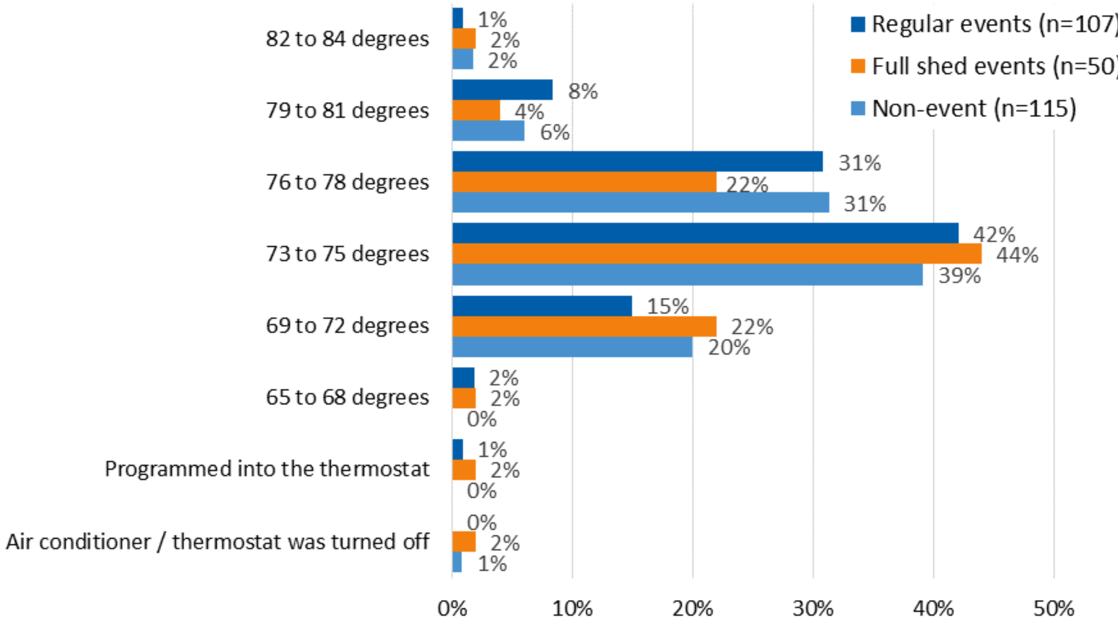


Source: PY2015 Event/Non-Event Survey Questions B5, B3, C1, C2, and C3. (See Figure 19, Figure 23, Figure 25, and Figure 26 for question wording). PY2012 and PY2013 event group survey questions are included in the TecMarket Works reports cited above.

Behavior During Events

Cadmus asked respondents about their thermostat settings during the event time period, or between 2:00 p.m. and 5:00 p.m. on the date of high temperature without a curtailment event. Figure 29 shows that 88% (n=107 regular events, n=50 full shed test event) of event respondents and 90% (n=115) of non-event respondents had their thermostats set between 69°F and 78°F.

Figure 29. Thermostat Settings During Event Time Period



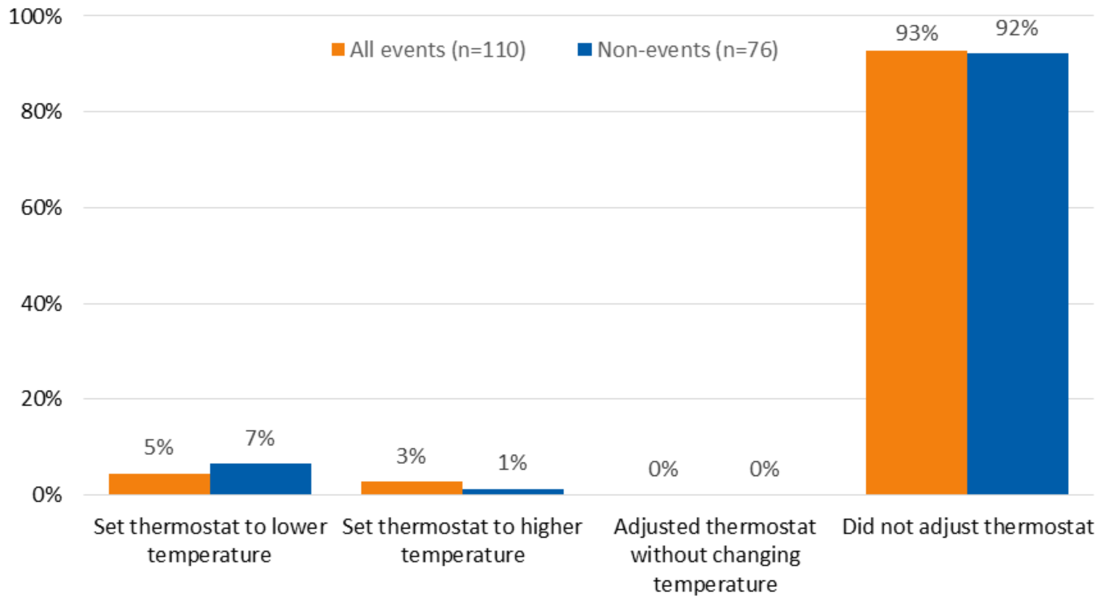
Source: Event/Non-Event Survey Questions B4. At what temperature was your thermostat set to between [START TIME] and [END TIME] on [DATE]?

Cadmus also asked event respondents if they made any adjustments to their thermostat during the event time period, and about their use of electric fans during this time period. We asked non-event respondents about the equivalent time period of 2:00 p.m. to 5:00 p.m. on the date of high temperature.

Figure 30 shows that nine in ten respondents did not adjust their thermostat during the time period. Event (5%; n=110) and non-event (7%; n=76) respondents were equally likely to set their thermostat to a lower temperature.

CADMUS

Figure 30. Thermostat Adjustments During Event Time Period



Source: Event/Non-Event Survey Questions C4. Between [START TIME] and [END TIME] on [DATE], did you or any other members of your household adjust the settings on your thermostat?

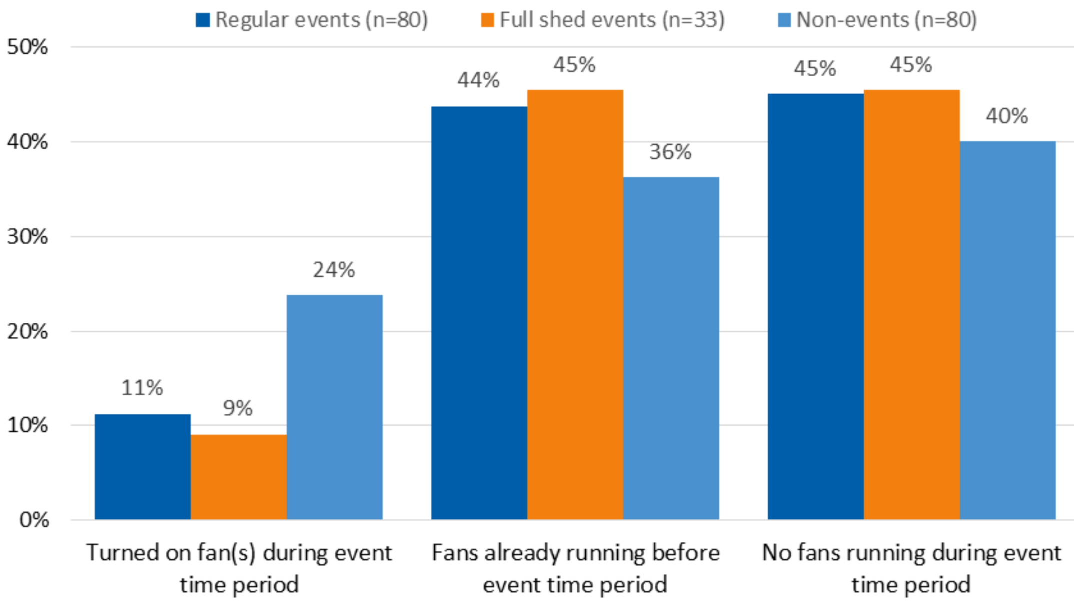
For event respondents who made thermostat adjustments, the average setting change was 2°F lower and the maximum change was 7°F lower. For non-event respondents, the average setting change was 2°F lower, and the maximum change was 4°F lower.

Most respondents (55%; n=113 for event and 60%; n=80 for non-event) had electric fans running in their home during the event time period, though most of these fans were already running before the event time period (Figure 31). Although the overall rate of using fans during the event time period was not significantly different between survey groups, non-event respondents were significantly more likely to have turned fans on during the event time period (24%; n=80) compared to event respondents (11%; n=113).[20]

[20] This difference is statistically significant at $p<0.05$ using a binomial t-test.

CADMUS

Figure 31. Electric Fan Use During Event Time Period

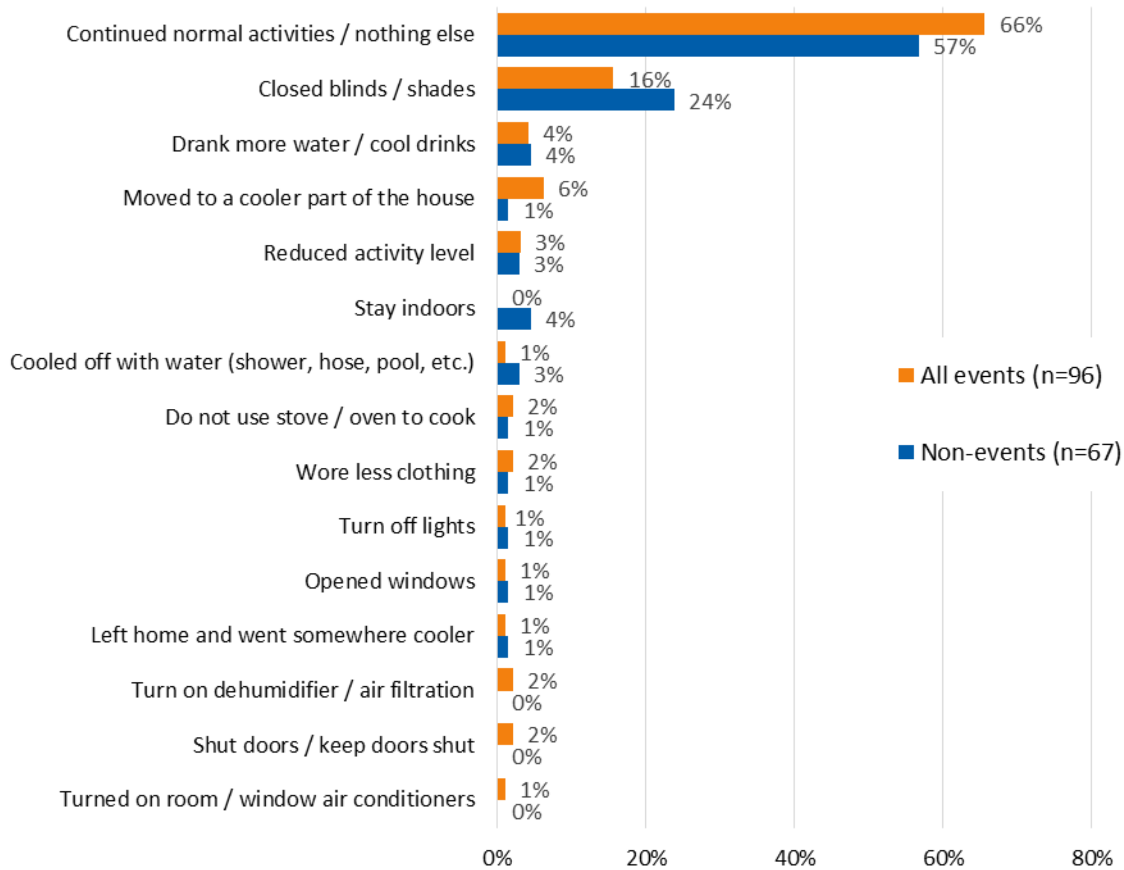


Source: Event/Non-Event Survey Questions C6 and C7. Between [START TIME] and [END TIME] on [DATE], were any electric fans being used in your home? and Did you or any other members of your household turn any electric fans on between [START TIME] and [END TIME], or were all of the fans already running before [START TIME]?

Cadmus asked respondents what else they or other members of their household did to stay cool during the event time period. Figure 32 indicates that most (66%; n=96 for event and 57%; n=67 for non-event) did not do anything in addition to using electric fans or making thermostat adjustments. Of those who took an action to stay cool, the most common activity was closing blinds and shades (16% for event and 24% for non-event), and only one event respondent turned on window or room air conditioners (1%).

CADMUS

Figure 32. Other Actions During Event Time Period



Source: Event/Non-Event Survey Question C8. What else (if anything) did you or other members of your household do to keep cool between [START TIME] and [END TIME] on [DATE]?

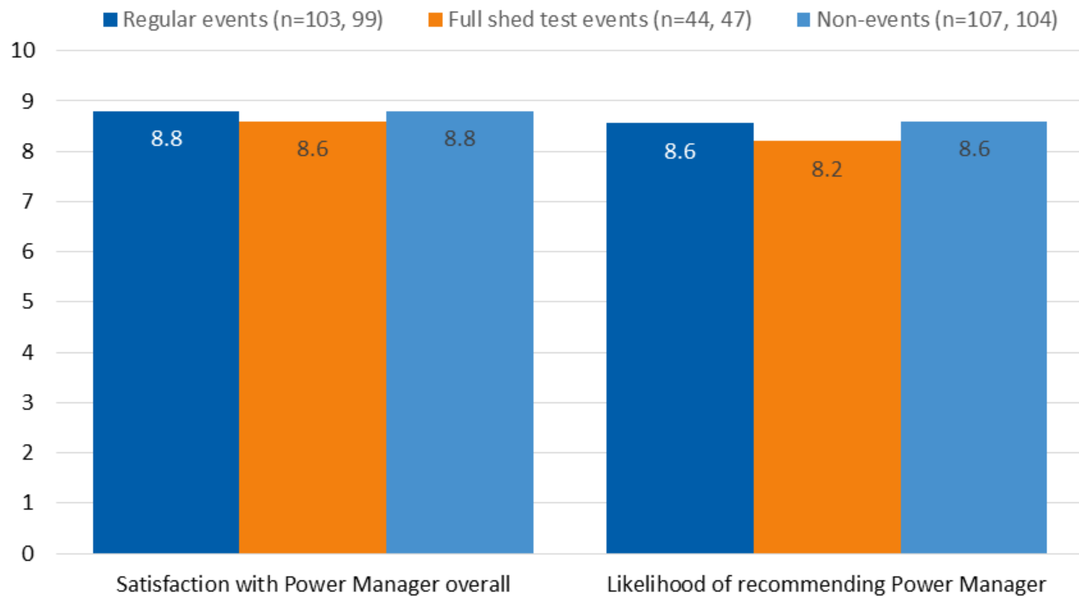
When it is controlling their air conditioner, respondents could mistake their Power Manager device for a power outage, so Cadmus asked respondents if there had been any power outages on the day of the event or high temperature. Four percent (n=105) of event respondents, 4% (n=49) of full shed test event respondents, and 2% (n=114) of non-event respondents reported having a power outage on the day in question. The differences between event and non-event respondents are not statistically significant, which indicates that respondents are not associating device activation with power outages.

Participant Satisfaction and Recommending the Program

Cadmus asked respondents to rate their overall satisfaction with the Power Manager Program on a scale from 0 to 10, where 10 means “very satisfied,” and to rate their likelihood of recommending the program on a similar scale where 10 means “very likely.” Figure 33 shows that the average ratings were almost identical for regular event and non-event respondents, and slightly lower for full shed test event respondents. Among all respondents combined, the average program satisfaction rating was 8.7 (n=254) and the average likelihood of recommending the program was 8.5 (n=250).

CADMUS

Figure 33. Average Ratings for Program Satisfaction and Likelihood of Recommending the Program



Source: Event/Non-Event Survey Questions E3 and F3. Using a scale of 0 to 10 where 0 indicates "very dissatisfied" and 10 indicates "very satisfied," what is your overall satisfaction with the Power Manager Program? and Using a scale of 0 to 10 where 0 means "extremely unlikely" and 10 means "extremely likely," how likely is it that you would recommend this program to a friend or colleague?

Ten respondents (4%; n=254 combined) gave the program a satisfaction rating of 4 or lower. Four of these respondents explained that their low satisfaction was due to issues with their air conditioning not being able to keep their house comfortable all of the time, and three said they have not saved any money and/or their bills have gone up since they joined Power Manager. Of the remaining three dissatisfied respondents, one said that they thought their device was "broken," one said "I don't like the power company trying to regulate what I do," and the third said "I don't know what it's doing, and I don't know what difference it makes."

Respondents who were aware of their devices having been activated since they joined the program gave significantly lower ratings (8.3; n=134) compared to those who were not aware (9.2; n=120), although there were no differences in ratings between respondents who were aware of an event in the past two days. Respondents who reported a decline in comfort during the event time period also gave lower ratings (7.5; n=23) compared to those who did not report a decline (8.9; n=136).[21]

Satisfaction with Duke Energy

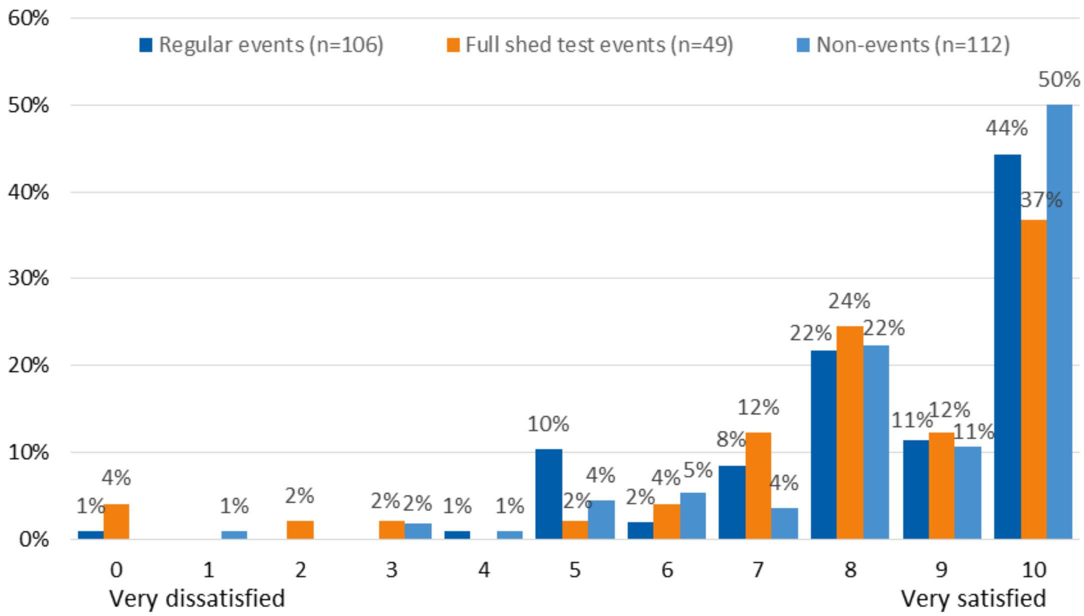
Cadmus asked respondents to rate their overall satisfaction with Duke Energy using a scale from 0 to 10, where 10 indicates high satisfaction. As shown in Figure 34, 57% of respondents (n=267 combined) gave

[21] These differences are statistically significant at $p<0.05$ using ANOVA.

CADMUS

Duke Energy a high satisfaction rating of 9 or 10. The mean rating from regular event respondents was 8.5, while the mean from full shed test event respondents was 8.0, and the mean from non-event respondents was 8.6. The median ratings were 9 for regular event, 8 for full shed test event, and 9.5 for non-event respondents. None of these differences are statistically significant.

Figure 34. Satisfaction with Duke Energy Overall



Source: Event/Non-Event Survey Question F1. Using a scale of 0 to 10 where 0 indicates "very dissatisfied" and 10 indicates "very satisfied," what what is your overall satisfaction with Duke Energy?

Ten survey respondents (4%; n=276) rated their satisfaction with Duke Energy at 4 or less on a 10-point scale. When we asked why they are dissatisfied, five said that their utility bills are too expensive, three mentioned poor environmental stewardship, one complained about slow response to downed power lines, one said Duke Energy field staff had damaged their lawn, and one complained that are no other options for power providers than Duke Energy (some respondents mentioned multiple reasons for their low satisfaction).

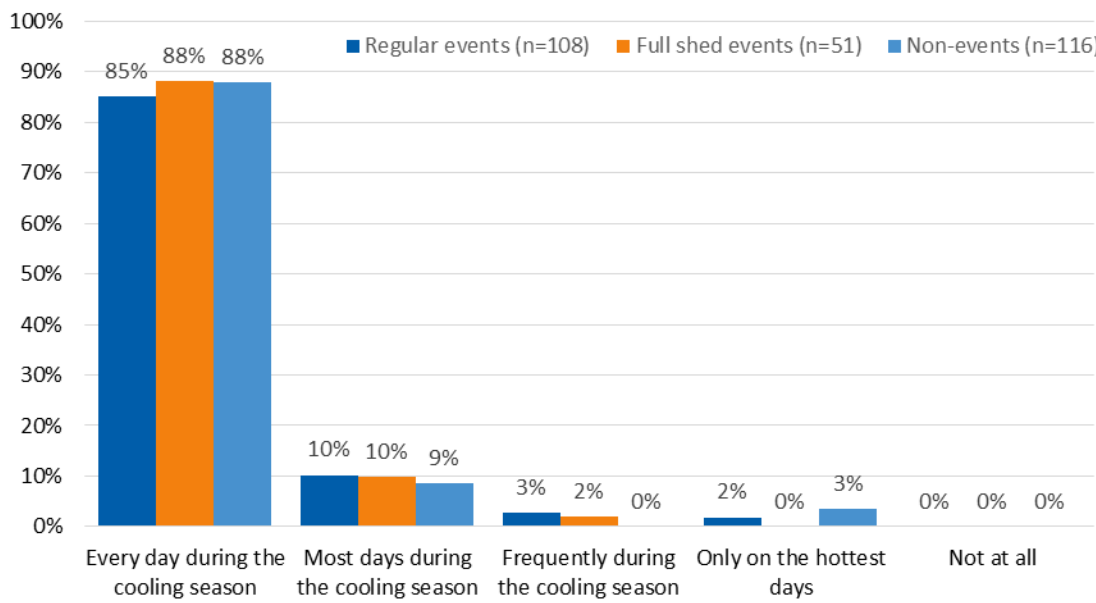
Respondents who were aware of their devices having been activated since they joined the program gave significantly lower ratings (8.2; n=136) compared to those who were not aware (8.7; n=131), although there were no differences in ratings between respondents who were aware of an event in the past two days.[22] Although respondents who reported a decline in comfort during the event time period reported lower ratings for satisfaction with the program, there was no difference between these groups' ratings for satisfaction with Duke Energy.

[22] These differences are statistically significant at $p<0.05$ using ANOVA.

Air Conditioner Use

Event/non-event respondents routinely use their air conditioners throughout the cooling season, and are therefore likely to be affected by Power Manager curtailment events, matching the results from the participant survey (see Figure 6). Figure 35 shows that a large majority of respondents (87%; n=275 combined) are using their air conditioning every day during the cooling season. This result is statistically significantly different from the participant survey fielded in November after the end of the cooling season, where only 56% of respondents said they used their air conditioning every day (see Figure 6).[23]

Figure 35. Respondents' Air Conditioner Use



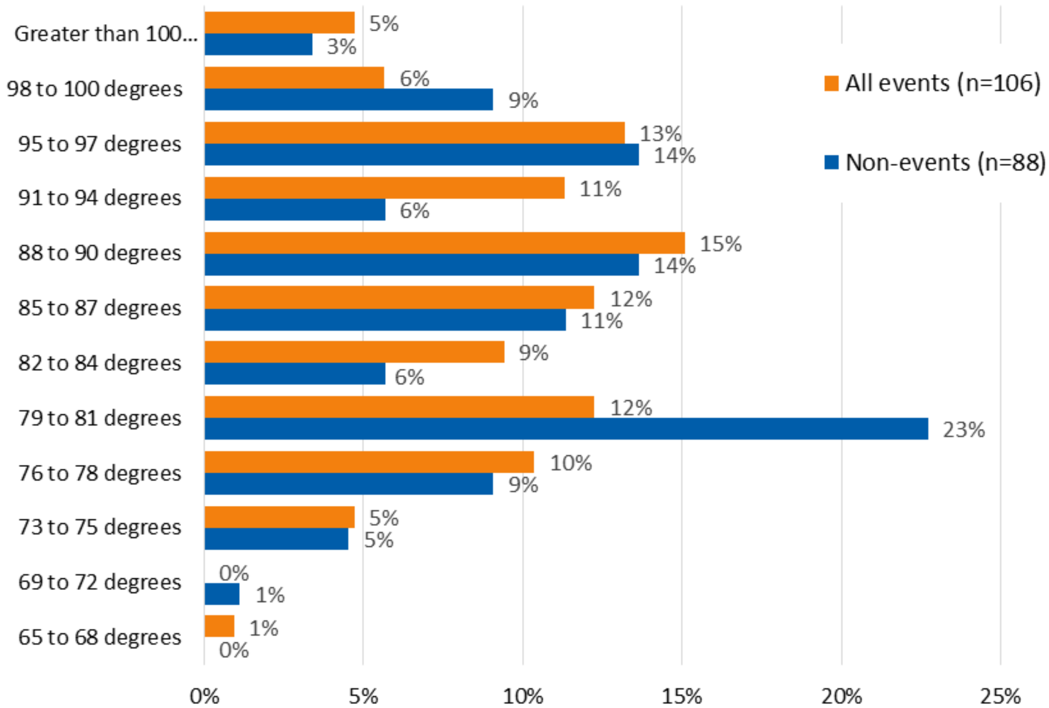
Source: Event/Non-Event Survey Question D1. How often do you use your central air conditioner? Would you say you use it...?

Cadmus asked respondents at what outdoor temperature they start to feel uncomfortable in their home, and at what outdoor temperature they tend to turn on their air conditioner. Figure 36 indicates that the median outdoor temperature at which customers start to become uncomfortable is 85°F to 87°F, and 76% of event (n=106) and 74% of non-event (n=88) respondents said they are uncomfortable when the outdoor temperatures reaches 91°F to 94°F.

---

[23] This difference is statistically significant at p<0.05 using a binomial t-test.

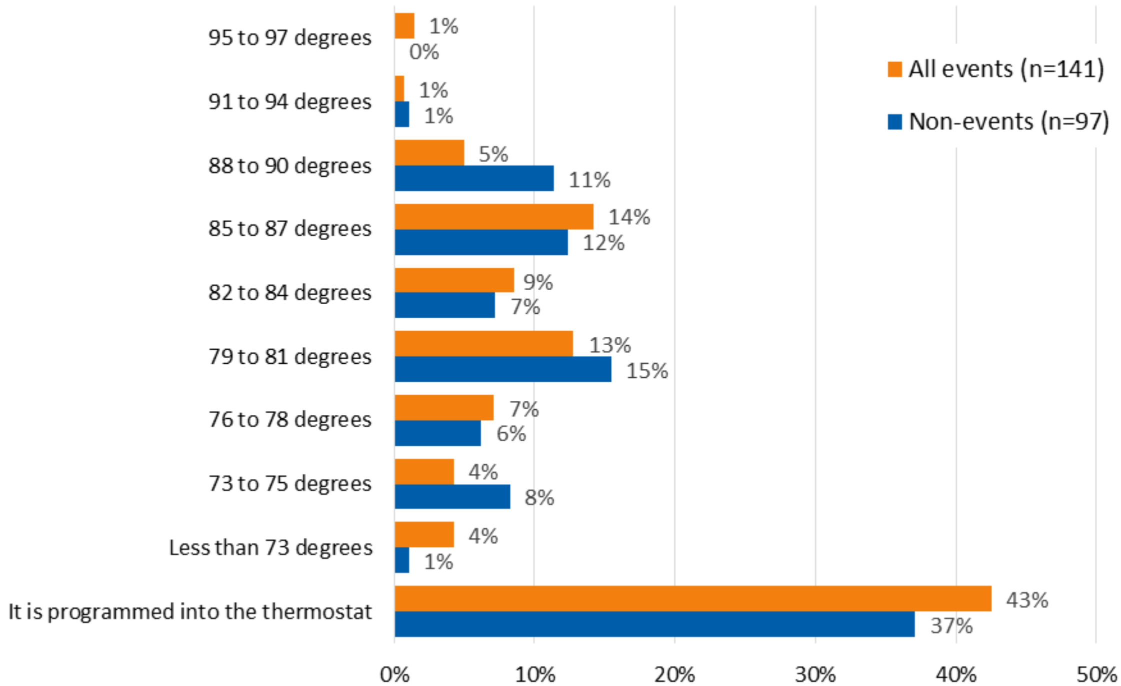
Figure 36. Outdoor Temperature at which Respondents Start to Feel Uncomfortable in their Home



Source: Event/Non-Event Survey Question D2. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm inside your home?

Only 3% of respondents (n=238 combined) said they typically turn on their air conditioner when the outdoor temperature is less than 73°F, while only 2% said they turn on their unit when the outdoor temperature is 91°F or higher (Figure 37). Two in five respondents (40%; n=238) did not respond with a specific temperature, saying that their air conditioner is programmed to turn itself on when the indoor temperature reaches a set point. Among those who answered with a specific temperature, there are no significant differences between event and non-event respondents. The median temperature at which respondents turn on air conditioning was 82°F to 84°F, which is approximately 3°F lower than the median response for the outdoor temperature at which they tend to become uncomfortable in their home.

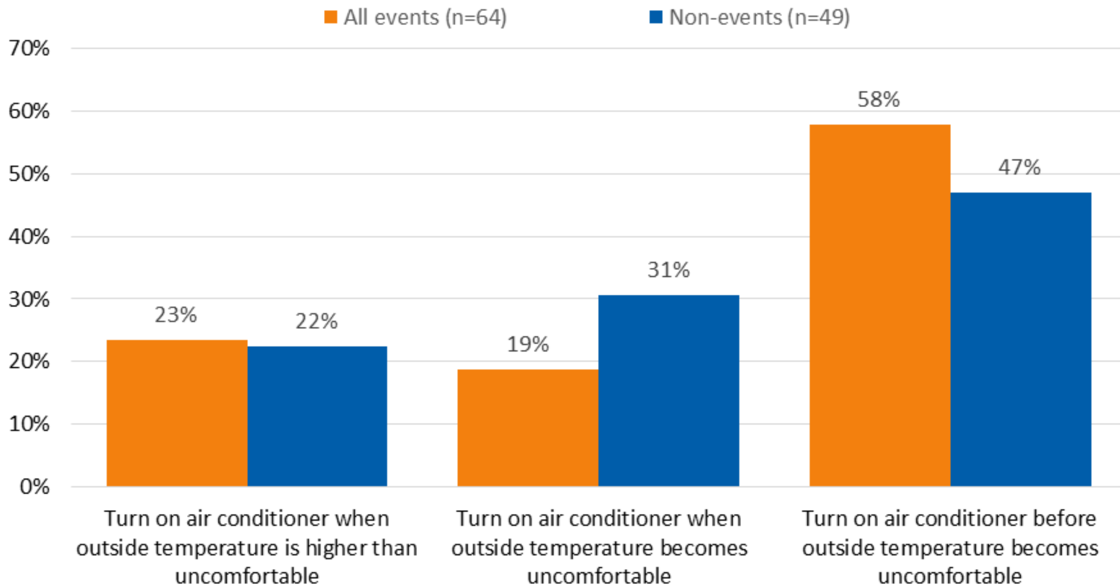
Figure 37. Outdoor Temperature at which Respondents Turn on Air Conditioners



Source: Event/Non-Event Survey Question D3. At what outside temperature do you tend to turn on the central air conditioner?

Cadmus cross-tabulated the responses to outdoor temperature at which a respondent becomes uncomfortable with the temperature at which they turn on their air conditioning (Figure 38). A minority of respondents wait until the outdoor temperature is higher than the temperature at which they become uncomfortable to turn on their air conditioner (23%; n=64 for event and 22%; n=49 for non-event). There are no statistically significant differences between event and non-event respondents.

Figure 38. Uncomfortable Outdoor Temperature Compared to Temperature at which Air Conditioners are Turned on



Source: Event/Non-Event Survey Questions D2 and D3. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm in your home? and At what outside temperature do you tend to turn on the central air conditioner? (n=83 who gave numeric responses to both questions).

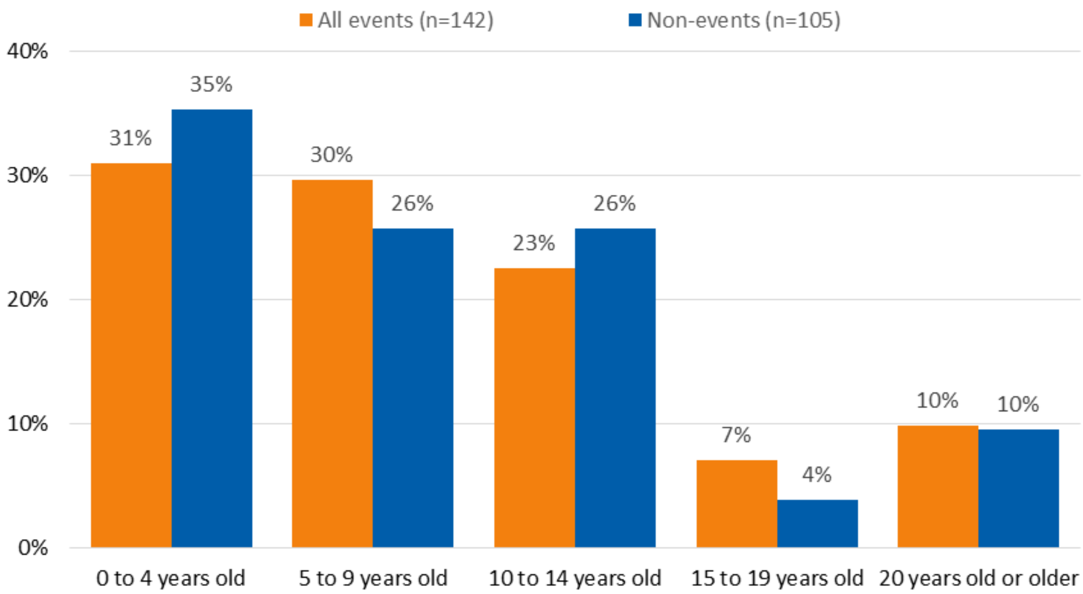
This result is statistically significantly different from the results of the participant survey (see Figure 10), where only 29% (n=56) said they would turn on their air conditioning before the outdoor temperature reached their level of discomfort, and 48% said they would turn on air conditioning when the temperature had reached their level of discomfort.[24]

Age of Air Conditioner

The self-reported median age of participants' air conditioning unit is between five and nine years for both event and non-event respondents (Figure 39). One-third of respondents (33%; n=247 combined) have units that are less than five years old.

[24] These differences between the participant survey (n=56) and event (n=64) and non-event (n=49) surveys are statistically significant at $p<0.10$ or better using binomial t-tests. The percentage of respondents who reported they would wait until the outdoor temperature was higher than the temperature of discomfort to turn on their air conditioners is not significantly different between surveys types or survey groups. The participant survey was fielded in November, two months after the end of the cooling season, while the event and non-event surveys were fielded on the hottest days of the summer.

Figure 39. Age of Air Conditioning Unit



Source: Event/Non-Event Survey Question D4. How old is your central air conditioner?

Impact Evaluation

Analytical Methodology

DEC conducted the impact evaluation of the Power Manager Program in a three step approach:

1. Tested the operability of the active switch devices installed at the customer premises
2. Calculated the impact or demand reduction per switch during events as determined by a duty cycle analysis
3. Provided documentation to Cadmus for review and approval as the independent EM&V contractor

Operability Study

In PY2015 a new Operability Study was conducted for the DEC. Duke Energy Carolinas determined the operability of the active switch devices installed at the customer premises using a representative sample group of customers. There are two components of device operability: the setup factor and the shed factor.

- ***Setup Factor*** - Quantifies the proper installation and configuration of switch devices in the sample group (including the physical installation, wiring, and programming)
- ***Shed Factor*** - Quantifies performance during actual load control events for switches with the correct setup, and measures the switch effectiveness at achieving the programmed load shed

Combined, the setup and shed factors provide an overall operability rate, which is used to de-rate the program impacts and capacity.

Setup Factor

In May 2015, DEC selected a random sample of 150 households with 209 switch devices[25] from the population of Power Manager participants in DEC territory.

In July 2015, DEC collected program configurations from the sample group, downloading it directly from the switch devices. A total of twenty-one (21) households were dropped from the operability study (reflecting 25 participating switches) due to the following reasons:

[25] Multiple switch devices are installed at a single household with more than one air conditioning unit enrolled in the program.

- 11 switches due to terminated participation in the Power Manager Program
- 14 switches from which program data could not be retrieved

Table 6. PY2015 Operability Group Removals

	Households	Switches
Beginning Sample Group	150	188
Removals from Sample Group	(21)	(25)
Final Sample Group	129	163

The final operability sample group size for the set-up factor was 129 households with 163 load control devices. Table 7 summarizes the Operability group observations pertaining to the setup factor.

Table 7. Operability Group Observations of Setup Factor

Reason for Removal from Operability Study	Switch Device Count	Qualifying Multiplier	Weighted Factor
No Switch Present	2	0	0
No Power to AC	1	0	0
Programming Errors	7	0	0
Switch set up correctly	153	1.00	153
Total	**163**		**153**
Set-Up Factor	**0.9387**		

DEC calculated the setup factor to be 93.87%.

Setup Factor = Total Weighted Factor / Total Switch Device Count

Shed Factor

Cannon devices were instructed to execute a Target Cycle. With Target Cycle, each device calculates a unique shed time for each hour of load control based on the Amps parameter for the attached AC unit (entered into the device at installation) and the expected hourly run-time of the attached AC unit stored in the historical profile registers. Expected run-time is accumulated in the historical profile by saving run-time of the attached AC unit on days with weather conditions similar to load control days.

Table 8 shows the list of events occurred during the summer of 2015 for Cannon switches. The data collection included both device scan data and device data logs. Device data logs contain hourly shed minutes and hourly run-time for the attached AC unit. We obtained shed minutes during each hour of load control from device data logs and this information was used to assess shed performance of devices.

CADMUS

Table 8. PY2015 Events for Cannon Devices

Event Date	Event Duration (EDT)
6/16/2015	2:30 p.m. – 6:00 p.m.
6/23/2015	2:30 p.m. – 5:00 p.m.
7/20/2015 (NC only)	3:30 p.m. – 6:00 p.m.
8/5/2015	2:30 p.m. – 6:00 p.m.

The shed factor measures correct response by properly configured devices to paging signals sent immediately prior to and during a load control event. In the PY2015 study, 98 devices were properly configured to shed. Operability Study Findings

The operability study performed in 2015 revealed that Power Manager switch devices were operational at a 93.87% rate. DEC applied this de-rate factor to all program switch devices to more accurately represent the available program capacity and kW reduction during events.

The following calculation determined switch operability:

93.87% [2015 sample group setup factor] * 100% [2011 sample group shed factor] = 93.87%

Table 9 shows de-rating factors used for the PY2015 impact evaluation. Cannon factors in DEC were determined by operability studies conducted in 2015. Comverge factors in DEC were determined by an operability study in 2010. Another operability study for non-Cannon switches is not expected due to the near completion of the replacement of these older devices.

Table 9. De-Rating Factors for Impact Evaluation

Switch Type	Carolinas
Cannon	0.939
Comverge	0.399
PLC	0.399

Impact Study

Power Manager load control was activated in DEC during eight days of the summer of 2015. There were four test events and four Power Manager events.

Measurement and Verification Sample

In the research group for DEC, there were 166 households with 206 switches. These households are equipped with Cannon switches and at the end of the season the switch run time data is collected along with interval meter data.

The historical profile is a component of calculating impacts. This information is obtained via downloads from the Cannon switches. The historical profile is a 24-hour run-time profile covering every switch and the percentage of run time for those hours. The run-time profile is made up of 'Saved Dates' which are high temperature dates that are not inclusive of event dates. Each 'Saved Date' goes into the run-time profile with one-eighth weighting.

Adjusters and gears are instructions telling the switch how long to shed. The adjusters are a part of Target Cycling which uses the historical profile to calculate shed time. The lower the adjuster, the greater impact achieved.

Test Events

For operational purposes DEC had four test events for Power Manager. The test event on May 20th was from 9:00 a.m. – 11:00 a.m., the test on June 4th was from 2:00 p.m. – 2:15 p.m., the test event on July 13th was from 4:00 p.m. – 4:15 p.m. and the test event on August 3rd was from 4:00 p.m. –4:30 p.m.. Impacts were not calculated on these test events due to their short duration.

Impact/Switch Realization Rate

Table 10 details the realization rate between the actual impact/switch and expected impact/switch on an event day. The programming of the switch, including gears and adjusters alters the impact/switch during an event. The calculation for the realization rate is:

Realization Rate (%) = Actual Impact / Expected Impact

Table 10. Impact Realization Rate

Date	Hour (EDT)	Expected Impact/Switch kW	Actual Impact/Switch (Cannon) kW	Realization Rate (%) (Cannon)	Actual Impact/Switch (Comverge)	Realization Rate (%) (Comverge)
6/16/2015	16	1.3	1.46	112%	1.33	102%
	17	1.3	1.57	121%	1.43	110%
	18	1.3	1.57	121%	1.44	111%
6/23/2015	16	1.3	1.47	113%	1.30	100%
	17	1.3	1.54	118%	1.37	105%
7/20/2015	17	1.3	1.52	117%	1.34	103%
	18	1.3	1.51	116%	1.34	103%
8/5/2015	16	1.3	1.35	104%	1.19	92%
	17	1.3	1.49	115%	1.32	102%
	18	1.3	1.47	113%	1.30	100%

PY2015 Load Impact Results

Table 11 details the calculated demand reduction per switch device under peak normal weather and using the de-rated impact from the operability study. These impacts are at the meter prior to calculating capacity at the plant. (At the plant capacity includes the transmission and distribution line losses.)

CADMUS

Table 11. Demand Reduction per Switch Device

Switch Type	Control Strategy	Potential Impact (kW)	De-rating Factor	De-rated Impact (kW)
Cannon	TC 1.3	1.51	0.939	1.42
	Full Shed	2.31	0.939	2.17
Comverge	FC 67%	1.35	0.399	0.54
	Full Shed	2.31	0.399	0.92
PLC[26]	Full Shed	2.31	0.399	0.92

Table 12. Impact Results by Event Date

Date	Hour (EDT)	NC De-Rated Impact (MW)	SC De-Rated Impact (MW)	NC Switch Count (1.3 kW)	SC Switch Count (1.3 kW)	CLT Temperature (°F)	GSO Temperature (°F)	GSP Temperature (°F)
6/16/2015	16	201.30	75.22	141,080	53,262	98°	95°	94°
	17	215.42	80.51			97°	97°	94°
	18	216.47	80.90			96°	94°	94°
6/23/2015	16	202.64	75.77	141,178	53,330	98°	94°	95°
	17	211.66	79.14			97°	96°	94°
7/20/2015	17	210.79	N/A	142,682	N/A	98°	93°	94°
	18	209.62	N/A			97°	93°	95°
8/5/2015	16	189.35	71.00	143,510	54,347	98°	94°	94°
	17	208.49	78.18			98°	92°	89°
	18	206.20	77.32			97°	95°	94°

PY2015 Program Capacity

Table 13 details the PY2015 total DEC Power Manager Program capacity, adjusted for peak normal weather, de-rated, and calculated at the plant. The last column of Table 13 shows the average capacity of the Power Manager program across the summer months in 2015.

Table 13. PY2015 Program Capacity, DEC (MWs)

State	Control Strategy	June	July	August	September	Summer Capacity
Carolinas	Cycling	288.94	292.92	296.97	303.48	295.58
Carolinas	Full Shed	445.04	451.13	457.34	467.32	455.21

Table 14 shows the peak normal weather conditions used to calculate the results in Table 11. The system peak is calculated to occur in the hour 4:00 p.m. – 5:00 p.m. EDT in DEC.

[26] PLC devices are included in Emergency Full Shed events only. These switches are being phased out and replaced with Cannon devices.

CADMUS

Table 14. Peak Normal Weather

Hour	Carolinas	
	Temp	Dewpt
11	89	69
12	91	69
13	92	68
14	94	68
15	93	69
16	95	67
17	95	66
18	95	67

Cadmus Reivew of Analytical Approach

Cadmus, as the third-party evaluator, reviewed the files for participation and impacts for the Power Manager program year 2015 provided by Duke Energy. A conservative approach was taken by the Duke Energy measurement and verification team to ensure accurate load reduction. The data reported here align with the information provided in the spreadsheets received. The methods reviewed are comparable with Cadmus' experience in other jurisdictions and confirmed as reliable estimates.

CADMUS

Appendix A. Participant Household Characteristics and Demographics

Table 15. Participant Household Characteristics and Demographics

Household Characteristics	
Home Ownership Status	**n=70**
Homeowner	96%
Renter	4%
Type of Home	**n=71**
Single-family home, detached construction	89%
Single-family home, manufactured or modular	3%
Single-family mobile home	3%
Row house	0%
Two- or three-family attached home	1%
Apartment home (4+ families)	0%
Condominium	4%
Home Age	**n=71**
Built before 1960	20%
1960 – 1969	8%
1970 – 1979	20%
1980 – 1989	23%
1990 – 1999	20%
2000 – 2005	7%
2006 – 2015	3%

CADMUS

Household Characteristics	
Years Living in Current Residence	**n=72**
Less than 1 year	1%
1 – 3 years	6%
3 – 5 years	6%
5 – 10 years	18%
10 – 15 years	21%
15 – 20 years	15%
20 – 25 years	11%
More than 25 years	22%
Home Size	**n=71**
500 – 999 square feet	6%
1,000 – 1,499 square feet	20%
1,500 – 1,999 square feet	32%
2,000 – 2,499 square feet	10%
2,500 – 2,999 square feet	14%
3,000 – 3,499 square feet	10%
3,500 – 3,999 square feet	4%
4,000 or more square feet	4%
Home Heating System	**n=70 (multiple responses permitted)**
Central forced air furnace	41%
Heat pump	60%
Electric baseboard heat	0%
Geothermal heat pump	0%
Other systems	1%
Primary Fuel Used for Heating	**n=71**
Electricity	61%
Natural gas	34%
Oil or kerosene	0%
Propane	4%
Wood	1%
None	0%
Age of Heating System	**n=68**
0 – 4 years	28%
5 – 9 years	35%
10 – 14 years	18%
15 – 19 years	10%
20 years or older	9%

CADMUS

Household Characteristics	
Home Cooling System	**n=72 (multiple responses permitted)**
Central air conditioning	63%
Heat pump for cooling	43%
Wall or window air conditioning unit(s)	1%
None, do not cool the home	0%
Fuel Used for Cooling	**n=71**
Electricity	93%
Natural gas	6%
Propane	1%
Age of Cooling System	**n=66**
0 – 4 years	29%
5 – 9 years	32%
10 – 14 years	18%
15 – 19 years	11%
20 years or older	11%
Number of Wall or Window Air Conditioning Units	**n=72**
None	99%
1	1%
2	0%
Number of Thermostats	**n=72**
1	65%
2	29%
3 or more	6%
Have a Programmable Thermostat	**n=71**
Yes	57%
No	43%
Primary Fuel Used for Water Heating	**n=71**
Electricity	63%
Natural gas	35%
Propane	1%
Age of Water Heater	**n=61**
0 – 4 years	36%
5 – 9 years	21%
10 – 14 years	25%
15 – 19 years	10%
20 years or older	8%

CADMUS

Household Characteristics	
Number of People Living in Home	**n=68**
1	22%
2	47%
3	15%
4	10%
5	6%
6 or more	0%
Number of Teenagers (Age 13 – 19) Living in Home	**n=62**
None	89%
1	5%
2	5%
3	0%
4 or more	0%
Age of Respondent	**n=71**
18 – 34	1%
35 – 49	11%
50 – 59	18%
60 – 64	15%
65 – 74	46%
75 or older	7%
Annual Household Income	**n=52**
Under $15,000	0%
$15,000 – $29,999	10%
$30,000 – $49,999	27%
$50,000 – $74,999	23%
$75,000 – $99,999	25%
Over $100,000	15%

Appendix B: Process Instruments Used for the PY2015 Evaluation

Three survey instruments and the management interview guide are included on the following pages:

- Participant Survey Instrument
- Event Survey Instrument
- Non-Event Survey Instrument
- Program Manager Interview Guide

CADMUS

Duke Energy
Participant Survey 2015

Researchable Questions	Item
Introduction / screening	A1-3
Program participation and enrollment	B1-9
Program information	C1-6
Awareness of activation	D1-4
Response to activation	E1-10
Satisfaction with the program	F1-5
Air conditioner usage	G1-22
Participation and interest in other programs	H1-2
Satisfaction with Duke Energy	I1-4
Bill credits	J1-3
Household demographics and characteristics	K1-20
Closing (confirm incentive address)	L1-2

Target Quota = [80 completes]

Introduction

Welcome! We are following up with participants of Duke Energy's Power Manager® Program to help Duke Energy understand opinions that will help improve this Program. This survey will take approximately 20 minutes to complete. Please complete the survey by November 30th. Thank you in advance.

As a token of our appreciation we will enter your name into a drawing for a $100 gift card once the survey is complete. Instructions for accepting the gift card are provided at the end of the survey. Winners will be notified in 4 to 6 weeks.

This survey is administered by The Cadmus Group, an independent consulting firm. The survey is designed for appearance on a computer screen rather than a mobile or tablet device. If you experience technical difficulties completing the survey, please email The Cadmus Group at David.Ladd@CadmusGroup.com.

If you have any questions or need to contact Duke Energy, you may reach out to Frankie.diersing@duke-energy.com.

Please click Next to enter the survey.

A1. Please identify the state in which you live.
1. North Carolina
2. South Carolina
3. Ohio
4. Indiana

A2. Are you aware of your participation in the Power Manager® program?
1. Yes
2. No
98. (Don’t know)
99. (Refused)

[ASK IF A2 <>1]

A3. Just to confirm, in the Power Manager program, Duke Energy installs a device outside on your central air conditioner or heat pump which allows the utility to cycle your cooling on and off for a few minutes during periods of critical need for electricity. Are you aware of your participation in the Power Manager program (is there a device installed outside on your air conditioner or heat pump)?
1. Yes
2. No [TERMINATE]
98. (Don’t know) [TERMINATE]

Program Participation and Enrollment

A4. Were you involved in the decision to participate in Duke Energy's Power Manager Program?
1. (Yes)
2. (No)
3. (It was already installed when I moved in)
98. (Don’t know)
99. (Refused)

CADMUS

[ASK IF B1=1]

A5. How did you hear about the Power Manager Program? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. (Something in the mail from Duke Energy)
2. (Phone call from Duke Energy (telemarketing)
3. (Email from Duke Energy)
4. (Duke Energy website)
5. (Other website,) [SPECIFY]
6. (Word-of-mouth (friend/neighbor/landlord))
7. (Newspapers)
8. (Television)
9. (Radio)
10. (Social media network) [SPECIFY]
11. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF B1=1]

A6. What was the main reason why you chose to participate in the program? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (For the bill credits)
2. (Helping Duke avoid power shortages/outages)
3. (Helping Duke avoid building power plants)
4. (To save energy)
5. (To save money (through lower utility bills))
6. (To help the environment) [ASK: Please explain]
7. (I don't use the air conditioner much)
8. (I'm usually not home when the events are supposed to occur)
9. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF B1=1]

A7. Were there any other reasons why you chose to participate in this program? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. (No other reasons)
2. (For the bill credits)
3. (Helping Duke avoid power shortages/outages)
4. (Helping Duke avoid building power plants)
5. (To save energy)
6. (To save money (through lower utility bills))
7. (To help the environment) [ASK: Please explain]
8. (I don't use the air conditioner much)
9. (I'm usually not home when the events are supposed to occur)
10. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A8. During the time you enrolled, Duke Energy provided you with information that described how the Power Manager program works. Do you recall this information?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

A9. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with this information in helping you to understand how the program works?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF B6 IS 4 OR BELOW]

A10. Why do you say you are dissatisfied with this information?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A11. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with the process of enrolling in the program?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF B8 IS 4 OR BELOW]

A12. Why do you say you are dissatisfied with this enrollment process?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

Program Information

A13. How many times per year did Duke Energy tell you it would activate the Power Manager device on your air conditioner?

1. [RECORD NUMBER]
98. (Don't know)
99. (Refused)

A14. Is anything unclear to you about how the program works?

1. (Yes) [ASK C2a]
   A14a. What is unclear to you? [RECORD RESPONSE]
2. (No)
98. (Don't know)
99. (Refused)

A15. Did you ever contact Duke Energy to find out more about the Power Manager Program?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF C3=1]

A16. What method did you use to contact Duke Energy? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. (Phone)
2. (Email)
3. (In person)
4. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF C3=1]

A17. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied were you with how the Duke Energy representative responded to your questions?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF C5 IS 4 OR BELOW]

A18. Why do you say you are dissatisfied? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (Didn't respond to my questions/ concerns)
2. (Unable to answer/address my questions/concerns)
3. (Not professional/not courteous)
4. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

Awareness of Device Activation

A19. Are you aware of any times when Duke Energy may have activated your Power Manager device since you joined the program? [IF ASKED WHAT THIS MEANS SAY, "Has your air conditioner been controlled so that it cycles off and on when energy demand is high?"]

1. (Yes)
2. (No) [SKIP TO F1]
98. (Don't know) [SKIP TO F1]
99. (Refused) [SKIP TO F1]

[ASK IF DD1=1]

A20. What happened that made you believe that the device had been activated? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (A/C shuts down)
2. (Home temperature rises)
3. (The light on the meter is on)
4. (Light on AC unit flashes)
5. (Bill credits)
6. (Lower bill)
7. (Contact or notification from Duke Energy (other than bill))
8. (Customer called the Power Manager 800 number)
9. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF D1=1]

A21. During the summer of 2015, about how many times do you believe Duke Energy activated your Power Manager device?

1. [RECORD NUMERIC RESPONSE >0]
2. (None) [SKIP TO E6]
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF D1=1]

A22. Were you or any members of your household home when Duke Energy activated your Power Manager device this past summer?

1. (Yes)
2. (No) [SKIP TO E6]
98. (Don't know) [SKIP TO E6]
99. (Refused) [SKIP TO E6]

Response to Activation

[ASK IF D4=1]

A23. Using a scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort before your device was activated?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF D4=1]

A24. Using the same scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort during the period when the device was activated?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF E2 IS LESS THAN E1]

A25. What do you feel was the main reason for your decrease in comfort? [RECORD ALL THAT APPLY] [IF CUSTOMER SAYS "rising temperature" or "rising humidity" ASK WHERE THEY ARE REFERRING TO INDOOR OR OUTDOOR OR BOTH.]

1. (Power Manager device activation)
2. (Rising outdoor Temperature)
3. (Rising indoor temperature)
4. (Rising outdoor Humidity)
5. (Rising indoor humidity)
6. (Power Outage)
7. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF D4=1]

A26. After your comfort level decreased during the Power Manager device activation, how long did it take for the comfort level in your home to return to normal? Would you say…

1. Less than one hour
2. More than 1 but less than 2 hours
3. More than 2 but less than 3 hours
4. More than 3 but less than 4 hours
5. Or more than 4 hours
98. (Don't know)
99. (Refused)

A27. Thinking about this summer, how many times do you think the activation of the Power Manager program affected your level of comfort?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF D1=1]

A28. On a day when Duke Energy activates your Power Manager device, for how many hours do you think they are typically controlling your air conditioner?

1. [RECORD NUMBER OF HOURS]
98. (Don't know)
99. (Refused)

[ASK IF D1=1]

A29. On a day when Duke Energy activates your Power Manager device, at what time of day do you think that they usually de-activate and stop controlling your air conditioner?

1. [RECORD TIME OF DAY]
98. (Don't know)
99. (Refused)

[ASK IF D4=1]

A30. When Duke Energy activated your Power Manager device, did you or any other members of your household adjust the settings on your thermostat?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF E8=1]

A31. At what temperature was it originally set, and what temperature did you set it to during the control event?

A31b. (ORIGINAL TEMPERATURE SETTING) [RECORD DEGREES F]

A31c. (ADJUSTED TEMPERATURE SETTING) [RECORD DEGREES F]

[ASK IF D4=1]

A32. Did you or other members of your household do anything else to keep cool? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (Continued normal activities/did not do anything else)
2. (Turned on room/window air conditioners)
3. (Turned on fan(s))
4. (Closed blinds/shades)
5. (Moved to a cooler part of the house)
6. (Left the house and went somewhere cool)
7. (Wore less clothing)
8. (Drank more water/cool drinks)
9. (Cooled off with water (shower, bath, sprinkler, hose, pool))
10. (Opened windows)
11. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

Satisfaction with the Program

[ASK EVERYONE]

A33. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", how satisfied are you with the Power Manager program in general?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF F1 IS 4 OR BELOW AND STATE IS NC, SCOR IN; DO NOT ASK FOR OHIO]

A34. Why do you say you are dissatisfied with the Power Manager Program? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF STATE = OHIO]

A35. How would you rate your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat satisfied
5. Very dissatisfied

98. (Don't know)
99. (Refused)

[ASK IF F3=1, 2, 3, 4 or 5]

A36. Why do you give it that rating?

1. [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

A37. Using a scale of 0 to 10, where zero means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend, neighbor, or co-worker?

1. [RECORD NUMBER] [RANGE 0 TO 10]

98. (Don't know)
99. (Refused)

Air Conditioner Use

Next are a few questions about your air conditioning use.

A38. How often do you use your central air conditioner? Would you say you use it ... [READ LIST UNTIL THEY REPLY]

1. Not at all
2. Only on the hottest days
3. Frequently during the cooling season
4. Most days during the cooling season
5. Every day during the cooling season

98. (Don't know)
99. (Refused)

CADMUS

A39. Have you had your central air conditioner tuned-up or serviced since you enrolled in the Power Manager program?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF G2=1]

A40. Was the Power Manager device disconnected while your air conditioner was being serviced?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF G3=1]

A41. Was the Power Manager device re-connected after completing service on the air conditioner?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF G4=2]

A42. Why wasn't the Power Manager device re-connected?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A43. Is the central air conditioner typically used to keep someone at home comfortable during summer weekdays before 6 P.M.? [IF NEEDED: SOMEONE INCLUDES PETS, IF APPLICABLE]

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A44. Is the air conditioner typically used to keep someone at home comfortable during summer weekdays after 6 P.M.? [IF NEEDED: SOMEONE INCLUDES PETS, IF APPLICABLE]

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A45. When you think of a typical hot and humid summer day, at what outside temperature would you start to feel uncomfortably warm in your home? [DO NOT READ LIST AND RECORD ONE RESPONSE]

1. (Less than 73 degrees)
2. (73 to 75 degrees)
3. (76 to 78 degrees)
4. (79 to 81 degrees)
5. (82 to 84 degrees)
6. (85 to 87 degrees)
7. (88 to 90 degrees)
8. (91 to 95 degrees)
9. (96 to 100 degrees)
10. (Greater than 100 degrees)
98. (Don't know)
99. (Refused)

A46. At what <u>outside temperature</u> do you tend to turn on the central air conditioner? [DO NOT READ LIST AND RECORD ONE RESPONSE]

1. (It is programmed into the thermostat)
2. (Less than 73 degrees)
3. (73 to 75 degrees)
4. (76 to 78 degrees)
5. (79 to 81 degrees)
6. (82 to 84 degrees)
7. (85 to 87 degrees)
8. (88 to 90 degrees)
9. (91 to 95 degrees)
10. (96 to 100 degrees)
11. (Greater than 100 degrees)
98. (Don't know)
99. (Refused)

[ASK IF G9=1]

A47. Do you set your thermostat based on the season or when the weather gets hot? [DO NOT READ LIST AND RECORD ONE RESPONSE]

1. (Based on the season)
2. (When the weather gets hot)
3. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

CADMUS

A48. Which of the following best describes how you control the temperature in your home during the summer? [CHECK ONE]

1. We leave the thermostat at the same setting all the time.
2. We have programmed the thermostat to adjust temperature settings automatically at pre-set times (including using a “smart thermostat”).
3. We manually adjust the setting on the thermostat at specific times (overnight, when leaving the house, etc.)
4. We manually adjust the setting on the thermostat as needed without any set pattern or schedule.

98. (Don’t know)
99. (Refused)

[ASK IF G11=1]

A49. What temperature is your thermostat usually set to during the summer? [DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)

98. (Don’t know)

[ASK IF G11<>1]

A50. On a hot weekday <u>morning</u> from 6 am to noon, what temperature do you set your thermostat to? [DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)

98. (Don’t know)
99. (Refused)

CADMUS

[ASK IF G11<>1]

A51. On a hot weekday afternoon from noon to 6 pm, what temperature do you set your thermostat to?
[DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G11<>1]

A52. On a hot weekday evening from 6 pm to 10pm, what temperature do you set your thermostat to?
[DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G11<>1]

A53. During a hot weekday night from 10pm to 6am, what temperature do you set your thermostat to?
[DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G11<>1]

A54. Do you use the same thermostat settings on summer weekends that you use on weekdays, or are your settings different on the weekend? [CHECK ONE]

1. Same settings on weekdays and weekends.
2. Different settings on weekends.
98. (Don't know)
99. (Refused)

[ASK IF G17=2]

A55. On a hot weekend morning from 6 am to noon, what temperature do you set your thermostat to? [DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G17=2]

A56. On a hot weekend afternoon from noon to 6 pm, what temperature do you set your thermostat to? [DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G17=2]

A57. On a hot weekend evening from 6 pm to 10pm, what temperature do you set your thermostat to?

[DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

[ASK IF G17=2]

A58. During a hot weekend night from 10pm to 6am, what temperature do you set your thermostat to?

[DO NOT READ LIST AND SELECT ONE RESPONSE]

1. (less than 65 degrees)
2. (65-68 degrees)
3. (69-72 degrees)
4. (73-75 degrees)
5. (76-78 degrees)
6. (greater than 78 degrees)
7. (Off)
98. (Don't know)
99. (Refused)

A59. On a weekday afternoon when the outdoor temperature is in the 90's, how often do you use electric fans to keep cool in your home? Would you say that you have fans on . . .

1. Always
2. Most of the time
3. Occasionally
4. Or never?
98. (Don't know)
99. (Refused)

Participation and Interest in Other Programs

A60. What, if any, Duke Energy programs or services have you heard of that help customers save energy? [PROBE:] Any others? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (Smart Saver (other than CFL) – rebates for HVAC equipment and maintenance, including duct sealing and attic insulation)
2. (Free CFL Programs (Smart Saver CFLs / CFLs by mail))
3. (Savings Store (specialty light bulbs sold online))
4. (Water Measures (water and energy saving kit or rebates for heat pump water heaters, pool pumps))
5. (Home Energy House Call (auditor visits home to give advice and install measures)
6. (My Home Energy Report (mailed or online report about household energy usage)
7. (Energy Star Homes)
8. (Low Income, Weatherization, or Low Income Weatherization)
9. (School-based programs: school performances, kits by mail)
10. (Appliance Recycling (remove old refrigerators and freezers)
11. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A61. Duke Energy is always looking for other ways to help their customers. If Duke were to offer a program that cycles on and off other equipment at your home such as an electric water heater, would you be interested in participating?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

Satisfaction with Duke Energy

A62. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with Duke Energy?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF I1 IS 4 OR BELOW AND STATE IS NC, SC OR IN (do not ask for OH)]

A63. Why do you say you are dissatisfied with Duke Energy?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF STATE = OHIO]

A64. How would you rate your overall satisfaction with Duke Energy, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat satisfied
5. Very dissatisfied
98. (Don't know)
99. (Refused)

[ASK IF I3=1, 2, 3, 4 or 5]

A65. Why do you give it that rating?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

BILL CREDITS

A66. What's your best estimate of how many dollars you will receive in yearly bill credits from Duke Energy for participating in the Power Manager program?

1. [RECORD DOLLAR AMOUNT]
98. (Don't know)
99. (Refused)

A67. Have you received any bill credits this year from Duke Energy for participating in this program?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF J2=1]

A68. How many times have you noticed the Power Manager credits on your bill this summer? [DO NOT READ LIST AND RECORD ONE RESPONSE]

1. (Every bill this summer)
2. (Once)
3. (Twice)
4. (Three times)
5. (Four or more times)
6. (Other) [SPECIFY]
7. (Don't know)
8. (Refused)

Demographics

Finally, we have some questions about your household.

A69. In what type of building do you live? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Single-family home, detached construction)
2. (Single-family home, factory manufactured/modular)
3. (Single family, mobile home)
4. (Row House)
5. (Two or Three family attached residence-traditional structure)
6. (Apartment (4 + families)---traditional structure)
7. (Condominium---traditional structure)
8. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A70. Approximately when was your home constructed? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Before 1960)
2. (1960-1969)
3. (1970-1979)
4. (1980-1989)
5. (1990-1999)
6. (2000-2005)
7. (2006-present)
98. (Don't know)
99. (Refused)

A71. How long have you been living in your current residence? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (less than 1 year)
2. (1 to 3 years)
3. (3 to 5 years)
4. (5 to 10 years)
5. (10 to 15 years)
6. (15 to 20 years)
7. (20 to 25 years)
8. (more than 25 years)
98. (Don’t know)
99. (Refused)

A72. Which of the following best describes your home's heating system? [READ LIST; RECORD ALL THAT APPLY]

1. Central forced air furnace
2. Electric Baseboard
3. Heat Pump
4. Geothermal Heat Pump
5. Other [SPECIFY]
6. (None; home has no heating system)
98. (Don’t know)
99. (Refused)

[ASK IF K4 <>6]

A73. How old is your heating system? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (0-4 years)
2. (5-9 years)
3. (10-14 years)
4. (15-19 years)
5. (20 years or older)
6. (Do not have)
98. (Don’t know)
99. (Refused)

[ASK IF K4 <>6]

A74. What is the primary fuel used in your heating system? Is it…[READ LIST; RECORD ONE RESPONSE]

1. Electricity
2. Natural Gas
3. Oil
4. Propane
5. Other [SPECIFY]
98. (Don't know)
99. (Refused)

A75. Do you use one or more of the following to cool your home? [READ LIST; RECORD ALL THAT APPLY]

1. Heat pump for cooling
2. Central air conditioning
3. Through the wall or window air conditioning unit
4. Geothermal Heat pump
5. Other [SPECIFY]
6. (None; do not cool the home)
98. (Don't know)
99. (Refused)

[ASK IF K7=3]

A76. How many window-unit or "through the wall" air conditioner(s) do you use? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (None)
2. (1)
3. (2)
4. (3)
5. (4)
6. (5)
7. (6)
8. (7)
9. (8 or more)
98. (Don't know)
99. (Refused)

[ASK IF K7 <>6]

A77. What is the fuel used in your cooling system? Is it… [READ LIST; RECORD ONE RESPONSE]

1. Electricity
2. Natural Gas
3. Oil
4. Propane
5. (Other) [SPECIFY]
6. (None)
98. (Don't know)
99. (Refused)

[ASK IF K7 <>6]

A78. How old is your cooling system? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (0-4 years)
2. (5-9 years)
3. (10-14 years)
4. (15-19 years)
5. (20 years or older)
6. (Do not have)
98. (Don't know)
99. (Refused)

A79. What is the fuel used by your water heater? [DO NOT READ LIST; RECORD ALL THAT APPLY]

1. (Electricity)
2. (Natural Gas)
3. (Oil)
4. (Propane)
5. (Other) [SPECIFY]
6. (No water heater)
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF K11 <>6]

A80. How old is your water heater? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (0-4 years)
2. (5-9 years)
3. (10-14 years)
4. (15-19 years)
5. (20 years or older)
98. (Don't know)
99. (Refused)

A81. About how many square feet of living space are in your home? [IF NEEDED: DO NOT INCLUDE GARAGES OR OTHER UNHEATED AREAS. A 10-FOOT BY 12-FOOT ROOM IS 120 SQUARE FEET.]

1. (Less than 500)
2. (500 to 999)
3. (1000 to 1499)
4. (1500 to 1999)
5. (2000 to 2499)
6. (2500 to 2999)
7. (3000 to 3499)
8. (3500 to 3999)
9. (4000 or more)
98. (Don't know)
99. (Refused)

A82. Do you own or rent your home?

1. (Own)
2. (Rent)
98. (Don't know)
99. (Refused)

A83. How many thermostats are there in your home?

1. (0)
2. (1)
3. (2)
4. (3)
5. (4 or more)
98. (Don't know)
99. (Refused)

A84. Do you have a programmable thermostat?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A85. Including yourself, how many people live in this home?

1. (1)
2. (2)
3. (3)
4. (4)
5. (5)
6. (6)
7. (7)
8. (8 or more)
98. (Don't know)
99. (Prefer not to answer)

A86. How many of the people living in your home are teenagers between ages 13 and 19?

1. (none)
2. (1)
3. (2)
4. (3)
5. (4)
6. (5)
7. (6)
8. (7)
9. (8 or more)
98. (Don't know)
99. (Prefer not to answer)

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

A87. Please select your age group. [READ LIST; RECORD ONE RESPONSE]

1. 18 to 34
2. 35 to 49
3. 50 to 59
4. 60 to 64
5. 65 to 74
6. Over 74
99. (Prefer not to answer)

CADMUS

A88. Please select your annual household income. [RECORD ONE RESPONSE]

1. Under $15,000
2. $15,000-$29,999
3. $30,000-$49,999
4. $50,000-$74,999
5. $75,000-$100,000
6. Over $100,000
98. (Don't know)
99. (Prefer not to answer)

CLOSING

A89. Please let us know if the email used to send you this survey is the best way to contact you about future surveys.

1. The email this survey was sent to is correct.
2. Please contact me in the future at (enter new email): [SPECIFY]

A90. Those were all the questions we have for you. Before you go, we need to verify your address for the $100 drawing. Please enter the best address for use to use.

1. [SPECIFY NAME, STREET ADDRESS, CITY, STATE, ZIP CODE]

Thanks again for your time today! We will notify the winner of the Visa gift card in about 4-6 weeks.

CADMUS

Duke Energy
Power Manager Event Survey 2015

Researchable Questions	Item
Introduction / screening	A1-5
Device activation awareness	B1-5
Response to activation	C1-9
AC usage	D1-4
Satisfaction with program	E1-4
Satisfaction with Duke Energy	F1-3
Demographics (number of occupants)	G1

<u>General Instructions</u>

- Interviewer instructions are in green **[LIKE THIS]** (the style is “Survey: Interviewer Instructions”).
- CATI programming instructions are in red **[LIKE THIS]** (the style is “Survey: Programming”).
- Items that should not be read by the interviewer are in parentheses like this ( ).

<u>Variables defined in survey programming (update for each event)</u>

- [DATE OF EVENT]
- [EVENT START TIME]
- [EVENT END TIME]

Calling Instructions:

Only calls to homes, please. Businesses are not eligible for this survey.

Make one call attempt per contact within 28 hours of the end of the event. Callbacks are OK as long as the survey is completed within 28 hours of the end of the event. Call times are from 10:00 a.m. to 8:00 p.m. EST Monday through Saturday. No calls on Sunday. For example, if a control event occurs on a Monday ending at 5 p.m., calling hours for that particular event would be:

Monday 5 p.m.-8 p.m. Eastern

Tuesday 10 a.m.-8 p.m. Eastern

CADMUS

INTRODUCTION

A1. Hello, my name is ______, and I'm calling on behalf of Duke Energy with a short customer satisfaction survey. This survey will take about five minutes to complete; do you have five minutes to answer some questions for us today?

1. Yes
2. No or not a convenient time **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

A2. Thank you. The information you provide will be confidential and will help to improve service. This call may be monitored or recorded for quality assurance puposes. According to our information, you participate in the Power Manager® Program. This program allows Duke Energy to cycle your air conditioner on and off during periods of critical need for electricity. Are you aware of your participation in the Power Manager program?

1. Yes
2. No **[ASK IF THERE IS SOMEONE ELSE AVAILABLE WHO WOULD KNOW AND RESTART SURVEY WITH THAT PERSON; IF NO ONE ELSE IS AVAILABLE THANK AND TERMINATE]**
98. (Don't know) **[ASK IF THERE IS SOMEONE ELSE AVAILABLE WHO WOULD KNOW AND RESTART SURVEY WITH THAT PERSON; IF NO ONE ELSE IS AVAILABLE THANK AND TERMINATE]**

A3. Just to confirm, do you still live at **[ADDRESS FROM CALL SHEET]**?

1. Yes
2. No **[THANK AND TERMINATE]**
98. (Don't know) **[THANK AND TERMINATE]**

A4. [CHECK STATE FROM CALL SHEET]

1. North Carolina / South Carolina
2. Ohio
3. Indiana

A5. [COPY RESPONDENT ID NUMBER FROM CALL SHEET]

1. [PASTE RESPONDENT ID NUMBER HERE]

Device Activation Awareness

A6. Has Duke Energy activated the Power Manager® device since you joined the program? *[IF THEY ASK WHAT THIS MEANS, RESPOND WITH:* "Duke Energy has the ability to send a signal to activate the device to cycle your central air conditioner on and off when there is peak demand foir electricity." *THEN REPEAT THE QUESTION.]*

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A7. How can you tell (how would you be able to tell) when the device has been activated? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (A/C shuts down)
2. (Home temperature rises)
3. (The light on the meter is on)
4. (Light on AC unit flashes)
5. (Bill credits)
6. (Lower bill)
7. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A8. Has your device been activated in the last two days? [IF NEEDED: Was your device activated yesterday or today?]

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A9. At what temperature was your thermostat set to between [EVENT START TIME] and [EVENT END TIME] on [EVENT DATE]? [DO NOT READ LIST]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)
14. (It's programmed into the thermostat)
15. (Thermostat was turned off)
16. (Air conditioner was turned off)
98. (Don't know)
99. (Refused)

A10. Were you or any members of your household home at that time?

1. (Yes)
2. (No) [SKIP TO D1]
98. (Don't know) [SKIP TO D1]
99. (Refused) [SKIP TO D1]

Response to Activation

[ASK IF B5=1]

A11. Using a scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort <u>before</u> [EVENT START TIME] on [EVENT DATE]?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

CADMUS

A12. Using the same scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort between [EVENT START TIME] and [EVENT END TIME] on [EVENT DATE]?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF C2<C1]

A13. What do you feel caused your decrease in comfort? [RECORD ALL THAT APPLY; DO NOT READ LIST] [IF CUSTOMER SAYS "rising temperature" or "rising humidity" ASK WHETHER THEY ARE REFERRING TO INDOOR OR OUTDOOR OR BOTH.]

1. (Power Manager device activation)
2. (Rising outdoor Temperature)
3. (Rising indoor temperature)
4. (Rising outdoor Humidity)
5. (Rising indoor humidity)
6. (Power Outage)
7. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

A14. Between [EVENT START TIME] and [EVENT END TIME] on [EVENT DATE], did you or any other members of your household adjust the settings on your thermostat?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF C4=1]

A15. At what temperature was it originally set, and what temperature did you set it to during the event?

A15a. (ORIGINAL TEMPERATURE SETTING) [RECORD DEGREES F]

A15b. (ADJUSTED TEMPERATURE SETTING) [RECORD DEGREES F]

CADMUS

[ASK IF B5=1]

A16. Between [EVENT START TIME] and [EVENT END TIME] on [EVENT DATE], were any electric fans being used in your home?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF C6=1]

A17. Did you or any other members of your household turn any electric fans on between [EVENT START TIME] and [EVENT END TIME], or were all of the fans already running before [EVENT START TIME]?

1. (Yes, turned fan(s) on during time period)
2. (No, all fans were already running before time period)
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

A18. What else, if anything, did you or other members of your household do to keep cool between [EVENT START TIME] and [EVENT END TIME] on [DAY OF HIGH TEMPERATURE]? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (Continued normal activities/did not do anything else)
2. (Turned on room/window air conditioners)
3. (Closed blinds/shades)
4. (Moved to a cooler part of the house)
5. (Left the house and went somewhere cool)
6. (Wore less clothing)
7. (Drank more water/cool drinks)
8. (Cooled off with water (shower, bath, sprinkler, hose, pool))
9. (Opened windows)
10. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A19. Did you experience any power outage issues on [DATE OF EVENT]?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

CADMUS

AC Usage

Now I'm going to ask you some questions about your air conditioning use.

A20. How often do you use your central air conditioner? Would you say you use it ... [READ LIST]

1. Not at all
2. Only on the hottest days
3. Frequently during the cooling season
4. Most days during the cooling season
5. Every day during the cooling season

98. (Don't know)
99. (Refused)

A21. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm inside your home? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)

98. (Don't know)
99. (Refused)

CADMUS

A22. At what outside temperature do you tend to turn on the central air conditioner? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)
98. (Don’t know)
99. (Refused)

A23. How old is your central air conditioner? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (0 to 4 years old)
2. (5 to 9 years old)
3. (10 to 14 years old)
4. (15 to 19 years old)
5. (20 years old or older)
98. (Don’t know)
99. (Refused)

Satisfaction with Program

[ASK IF STATE=OHIO]

A24. How would you rate your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat dissatisfied
5. Very dissatisfied
98. (Don’t know)
99. (Refused)

CADMUS

[ASK IF E1=1, 2, 3, 4 or 5]

A25. Why do you give it that rating?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A26. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with the Power Manager® program?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF E3=4 OR BELOW AND STATE=NC, SC or IN]

A27. Why do you say you are dissatisfied with Power Manager®?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

Satisfaction with Duke Energy

A28. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with Duke Energy?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF F1 IS 4 OR BELOW]

A29. Why do you say you are dissatisfied with Duke Energy?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A30. Using a scale of 0 to 10, where zero means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend or colleague?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

CADMUS

Demographics and Closing

A31. Including you, how many people live in this home?

1. (1)
2. (2)
3. (3)
4. (4)
5. (5)
6. (6)
7. (7)
8. (8 or more)
99. (Refused)

Thank you for your time and feedback today!

CADMUS

Duke Energy
Power Manager Non-Event Survey 2015

Researchable Questions	Item
Introduction / screening	A1-5
Device activation awareness	B1-5
Response to activation	C1-9
AC usage	D1-4
Satisfaction with program	E1-4
Satisfaction with Duke Energy	F1-3
Demographics (number of occupants)	G1

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red **[LIKE THIS]** (the style is "Survey: Programming").
- Items that should not be read by the interviewer are in parentheses like this ( ).
- Differences from Event Survey question text are highlighted yellow.

Variables defined in survey programming (update for each non-event high temperature day)

- [DATE OF HIGH TEMPERATURE]

Calling Instructions:

Only calls to homes, please. Businesses are not eligible for this survey.

Make one call attempt per contact within 28 hours beginning at 5 p.m. on the non-event high date of high temperature. Callbacks are OK as long as the survey is completed within the 28 hour timeframe. Call times are from 10:00 a.m. to 8:00 p.m. EST Monday through Saturday. No calls on Sunday. For example, if there is a high temperature day without an event on a Monday, calling hours for that particular non-event would be:

Monday 5 p.m.-8 p.m. Eastern

Tuesday 10 a.m.-8 p.m. Eastern

Introduction

A32. Hello, my name is _____, and I'm calling on behalf of Duke Energy with a short customer satisfaction survey. This survey will take about five minutes to complete; do you have five minutes to answer some questions for us today?

1. Yes
2. No or not a convenient time **[THANK AND TERMINATE]**

99. (Refused) **[THANK AND TERMINATE]**

A33. Thank you. The information you provide will be confidential and will help to improve service. This call may be monitored or recorded for quality assurance puposes. According to our information, you participate in the Power Manager® Program. This program allows Duke Energy to cycle your air conditioner on and off during periods of critical need for electricity. Are you aware of your participation in the Power Manager program?

1. Yes
2. No **[ASK IF THERE IS SOMEONE ELSE AVAILABLE WHO WOULD KNOW AND RESTART SURVEY WITH THAT PERSON; IF NO ONE ELSE IS AVAILABLE THANK AND TERMINATE]**
98. (Don't know) **[ASK IF THERE IS SOMEONE ELSE AVAILABLE WHO WOULD KNOW AND RESTART SURVEY WITH THAT PERSON; IF NO ONE ELSE IS AVAILABLE THANK AND TERMINATE]**

A34. Just to confirm, do you still live at **[ADDRESS FROM CALL SHEET]**?

1. Yes
2. No **[THANK AND TERMINATE]**
98. (Don't know) **[THANK AND TERMINATE]**

A35. **[CHECK STATE FROM CALL SHEET]**

1. North Carolina / South Carolina
2. Ohio
3. Indiana

A36. **[COPY RESPONDENT ID NUMBER FROM CALL SHEET]**

1. **[PASTE RESPONDENT ID NUMBER HERE]**

Device Activation Awareness

A37. Has Duke Energy activated the Power Manager® device since you joined the program? *[IF THEY ASK WHAT THIS MEANS, RESPOND WITH:* "Duke Energy has the ability to send a signal to activate the device to cycle your central air conditioner on and off when there is high demand for electricity." *THEN REPEAT THE QUESTION.]*

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A38. How can you tell (how would you be able to tell) when the device has been activated? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (A/C shuts down)
2. (Home temperature rises)
3. (The light on the meter is on)
4. (Light on AC unit flashes)
5. (Bill credits)
6. (Lower bill)
7. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A39. Has your device been activated within the last two days? [IF NEEDED: Was your device activated yesterday or today?]

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

A40. At what temperature was your thermostat set to between 2:00 and 5:00 p.m. on [DAY OF HIGH TEMPERATURE]? [DO NOT READ LIST]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)
14. (It's programmed into the thermostat)
15. (Thermostat was turned off)
16. (Air conditioner was turned off)
98. (Don't know)
99. (Refused)

A41. Were you or any members of your household home at that time?

1. (Yes)
2. (No) [SKIP TO D1]
98. (Don't know) [SKIP TO D1]
99. (Refused) [SKIP TO D1]

Response to Activation

[ASK IF B5=1]

A42. Using a scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort before 2:00 pm on [DAY OF HIGH TEMPERATURE]?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

A43. Using the same scale of 0 to 10 where zero means very uncomfortable and 10 means very comfortable, how would you describe your level of comfort between 2:00 pm and 5:00 pm on [DAY OF HIGH TEMPERATURE]?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF C2<C1]

A44. What do you feel caused your decrease in comfort? [DO NOT READ LIST; RECORD ALL THAT APPLY] [IF CUSTOMER SAYS "rising temperature" or "rising humidity" ASK WHETHER THEY ARE REFERRING TO INDOOR OR OUTDOOR OR BOTH.]

1. (Power Manager device activation)
2. (Rising outdoor Temperature)
3. (Rising indoor temperature)
4. (Rising outdoor Humidity)
5. (Rising indoor humidity)
6. (Power Outage)
7. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

[ASK IF B5=1]

A45. Between 2:00 pm and 5:00 pm on [DAY OF HIGH TEMPERATURE] did you or any other members of your household adjust the settings on your thermostat?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF C4=1]

A46. At what temperature was it originally set, and what temperature did you set it on [DAY OF HIGH TEMPERATURE]

A46c. (ORIGINAL TEMPERATURE SETTING) [RECORD DEGREES F]

A46d. [ADJUSTED TEMPERATURE SETTING) [RECORD DEGREES F]

[ASK IF B5=1]

A47. Between 2:00 pm and 5:00 pm on [DAY OF HIGH TEMPERATURE], were any electric fans being used in your home?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF C6=1]

A48. Did you or any other members of your household turn any electric fans on between 2:00 pm and 5:00 pm, or were all of the fans already running before 2:00 pm?

1. (Yes, turned fan(s) on during time period)
2. (No, all fans were already running before time period)
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF B5=1]

A49. What else, if anything, did you or other members of your household do to keep cool between 2:00 and 5:00 on [DAY OF HIGH TEMPERATURE]? [RECORD ALL THAT APPLY; DO NOT READ LIST]

1. (Continued normal activities/did not do anything else)
2. (Turned on room/window air conditioners)
3. (Closed blinds/shades)
4. (Moved to a cooler part of the house)
5. (Left the house and went somewhere cool)
6. (Wore less clothing)
7. (Drank more water/cool drinks)
8. (Cooled off with water (shower, bath, sprinkler, hose, pool))
9. (Opened windows)
10. (Other) [SPECIFY]
98. (Don't know)
99. (Refused)

A50. Did you experience any power outage issues on [DAY OF HIGH TEMPERATURE]?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

AC Usage

Now I'm going to ask you some questions about your air conditioning use.

A51. How often do you use your central air conditioner? Would you say you use it ... [READ LIST]

1. Not at all
2. Only on the hottest days
3. Frequently during the cooling season
4. Most days during the cooling season
5. Every day during the cooling season
98. (Don't know)
99. (Refused)

CADMUS

A52. When you think of a typical hot and humid summer day, at what outside temperature do you tend to feel uncomfortably warm inside your home? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)
98. (Don't know)
99. (Refused)

A53. At what outside temperature do you tend to turn on the central air conditioner? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Less than 65 degrees)
2. (65 to 68 degrees)
3. (69 to 72 degrees)
4. (73 to 75 degrees)
5. (76 to 78 degrees)
6. (79 to 81 degrees)
7. (82 to 84 degrees)
8. (85 to 87 degrees)
9. (88 to 90 degrees)
10. (91 to 94 degrees)
11. (95 to 97 degrees)
12. (98 to 100 degrees)
13. (Greater than 100 degrees)
98. (Don't know)
99. (Refused)

A54. How old is your central air conditioner? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (0 to 4 years old)
2. (5 to 9 years old)
3. (10 to 14 years old)
4. (15 to 19 years old)
5. (20 years old or older)
98. (Don't know)
99. (Refused)

Satisfaction with Program

[ASK IF STATE=OHIO]

A55. How would you rate your overall satisfaction with the Power Manager Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied?

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 E1=1, 2, 3, 4 or 5]

A56. Why do you give it that rating?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A57. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with the Power Manager® program?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF E3 IS 4 OR BELOW AND STATE IS NC, SC or IN]

A58. Why do you say you are dissatisfied with Power Manager®?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

CADMUS

Satisfaction with Duke Energy

A59. Using a scale of 0 to 10 where zero indicates "Very Dissatisfied" and 10 indicates "Very Satisfied", what is your overall satisfaction with Duke Energy?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

[ASK IF F1 IS 4 OR BELOW]

A60. Why do you say you are dissatisfied with Duke Energy?

1. [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A61. Using a scale of 0 to 10, where zero means "Extremely Unlikely" and 10 means "Extremely Likely", how likely is it that you would recommend this program to a friend or colleague?

1. [RECORD NUMBER] [RANGE 0 TO 10]
98. (Don't know)
99. (Refused)

Demographics and Closing

A62. Including you, how many people live in this home?

1. (1)
2. (2)
3. (3)
4. (4)
5. (5)
6. (6)
7. (7)
8. (8 or more)
99. (Refused)

Thank you for your time and feedback today!

CADMUS

Duke Energy
Power Manager Management Interview Guide 2015

Interviewer: ____________________ Date of Interview: ______ Interview method: _____

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with the Power Manager Program. We'll talk about the Program and its objectives, your thoughts on improving the program and its participation rates. As you may know, due to regulatory requirements Duke Energy needs to conduct periodic evaluations whether they are needed or not. Today's interview will take about an hour to complete. May we begin?

Program Overview

1. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program? When did you take on this role?

2. In your own words, please briefly describe the Power Manager Program's objectives. Are there any objectives at the participant level? What are they?

   Are there any objectives at the state portfolio level?

   Are there any objectives at the company level, across all the Power Manager states? Or for reporting to balancing authorities such as MISO or PJM?

3. What are the options for enrolling, what is the process?

4. What is the current enrollment in Power Manager? What is the dropout rate?

5. In your own words please describe how the Power Manager Program works and go over its design, marketing and operational approaches. Walk us through the participatory steps starting with a customer who knows nothing about the program.

6. Please describe for me the roles and responsibilities of vendors that are supporting Duke Energy's Power Manager program?

7. Are there any changes you would like to see in the vendors' roles or responsibilities that would improve the Power Manager program's operations?

Objectives

8. Have the Power Manager's objectives changed in the last year or so, and if so how? Why?

9. In your opinion, which objectives do you think are being, or will be, met?

10. Since the program objectives were devised, have there been any changes in external influences (such as market conditions) or internal influences that have affected the Power Manager program's operations?

11. Should the current objectives be revised in any way because of these changes that developed since the program objectives were devised? What changes would you put into place, and how would it affect the objectives?

12. Are there any pre-existing conditions that are associated with the program or the market that are not being addressed or that you think should have more attention?

    If yes, which conditions are they? How should these conditions be addressed? What should be changed? How do you think these changes will increase program participation or impacts?

Incentives

13. Do you think the incentives offered through the Power Manager Program are adequate enough to entice customers to enroll in the program? Why or why not?

14. Do you think the customers understand the incentive levels?

Marketing

15. What kinds of marketing, outreach and customer contact approaches do you use to make your customers aware of the program? Are there any changes to the program marketing that you think would increase participation?

16. Do you use Duke Energy Energy Efficiency programs to generate leads for Power Manager?

17. What are the key market or operational barriers that impede a more efficient program operation or limit obtainable impacts?

Overall Power Manager Management

18. Describe the use of any internal or outside program advisors, technical groups or organizations that have in the past or are currently helping you think through the program's approach or methods. How often do you use these resources? What do you use them for?

19. Could you share with me when AC duty cycle and switch operability studies will be taking place?

20. Are there any other studies Duke Energy will be carrying out to better understand the response rate of the market?

21. Do you currently use any smart grid technologies in your DR programs? Do you have plans to do so?

Event calls

22. Under what conditions would you call an event? Who is involved in the call?

23. How do you coordinate events calls between your res and non-res DR programs?

24. Can residential customers opt out of an event?

25. How do you verify load shed? What is the quality control, tracking and accounting processes for determining how well control strategies worked?

26. Overall, what about the Power Manager Program works well and why?

27. What doesn't work well and why? Do you think this discourages participation?

28. In what ways can the Power Manager Program's operations be improved?

29. If you could change any part of the program what would you change and why?

30. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Process Evaluation of the 2013-2015 Smart $aver® Custom Incentive Program in the Carolinas System

December 23, 2016

**Evaluation, Measurement, & Verification
for Duke Energy Carolinas**

The Cadmus Group, Inc.
An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

CADMUS

Table of Contents

CADMUS

Evaluation Summary

This report presents process evaluation findings for Duke Energy Carolinas (DEC) Smart $aver Custom Incentive Program (Custom Program) projects from January 2013 through January 2016. This evaluation was completed in three phases. TecMarket Works completed the first phase of the process evaluation in 2014. Following the transfer of the evaluation contract in 2015, Cadmus, along with subcontractor Yinsight, Inc., completed the final two phases of the process evaluation. This report describes the results of the evaluation based on all three phases of work, representing a combination of TecMarket Works' and Cadmus' (the evaluation team) efforts.

Program Description

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. Successful applications that receive a Custom Program incentive are called Closed Won in this report, and those that do not receive an incentive are called Closed Lost in this report.

Evaluation Objectives

The evaluation team sought to document program operations, identify areas for improving future program implementation, and gauge customer and trade ally satisfaction with the program. Key research questions included the following:

- What level of satisfaction do participants and trade allies have with the Custom Program?
- What have been recent program challenges, and how have they been addressed by DEC program staff?
- Can any improvements be made to the application process?
- Does the program provide adequate information to facilitate participation, including for the various stakeholders involved in the program implementation?
- What can be done to increase participation from both customers and trade allies, other than by increasing marketing?
- Are changes to program design or operations warranted?

Evaluation Parameters

The evaluation team used in-depth program manager interviews, participant surveys, and trade ally interviews to conduct this process evaluation. Table 1 lists these activities' parameters, along with estimated confidence and precision levels (confidence/precision).

Table 1. Evaluated Parameters with Value, Units, and Confidence/Precision

Program	Parameter	Value	Units	Confidence/Precision
Custom	Participant survey responses	Varies by question	Varies by question	±10.9% precision at the 90% confidence interval*

* The precision reported is based on 54 surveys completed from an estimated Closed Won and Closed Lost applicant population of 1,092. The level of precision for Closed Won customers only is ±13.2% at the 90% confidence interval based on 35 surveys completed with a known population of 344 paid applications from Closed Won customers during the evaluation period. The confidence and precision for each individual survey question or combination of questions will vary.

Table 2 lists the start and end dates for activities conducted for the process evaluation. The evaluation team collected data in three phases: Phase 1 surveys covered participation (defined by the application closing dates) from 2013 and the first half of 2014, Phase 2 covered participation from the second half of 2014, and Phase 3 covered participation in 2015. The trade allies we surveyed assisted Closed Won customers with installations that were rebated through the program during the time period mentioned.

Table 2. Sample Period Start and End Dates

Evaluation Component	Sample Period	Dates Conducted	Total Conducted
Management Interviews	–	July 25, 2014 May 28, 2015 July 21, 2016	3
Participant Surveys*	<u>Phase 1</u>: January 2013 – May 2014 <u>Phase 2</u>: June 2014 – January 2015 <u>Phase 3</u>: February 2015 – January 2016	<u>Phase 1</u>: July 23, 2014 – September 12, 2014 <u>Phase 2</u>: August 5, 2015 – September 5, 2015 <u>Phase 3</u>: June 1, 2016 – June 9, 2016	54
Trade Ally Interviews**	<u>Phase 1</u>: January 2013 – May 2014 <u>Phase 2</u>: June 2014 – January 2015 <u>Phase 3</u>: February 2015 – January 2016	<u>Phase 1</u>: August 7, 2014 – September 10, 2014 <u>Phase 2</u>: August 28, 2015 – September 3, 2015 <u>Phase 3</u>: June 3, 2016 – June 6, 2016	16

* Cadmus included participants in the process evaluation sample frame based on the date on which the application was paid (for Closed Won) or closed (Closed Lost).
** Trade allies included in the process evaluation sample frame assisted customers with Closed Won applications that were paid an incentive during the time period mentioned.

High-Level Process Findings

This section summarizes the evaluation team's key process findings for the evaluation period.

Management Interviews

The team focused its interviews with the DEC program managers on elements of the program process and delivery, along with recent program changes.[1] Program operations have remained fundamentally unchanged and the program managers reported having an understanding of program challenges. DEC recently instituted a number of improvements to meet those challenges. The program managers reported that the heavier involvement of the energy efficiency engineers in late 2013 has allowed for a better distribution of resources, enabling program staff to focus on increasing customer energy savings. Other changes included providing a flat rate incentive that removes much of the participants' uncertainty about the amount of the incentive they will receive (March 2015) and the addition of online calculators to assist customers with providing the necessary savings calculations (July 2015).

As DEC recently instituted these changes, it is unlikely that the participant surveys we conducted for this study captured any resulting increases in satisfaction.

Trade Ally Feedback

As found in past evaluations, trade allies continued to value this program as a key energy cost-reduction service to their customers, as well as a way of increasing sales for their business, and they reported that the Custom Program incentive is critical to advancing a customer project. Trade allies continued to praise the DEC's trade ally outreach representatives as being unfailingly helpful with a wide range of issues.

Trade allies rated their overall satisfaction with the Custom Program overall at 7.3 and DEC specifically at 8.3.[2] Due to the small sample size, these ratings are not representative of the larger trade ally population. In this sample, the trade ally feedback only provides a glimpse into the range of issues they encountered, but does not reveal a prevalence of issues.

The trade allies also reported some difficulty understanding how the incentive is calculated and with the length of the time it took to review the application. However, the team gathered this trade ally input, including their satisfaction ratings, over three years, and many of their concerns may have been resolved by DEC's recent program improvements.

---

1 The Phase 1 interview on 7/25/14 was conducted with program managers of both the Midwest and DEC Smart $aver Custom programs at the same time. Subsequent interviews were conducted only with the DEC program manager.

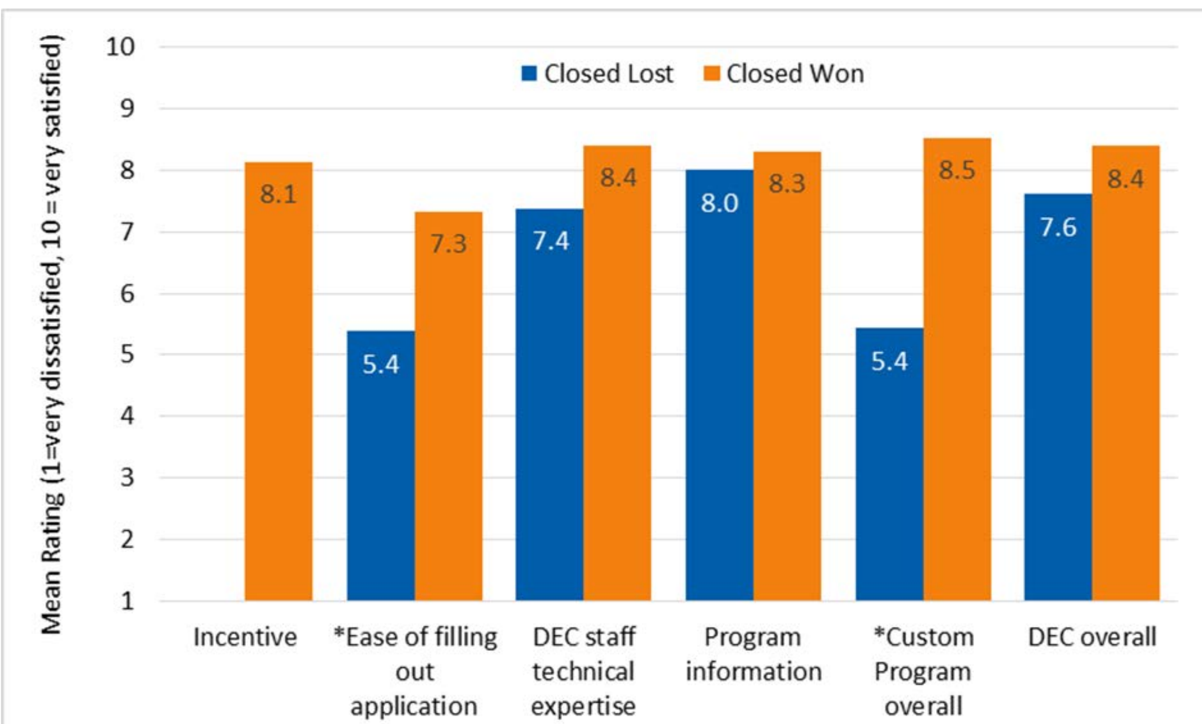
2 On a scale of 1 to 10, where 1 indicates being very dissatisfied and 10 indicates being very satisfied.

Participant Feedback

Most participants learned about the Custom Program through one of three sources: a trade ally, their DEC representative, or through word-of-mouth from a colleague. The primary driver of participation was energy cost savings, but over half also mentioned a need to reduce repair or labor costs. During the application process, participants directed program- and application-related questions to their DEC account managers (if they had account managers). However, they directed both program-related and technical questions to the trade allies.

Unsurprisingly, Closed Won participants have higher satisfaction with the overall Custom Program than Closed Lost participants. However, all participants have high satisfaction with DEC. While participants continued to find the application process satisfactory, they gave this program element the lowest ratings. Figure 1 shows participant satisfaction ratings, on a scale of 1 to 10, where 1 indicates being very dissatisfied and 10 indicates being very satisfied.

Figure 1. Participant Satisfaction with the Custom Program in the Carolinas System



Closed Lost (n)	N/A	16	16	12	7	18
Closed Won (n)	35	24	22	13	32	35

* Differences between groups are statistically significant at $p<0.05$ using two-tailed t-test.

Conclusions and Recommendations

In summary, the Custom Program is well-integrated into DEC's offerings to its nonresidential sector, and participants have moderately high satisfaction with the program and with DEC. However, during the Phase 3 interview, the program manager expressed the perception that customers in the Duke Energy

Carolinas market have increasingly opted out of energy efficiency programs, and the program staff has continued to balance program resources to encourage customers to take on larger, more complex projects with greater energy savings. DEC has expanded program staffing in the past few years and made a number of process improvements to address the needs of its customers. Due to the recent introduction of these new program elements, the evaluation team was not able to include them in the scope of this study.

Given the recent program improvements, few recommendations are warranted at this time. However, the evaluation team recommends that DEC conduct a process evaluation of new Custom Program components in the near term to understand customer satisfaction to the recently implemented program changes. The process evaluation conclusions and recommendation are as follows:

- **Conclusion:** Program managers need to reallocate resources to allow program staff to proactively reach out to customers and encourage them to take on larger projects with deeper energy savings.
  - **Action Taken, No Recommendation Needed:** Program managers added online calculators that participants and trade allies can use to provide savings calculations for a wide number of applications. DEC hopes that this will allow program staff to focus on pursuing larger and more complex projects with deeper energy savings or demand reduction.
- **Conclusion:** Participants and trade allies reported that uncertainty about the amount of the incentive makes it difficult to decide on the project scope. Fewer participants and trade allies expressed this concern during Phase 3 of this evaluation.
  - **Action Taken, No Recommendation Needed:** Program managers introduced a flat rate incentive to remove uncertainty for certain projects.
- **Conclusion:** Participants and trade allies reported that they would like the option of submitting an online application. Fewer participants and trade allies expressed this concern during Phase 3 of this evaluation.
  - **Action Taken, No Recommendation Needed:** DEC launched an online application system.
- **Conclusion:** The Custom Program has achieved high success with energy savings and is perceived by trade allies as an important influence on the energy efficiency equipment market.
  - **Recommendation:** Conduct a process evaluation within the next year to ensure that customer experiences with and attitudes toward the Custom Program continue to be positive and the program continues to achieve high energy savings.

Introduction

Program Description

Through the Smart $aver Custom Incentive Program (Custom Program), Duke Energy Carolinas (DEC) provides incentives for its nonresidential customers to use high-efficiency equipment. This program supplements the Smart $aver Prescriptive Incentive Program (Prescriptive Program), through which DEC provides prescriptive rebates for preselected measures. Customers who want to install eligible measures that are not included in the Prescriptive Program equipment list can apply for a rebate through the Custom Program. DEC originally designed the Custom Program to provide incentives for larger and more complex retrofit projects that could not fit within the parameters of the Prescriptive Program. Over the years, the success of the Custom Program has driven the expansion of the website, outreach materials, and the trade ally network.

The Custom Program differs from the Prescriptive Program in a number of ways, but the two programs are closely coordinated. As measures in the Custom Program become more popular, DEC must decide whether to move them to the Prescriptive Program. Moving measures from the Custom Program to the Prescriptive Program gives customers easier access to the associated incentive, but also affects the ability to meet Custom Program savings objectives.

From the customers' perspectives, the Custom Program allows them to receive incentives that are not available on the list of approved Prescriptive Program measures, but they must also apply for the incentive prior to purchasing or installing the measures. The Prescriptive Program allows customers to apply for an incentive after purchase and installation.

Approving the Custom Program applications is resource intensive because each requires review by qualified engineers. DEC caps Custom Program incentives at 75% of the incremental project cost, and the project's simple payback must be greater than one year. The level of rigor required to review an application for a small project is about the same as for a large project, although the review time for small lighting projects tends to be faster than for other projects. As was noted in past evaluations, Custom Program staff continued to seek a balance between providing low-effort support to all customers with smaller projects, while providing a higher level of support to developing and reviewing applications for larger projects.

To provide more support for customers with smaller applications and customers who do not have account managers, DEC developed two ways to facilitate participation in the Custom Program: the Custom-to-Go online tools and "Fast Track," which offers an expedited review for a fee. The DEC program manager said that Custom-to-Go will likely address some historical concerns voiced by participants about the Custom Program, such as the difficulty in providing savings calculations. The Custom-to-Go calculator was available as of July 2015. At the time of Phase 3 evaluation activities in 2016, Fast Track was still under consideration by DEC; therefore, Fast Track projects were not included in the scope of this evaluation. The sample consisted predominantly of participants who closed before the launch of Custom-to-Go.

In addition, DEC started offering Custom Program customers a flat rate incentive in March 2015 in order to remove uncertainty about the incentive calculation and to give customers solid financial information on which to base their decisions. Because of these recent additions to the program, many of the concerns documented in this report may no longer be relevant.

Program Design and Goals

The Custom Program is marketed primarily through two channels. DEC's extensive network of trade allies—including vendors, distributors, and contractors—share their expertise in energy-efficient technologies and take advantage of the incentive to increase their own businesses. DEC's large account managers also market the program to their assigned large customers (those who use more than 500 kW). In mid-2014, DEC also introduced a team of business energy advisors who play a role similar to account managers for small and medium businesses that are interested in participating.

Table 3 shows the annual peak demand reduction and energy saving objectives of the DEC Custom Program in 2013, 2014, and 2015.

Table 3. DEC Custom Program Saving Targets*

Program Year	Peak Coincident Demand Reduction (kW)**	Gross Energy Savings (kWh)
2013	10,100	88,300,000
2014	8,700	75,800,000
2015	8,500	74,700,000

* The program manager provided these targets to Cadmus based on the DEC internal yearly budget files.

** The reported impacts do not include losses.

Evaluation Methodology

Overview of the Evaluation Approach

The evaluation team collected data from in-depth telephone interviews with program managers, telephone interviews with trade allies, and participant surveys that were fielded by telephone and online. The team analyzed the data by coding open-ended responses and, when warranted, reporting descriptive statistics by the number of responses. Other than screening questions designed to ensure that the survey participant was knowledgeable about the Custom Program project, no questions in the surveys or interviews were mandatory. This resulted in an inconsistent number of responses to the various survey questions.

Table 4 lists the start and end dates for activities the team conducted for this process evaluation.

Table 4. Sample Period Start and End Dates

Evaluation Component	Sample Period	Dates Conducted	Total Conducted
Management Interviews	–	July 25, 2014 May 28, 2015 July 21, 2016	3
Participant Surveys*	Phase 1: January 2013 – May 2014 Phase 2: June 2014 – January 2015 Phase 3: February 2015 – January 2016	Phase 1: July 23, 2014 – September 12, 2014 Phase 2: August 5, 2015 – September 5, 2015 Phase 3: June 1, 2016 – June 9, 2016	54
Trade Ally Interviews**	Phase 1: January 2013 – May 2014 Phase 2: June 2014 – January 2015 Phase 3: February 2015 – January 2016	Phase 1: August 7, 2014 – September 10, 2014 Phase 2: August 28, 2015 – September 3, 2015 Phase 3: June 3, 2016 – June 6, 2016	16

* Cadmus included participants in the process evaluation sample frame based on the date on which the application was paid (for Closed Won) or closed (Closed Lost).

** Trade allies included in the process evaluation sample frame assisted customers with Closed Won applications that were paid an incentive during the time period mentioned.

Management Interviews

In 2014, the evaluation team conducted a joint interview with the two Duke Energy program managers responsible for the Custom Program in the Midwest and in the Carolina System. We combined these interviews due to the close coordination of program delivery across Duke Energy's service territories. In 2015 and 2016, the evaluation team conducted brief interviews to obtain updates about program operations with the Custom Program manager for the Carolina System. The team conducted the following interviews as part of this evaluation:

- 2014 Custom Program Managers for the Carolina System and the Midwest
- 2015 and 2016 Update Interviews with the Custom Program Manager for the Carolina System

CADMUS

Trade Ally Interviews

The evaluation team interviewed 16 trade allies who had worked on or submitted Custom Program applications. We completed 10 interviews in early 2015 with trade allies involved in applications during the 2013 program year, four interviews in late 2015 with trade allies involved in 2014 applications, and two interviews in 2016 with trade allies involved in 2015 applications. The number of trade ally interviews targeted in each phase generally followed the length of time covered in each phase of the process evaluation.

Participant Surveys

Fifty-four DEC Custom Program participants agreed to answer questions about their program experience; 35 successfully applied for and received an incentive (Closed Won), while 19 did not receive an incentive (Closed Lost). The team conducted surveys in three phases: 26 in Phase 1 (program participants who were paid an incentive in 2013 or first half of 2014 or whose application was Closed Lost during this time period), 11 in Phase 2 (program participants who were paid an incentive during the second half of 2014 or whose application was Closed Lost during this time period), and 17 in Phase 3 (program participants who were paid an incentive during 2015 or whose application was Closed Lost during this time period).

Study Methodology

Data Collection Methods, Sample Sizes, and Sampling Methods

The evaluation team randomly selected participant survey respondents from DEC's database of Custom Program application records between January 2013 and December 2015. The database listed both a contact within the customer company and a contact from the trade ally who assisted the customer. Therefore, the evaluation team selected trade ally interviewees from the same sampled applications. However, because the team could not reach all participants or trade allies (and they did not all agree to participate in the survey), not all of the survey and interview respondents were from the same applications.

The evaluation team administered the participant survey as a phone survey in Phase 1. In Phases 2 and Phase 3, the team administered the survey online using the Qualtrics survey platform to increase efficiency in completing the surveys and facilitate data analysis. Qualtrics offers a straightforward programming interface for the evaluation team and a user-friendly interface for the respondents.

Since questions cannot be clarified or expanded in an online survey, prior to implementing the participant surveys online, the evaluation team revisited the survey instruments to clarify questions as necessary. The team moved a number of questions to allow for branching in the online survey and added prompted responses to some questions to facilitate data analysis. The survey had a satisfaction response scale from 1 to 10, which was consistent with the response scales used in Phase 1.

The evaluation team offered and provided a $10.00 gift card to Phase 2 and Phase 3 participants who completed the survey online.

The evaluation team conducted trade ally interviews via telephone in all three phases. In Phase 2, the team revisited the survey instrument to clarify questions as necessary.

Number of Completed Surveys and Sample Disposition

In Phase 1, the evaluation team attempted to contact 92 participants by telephone and e-mail and completed 26 surveys. In Phase 2, we attempted to contact 59 participants by e-mail and completed 11 surveys. In Phase 3, the team attempted to contact 126 participants by e-mail and completed 16 surveys and obtained responses to one partially completed survey. Overall, we surveyed 54 participants out of 277 attempted contacts.

In Phase 1, the evaluation team attempted to contact 45 trade allies by telephone and e-mail and completed 10 interviews. In Phase 2, the team attempted to contact 10 trade allies by telephone and e-mail and completed four interviews. In Phase 3, we attempted to contact eight trade allies by telephone and e-mail and completed two interviews. Overall, the team surveyed 16 trade allies out of 63 attempted contacts.

Expected and Achieved Precision

The team surveyed 54 participants from an estimated sample frame of 1,092 applicants,[3] providing ±10.9% precision at the 90% confidence interval. The level of precision for Closed Won customers only is ±13.2% at the 90% confidence interval, based on 35 surveys completed from a known population of 344 paid applications during the evaluation period. Table 5 summarizes the confidence interval and precision value achieved for the evaluated parameters.

Table 5. Evaluated Parameters with Value, Units, and Confidence/Precision

Program	Parameter	Value	Units	Confidence/Precision
Custom	Participant survey responses	Varies by question	Varies by question	±10.9% precision at the 90% confidence interval*

* Precision is reported based on 54 surveys completed and an estimated Closed Won and Closed Lost applicant population of 1,092. The level of precision for Closed Won customers only is ±13.2% at the 90% confidence interval based on 35 surveys completed with a known population of 344 paid applications during the evaluation period. The confidence and precision for each individual survey question or combination of questions will vary.

[3] The population of unique companies in the application file cannot be precisely determined, since some records are incomplete. Some companies have multiple applications during the evaluation period, including both Closed Won and Closed Lost projects.

Addressing Threats to Validity and Sources of Bias

The sample sizes for the participant surveys were too small to allow for statistical representation. As a result, the responses should be considered indicative of the program, but should not be generalized to all Custom Program participants. The evaluation team survey staff reviewed the survey instruments to help ensure that questions were clear and unbiased. Because of the relatively small size of the sample, the unique characteristics of the individuals selected for the sample may affect the evaluation team's ability to extrapolate the current findings to the larger program population.

CADMUS

Process Evaluation Findings

This chapter presents process evaluation findings in three sections: management interviews, trade ally interviews, and participant surveys, followed by a section about overall program strengths and weaknesses.

Management Interviews

Marketing and Outreach

The Custom Program is marketed primarily through DEC's trade ally network and directly to customers. Program information and outreach to the trade allies are currently handled by a team of nine trade ally representatives.

The trade ally representatives host "lunch and learns" at trade ally offices and may accompany trade allies on visits to prospective customers. These representatives hold periodic webinar presentations about Smart $aver and advertise these programs to trade allies through e-mail. DEC relies on the trade ally network to reach customers and offers trade allies the benefit of being able to use Smart $aver incentives to increase their own sales.

DEC assigns its large usage customers to the large account managers, who are responsible for generating interest in the program and helping with applications. These managers already have an ongoing relationship with their assigned account customers, which includes a regular review of the large use customer's energy usage and energy efficiency needs.

DEC assigns its small and medium customers to a business energy advisor who is responsible for generating interest in the program and helping with applications. These managers are currently working to build relationships with their assigned accounts.

Program staff coordinate Custom Program marketing efforts with the Prescriptive Program. If a project is not eligible for a Prescriptive Program incentive, customers are encouraged to check if they qualify for a Custom Program incentive. The two programs are so closely coordinated that sometimes customers and occasionally trade allies do not make a distinction between the two, as evidenced by the number of comments about the Prescriptive Program provided in response to questions about the Custom Program in this and previous evaluations.

DEC also provides information about both Smart $aver programs on its website. During outreach to the trade allies, DEC reinforces the website as the repository of the most up-to-date program information. For the Custom Program, the DEC website includes separate portals for customers and for trade allies. These pages offer application materials, Custom-to-Go calculators, and information on local trade allies who ask to be listed.

CADMUS

Application Review Process

DEC sends an e-mail acknowledgement that provides an estimate of the approval time and a reminder to not purchase or install any equipment prior to the application approval. The review is conducted in stages by different teams. First, a team of subcontractors conducts an administrative review and completeness check, notifying the customer immediately if any information is missing. Next, a second team reviews the measures to make sure they meet the criteria for the Custom Program. Finally, engineering staff perform a technical review of the application to determine, among other things, if savings can persist throughout the life of the measure and if incorrect maintenance or operation may degrade savings. Once an application is approved, DEC sends an offer letter with the incentive amount to the customer. After the project is completed, DEC staff conducts a final technical review of project savings, invoices, and documentation before issuing a check.

During the evaluation team's update interview in July 2016, the program manager reported that customers are told that the review entire application review period may take four to six weeks. However, the current review time is approximately 30 days from the application receipt date to the offer letter, depending on a number of factors such as completeness of the application.

Process Improvements

DEC has made a number of changes to the Custom Program participation process since 2015, as described below. However, due to the timing of the participant sample, these changes likely only affected a few of the participant survey and trade ally interview respondents in this evaluation. The Phase 3 participant surveys included 17 respondents whose applications were either paid or closed in 2015, but their applications were likely submitted in 2014 prior to these changes. Likewise, we only interviewed two trade allies in Phase 3.

In late spring of 2015, DEC launched an integrated customer database system that contains information about each Custom Program application, along with the associated trade ally contacts. At the time of the Phase 1 interviews, due in part to a transition to a different vendor, DEC was tracking applications across three databases. The DEC Custom program manager reported during the Phase 3 interviews that this new database has allowed DEC to improve application processing times. The new customer databases have status flags for each Custom application that makes it possible to track a Closed Won application from submission to approval, to offer letter, to project completion and payment. DEC periodically reviews these flags to see whether follow up is warranted with certain applications. With the new database, DEC sends up to three follow up requests for information (RFIs) over the course of three weeks. If a customer does not respond to these RFIs, their entry in the customer database is automatically changed to Closed Lost.

The program manager reported that DEC also launched an online application system at the end of 2015. After a few months of testing the system with a few trade allies, DEC made the online application available in late spring of 2016.

DEC also launched a Custom-to-Go calculator early in 2015. This tool is available on the DEC website and allows customers to estimate the potential savings resulting from their proposed retrofit project. The intent of Custom-to-Go is to reduce uncertainly about the incentive amount and allow customers to plan their projects. Customers can continue to calculate their own savings using the preexisting Excel spreadsheets, or they can elect to use the calculator for projects with less than 700,000 kWh in savings. The program manager reported that in recent months, the review time hit a record low of 23 days from application receipt date, which reflects the improved processing system and procedure, the online application, and the use of Fast Track applications.

DEC began offering of a preliminary flat rate incentive in March of 2015, the amount of which DEC reserves the right to update in the Custom Program offer letter. Customers who use the Custom-to-Go calculator will automatically get a flat rate incentive estimate, while customers who use the traditional Excel spreadsheet to calculate energy savings can estimate their incentive based on DEC's published payment rates. The program manager reported that, in practice, the flat rate incentive has been fairly close to the calculated incentive, with the biggest incentive difference coming from discrepancies in peak kW. The program manager reported being highly satisfied with the flat rate incentive because the estimate reduces customers' uncertainty about their incentive.

Energy Efficiency Engineers

To encourage customers to take on larger and more complex projects, DEC hired a team of three energy efficiency engineers over the past few years. These engineers help customers, both small and large, with the front-end application process. They act as technical advisors and subject matter experts about Custom Program requirements and benefits. The program manager reported that, so far, feedback on the engineers has been good and these staff members have been able to help with program operations. The engineers prioritize larger and more complex projects and, according to the program manager, they have not had to decline assistance to any smaller customers who do not meet those characteristics.

Program Challenges

In 2015, DEC added a key measure, LED tubes, to the Prescriptive Program due to its popularity with Custom Program participants. Even though this type of transition is part of the Smart $aver programs' design, this change impacted the Custom Program savings because when popular measures move to the Prescriptive Program, the Custom Program loses the impacts expected from those measures. Despite this transition, the program manager reported that the Custom Program had achieved more than 90% of its program goals by the end of 2015.

The program manager reported that an increasing number of customers are opting out of paying DEC's energy efficiency rider, and thus are not eligible to participate in incentive programs. The program manager reported that this seems particularly common after a customer has completed a project and is not planning to take on more energy efficiency projects.

During the 2015 update interview, the program manager reported that there were fewer Custom Program projects, but they had higher savings and more non-lighting measures. However, in the 2016 interview, she reported that the Custom Program no longer has as many large, complex projects. In the past, 90% of Custom Program applications were for lighting and they constituted only a small percentage of program savings. In 2016, at the time of the interviews, the program manager reported that 90% of the applications are still for lighting, but now those savings constitute the majority of program achievements.

Historically, the Custom Program has achieved high realization rates, which is challenging according to the program manager. DEC continues to strive to reduce the application processing time and to clarify the requirements on the application. The program manager reported that DEC representatives have recently made a concerted effort to talk to both customers and trade allies in order to get constructive feedback on the Custom Program process. The program manager said that as a result of feedback DEC has received, it has shortened the length of the Custom Program application and made some questions clearer.

The program manager reported that DEC is considering a Fast Track program option, where customers would pay a fee to expedite their Custom Program application review. DEC is also exploring a separate pay-for-performance program, where customers would be paid for the savings achieved by their projects.

The program manager also said that with the recent additions of the program energy efficiency engineers and the Custom-to-Go tools, program staff will be able to devote more time and resources to encouraging customers to take on larger projects with higher energy savings. In addition, DEC wants to begin conducting internal training sessions to help program staff gain more technical background on the incentive calculations in order to better respond to customer questions.

Trade Ally Interviews

Trade Ally Sample Characteristics

The evaluation team interviewed 16 trade allies (six from South Carolina and 10 from North Carolina) who had worked on or submitted applications for the Custom Program in the Carolina System from 2013 through 2015. These trade allies have an average of 17.38 years of experience in their field.

Fifteen of these trade allies were able to recall how they first learned of the Custom Program. Three learned about it from a customer, three from co-workers, three from past experience with DEC programs, two from the DEC website, one from a DEC representative, and one trade ally who said they regularly conduct research to find incentives. (Despite saying they recalled how they learned of the program, when pressed two trade allies said they did not know.)

The trade allies included those who had past experience with the Custom and Prescriptive programs (n=14) and with the Custom Program only (n=2). Eleven respondents said they were listed as trade allies on the DEC website, two were not, and one could not recall.

CADMUS

Custom Program Participation Process

The evaluation team asked the 14 trade allies who had experience filling out the Custom Program application if they had any suggestions for streamlining the applications. Only five had ideas: one suggested clearer instructions, another suggested having an online application (which DEC recently implemented), two suggested faster approval times, and one suggested having a single application for both Prescriptive and Custom programs for projects that are eligible for both types of incentives.

Seven of the trade allies the team interviewed during Phase 1 about their participation in 2013 reported experiencing one or two problems: three trade allies mentioned they had communication problems during the application stage, with one person saying this occurred during the transition between Smart $aver vendors; two trade allies mentioned that the invoicing requirements were difficult; two trade allies said they would like more detail on how the incentive was calculated; and one trade ally wanted to receive a copy of the offer letter, but it was sent to the customer. The evaluation team notes that these responses may be outdated and not enough data were collected during Phase 2 and Phase 3 to determine if these problems still persisted. However, Cadmus' evaluations of this program in other states have documented that the transition between Smart $aver vendors has been completed and transition-related problems affecting application processing have been resolved by DEC taking significant portions of the process under their direct oversight.[4]

Eleven trade allies interviewed across all three phases estimated that their application took an average of five weeks; of the two that were interviewed in Phase 3, one reported that it took between six and eight weeks and the other reported it took at least four to six weeks.

Twelve trade allies reported that they contacted DEC staff with questions. Eight contacted their outreach representatives, two contacted an energy efficiency engineer, one contacted an application process staff member, and three trade allies contacted other people (multiple responses accepted). The purpose of this communication was for trade allies to ask about their application status (n=4), program requirements (n=4), clarification on application items (n=3), and technical information (n=2; multiple responses accepted).

Four trade allies offered suggestions for improving communications, and two said that nothing needed improvement. The suggestions were as follows:

- Have trade allies work with the same reviewer throughout the application process[5]
- Give trade allies more feedback on the review

---

4 Cadmus. Process *Evaluation of the 2013-2014 Smart $aver Nonresidential Custom Incentive Program in Indiana.* August 2016.
Cadmus. *Process Evaluation of the 2013-2014 Smart $aver Nonresidential Custom Incentive Program in Ohio and Kentucky.* March 2016.

5 As a rule, each application has only one technical reviewer, but in some cases the initial and final reviews may be conducted by different reviewers.

- Because the project code used in the e-mails was not intuitive, just reference the business name and street address
- Provide trade allies with e-mail updates about program changes (something DEC reports is already being done by the trade ally outreach team).

One respondent said he was not able to get answers on program eligibility. Two respondents named their outreach representative and lauded their helpfulness.

Trade Ally Outreach Feedback

Nine of the trade allies reported having attended the Smart $aver outreach presentations; all but one of these learned about the opportunity through an e-mail newsletter directly from DEC, while the other was invited by his outreach representative. The trade allies rated the usefulness of these presentations at 6.07, on a scale of 0 (not useful at all) to 10 (always useful). One trade ally commented that he considered there to be a difference between “usefulness” and “value,” and said that he did not give a high rating for value because he stayed on top of new offerings. When asked for suggestions of additional information that could be presented, the only idea was to provide more training on how to fill out applications. Another trade ally volunteered that he would “always get something out of the webinars.”

Most of the trade allies reported that they did not provide Smart $aver marketing materials to a customer. When asked if there were any materials that they would like to have, one suggested an easier way to estimate the incentive and mentioned that he heard there was going to be a new tool for this purpose on the website (which has already been implemented). Two others suggested that a flyer would be useful (DEC notes that this is already done), and one commented that some of the qualifying measure specifications did not seem to have “real world options.”

Only three of the 16 respondents reported that they have directed customers to the DEC website. One commented, “our customers rely on us [the trade allies] for this information,” and another stated that “without communication, the tools don’t make any difference.”

Trade Ally Perspective on Customers

The evaluation team asked respondents to estimate what percentage of their customers were already aware of the Custom Program incentive. Two estimated that almost none of their customers were aware, five estimated that about 25% were already aware, two estimated about half were aware, one estimated that about 75% of their customers were aware, and four estimated that their customers were almost always aware. One lighting trade ally said awareness had increased over the past year because electrical distributors were “banging on doors and telling people about it.” Four respondents mentioned that customers seemed to have general awareness that incentives were available, particularly for the Prescriptive Program, but there seemed to be less awareness about the Custom Program. One trade ally remarked that the incentives were excellent, and another mentioned that the incentives were very important to a customer’s decision to undertake a project.

CADMUS

Importance of the Custom Incentive

Eleven trade allies brought up the availability of a Custom Program incentive early in their discussions with the customers, with four saying this was one of the first things they talked about, and another six reporting that they mentioned the incentive after completing the initial scoping. Another said that their proposal form included a space for available incentives.

Nearly all of the trade allies agreed that the incentive was high enough to motivate customers to install high-efficiency equipment (one trade ally said he did not know). One trade ally who worked in other states said that DEC's incentives rated as a "B+" compared with other states across the U.S.

When asked what they thought customers would do if there were no incentives, only two of the 14 respondents said the customers would go ahead with the project anyway. Four respondents reported that customers would go ahead with less expensive, lower quality equipment, or re-scope the project, and four respondents said that customers would not complete the project at all. The remaining four said they did not know.

Increasing Participation

To try to understand barriers to participation for the trade allies, the evaluation team asked respondents why they thought their competitors might not be participating in the Custom Program. Of the 11 who responded, five reported that the complexity or length of the process was a deterrent. One trade ally thought more technical assistance was needed, while another suggested that DEC offer seminars (which DEC already does), and another trade ally simply suggested that DEC market the program more. Three other trade allies disagreed, and said that in their experience, their competitors were already participating in the Smart $aver programs.

Strengths and Areas of Improvement

The evaluation team asked trade allies if they thought the Custom Program had any aspect that was working particularly well. Two of the six respondents said the outreach representative and energy efficiency engineers were doing a great job, two others mentioned the incentive payment timeframe, and one mentioned that DEC gave the best incentives across the majority of utilities.

When asked about areas where the Custom Program needed improvement, eight of the nine trade allies wanted a faster application review time, four wanted better communication with DEC, one wanted more details on how the incentive was calculated, one wanted the online application to be more streamlined, and the last trade ally made a comment about the Prescriptive Program, unrelated to the Custom Program.

Trade allies rated their overall satisfaction (on a scale of 1 to 10, where 1 indicates being very dissatisfied and 10 indicates being very satisfied) with the Custom Program at 7.28, and their overall satisfaction with DEC at 8.25.

CADMUS

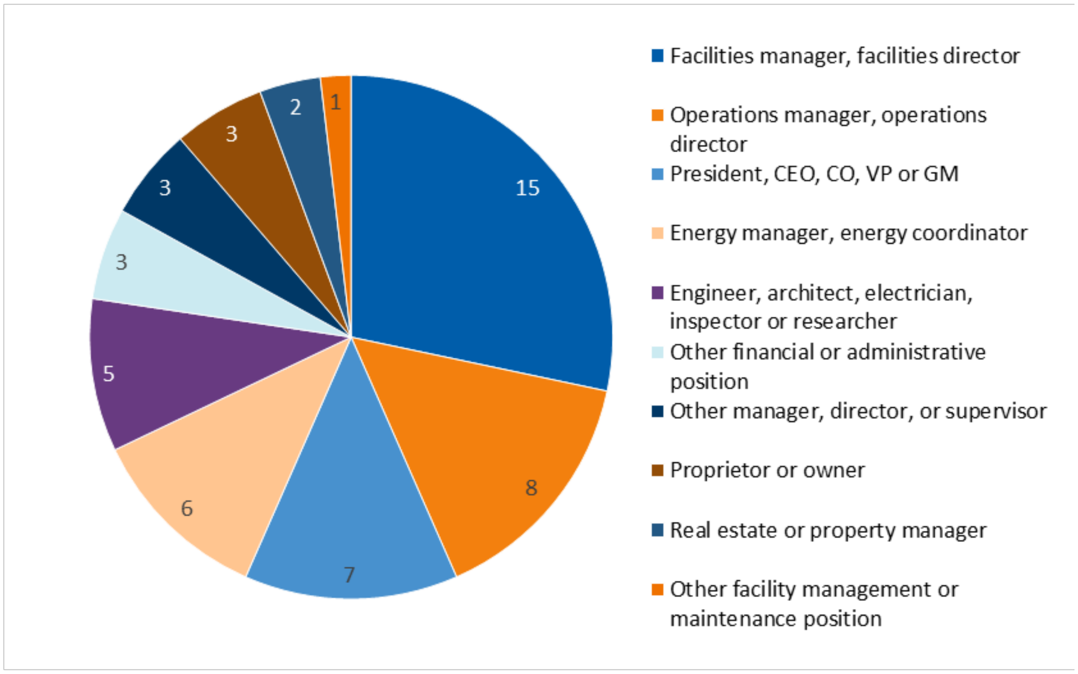
Participant Surveys

Participant Sample Characteristics

The evaluation team surveyed 54 Carolina System Custom Program participants who agreed to answer questions about their experience with the program: 35 were Closed Won participants (25 from North Carolina and 10 from South Carolina) and 19 were Closed Lost participants (11 from North Carolina and eight from South Carolina). We collected participant survey data across three phases, with 26, 11, and 17 participants from each phase, respectively.

Figure 2 shows that these respondents held a variety of roles within their companies, with the facility managers being the largest percentage of respondents (27.8%).

Figure 2. Distribution of Survey Responses to Role at Company*

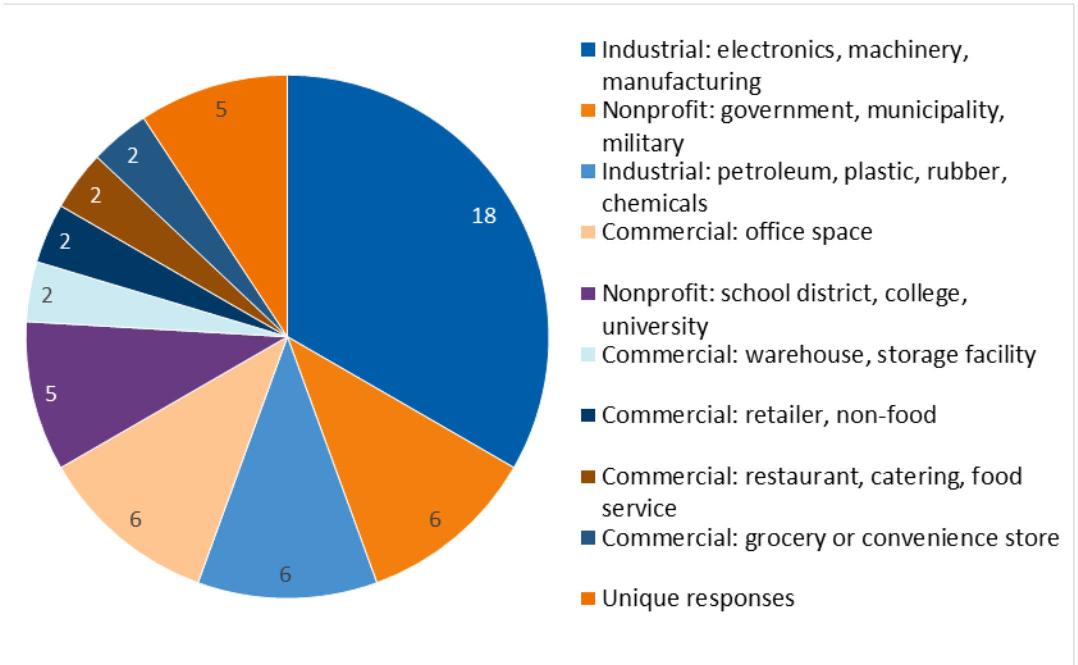


* n=53.

Figure 3 shows the distribution of respondents across various commercial and industrial sectors, with 46% (n=25) from in the industrial sector, 30% (n=16) from the commercial sector, 22% (n=12) from the nonprofit sector, and 2% (n=1) from the agricultural sector.[6]

[6] The counts include unique responses categorized as commercial (n=2), industrial (n=1), agricultural (n=1), and nonprofit (n=1) that are grouped together in the figure.

Figure 3. Distribution of Survey Responses to Business Sector Category*



* The five unique responses to this survey question were: an auto dealership, a house of worship, a farm, a telecommunications company, and an outdoor advertising company; n=54.

Thirty-five respondents reported that their company had a DEC-assigned account manager, nine reported they did not, and the remaining 10 did not know whether they had an account manager.

The majority of both Closed Won and Closed Lost respondents applied for a lighting incentive (n=40), while six applied for a process equipment incentive, three for an HVAC incentive, two for a roofing incentive, and one for an energy management system incentive.

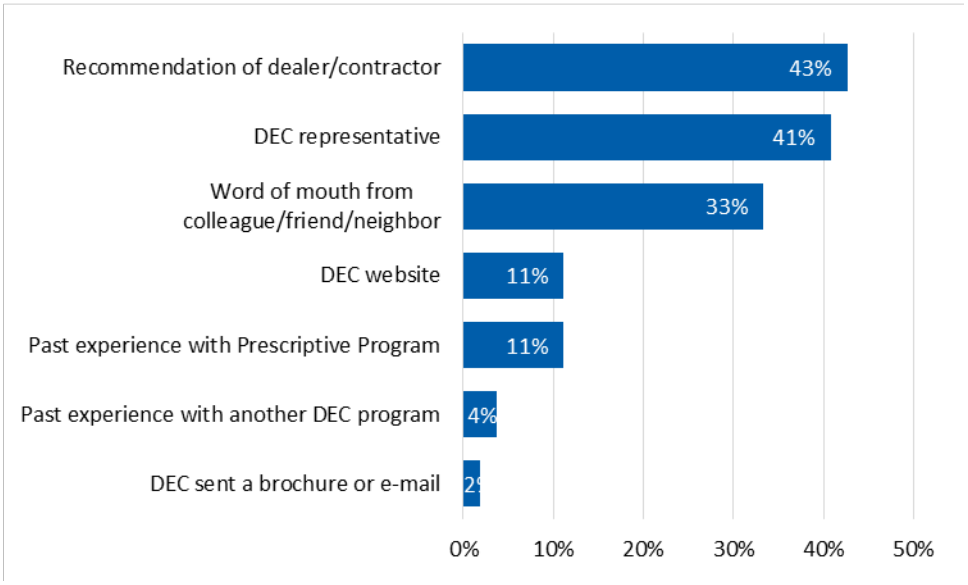
Half of the respondents were new to the Smart $aver programs. Of the remaining, 11 had previously submitted both Custom and Prescriptive applications, five had applied for Custom only, four had applied for Prescriptive only, and the remaining did not remember.

Custom Program Outreach

Source of Custom Program Awareness

Participants primarily learned of the Custom Program from one (or more) of three ways: a DEC representative (41%), a trade ally (43%), or word-of-mouth (33%; Figure 4). This finding aligns with DEC's strategy to market the Custom Program primarily through its account managers and trade allies. The relatively large proportion of customers who learned through word-of-mouth suggests that the Custom Program may be becoming a well-known incentive program.

Figure 4. Distribution of How Respondents' Heard about the Smart $aver Programs*

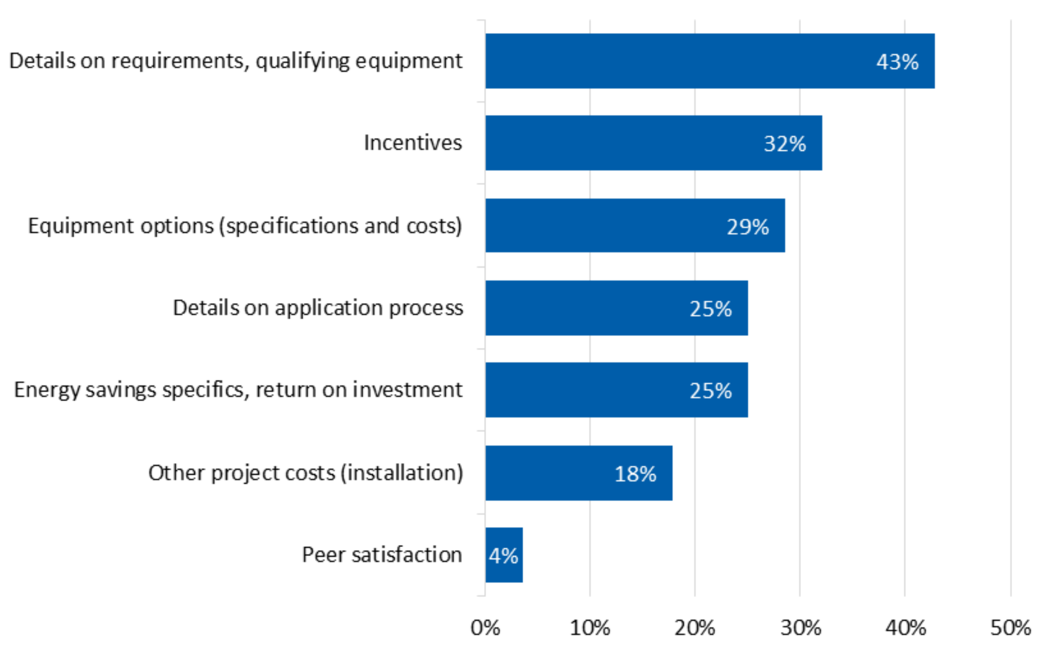


* Multiple responses accepted; n=54.

Program Information Needed

The evaluation team investigated whether the program information provided to the participants could be improved or augmented. When we asked the respondents, 28 of 54 said they needed to seek out any additional information when they were first learning about the Custom Program benefits and requirements. Twenty-four said they did not need additional information and the remaining two did not remember. The 28 who were able to share details on what they needed listed anywhere from one to four types of information (multiple responses accepted). Figure 5 shows the types of additional information these participants sought.

Figure 5. Additional Information Needed for Participation in Custom Program*



* Multiple responses accepted; n=28.

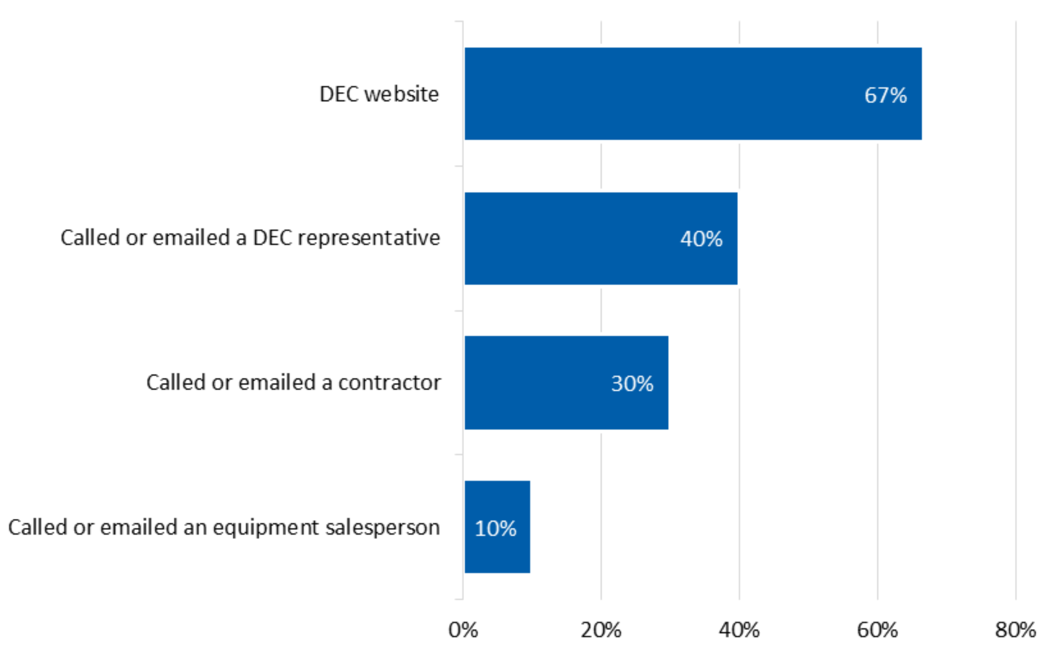
These responses could be placed into two overall categories: (1) program and application information that DEC can potentially provide, and may wish to include with outreach materials if not already, and (2) information specific to the Custom Program project that DEC may not be able to provide, such as energy savings specifics and return on investment. The responses revealed that much of the needed information is project-specific, and may not be something DEC could easily provide. Project-specific outcomes were frequently mentioned by respondents who sought additional information, including the size of the incentive (n=9) and the amount of energy that could be saved (n=7).

Information needs pertaining to program requirements were mentioned more frequently than any other topic (n=12). The application process and time frame were also mentioned by several respondents (n=7). DEC may wish to investigate whether Custom Program staff can provide more details of these processes in their outreach and online materials. Given the nature of the open-ended questions, respondents only provided a high-level description of their needs. However, DEC account managers likely understand the types of information that prospective participants need, and the evaluation team expects these details are already included in reviews of outreach material.

Sources of Additional Information

Respondents turned mainly to DEC resources (staff and website) to find the additional program information they needed (Figure 6); all but one of the 30 respondents reported being able to find the information successfully. This suggests that that DEC's trade ally network and representatives are equally important in implementing the Custom Program. Of the 20 who visited the DEC website, a conditional analysis shows that 11 only went to the website, while three also contacted their DEC representative, another three also contacted their contractor, and another two contacted both their DEC representative and a contractor to get the information they needed. Only one respondent used all three sources—the website, their representative, and their contractor—in addition to an equipment sales person. This respondent was also the only one of the 30 who did not get the information they needed regarding whether there was a provision for theatrical, worship, or presentation spaces.

Figure 6. Sources of Additional Information for Custom Program Participants*



* Multiple responses accepted; n=30.

Suggestions to Increase Participation

The evaluation team asked all respondents if they had suggestions to increase Custom Program participation "other than increasing the level of marketing." We devised this questioning tactic to avoid the tendency of respondents to only suggest increasing the marketing, and we accepted multiple responses. Although five of the 40 respondents still suggested "more marketing," there was a wider range of responses than in past years.

Three respondents suggested that DEC provide more help identifying projects at their facilities. Over half (n=21) made some outreach-related suggestion. There were six suggestions related to finances, with one person suggesting that DEC help with project financing. Three people suggested either removing or reducing the energy efficiency rider, with one person specifically suggesting that DEC either reduce the energy efficiency rider or increase the incentive. There were 11 suggestions related to the application, including to simplify the form, allow online submission, and to keep applicants updated on the application status.

While the team designed this survey instrument to remind respondents to answer with the Custom Program in mind, another seven respondents made a suggestion that was more pertinent to the Prescriptive Program, such as to increase the number of measures eligible for the program. Table 6 shows the distribution of suggestions.

Table 6. Suggestions for Increasing Participation

Suggestion Category	Suggestion Details	Frequency*
Outreach	More marketing (general)	7
	Use e-mail, bill inserts	4
	More personal outreach, in-person meetings	3
	Partner with vendors	3
	Partner with landlords, mayors, city councils	2
	Share success stories, peer support	2
Application	Simplify application process (too technical)	8
	Online submission, speed up process, keep informed about status	3
Prescriptive	Pre-approve more measures or other Prescriptive Program comments	7
Finances	Remove/reduce rider	3
	Larger incentives	2
	Help with financing	1
Assessment	Identify projects based on energy usage	3

* Multiple responses accepted; n=33.

Assistance with Application Process

Respondents worked with trade allies and account managers during the project scoping and application phases. Of the 35 who had an assigned account manager, 19 reported working with their account manager on their Custom Program application (although two could not recall the details of their collaboration). Table 7 shows that the account managers provided a variety of assistance to the respondents on program and application-related matters. Account managers were most frequently contacted for general program information and for questions about the application paperwork.

Table 7. Account Manager Assistance to Respondents

Response	Mentions*
Verify completeness of rebate applications/paperwork	59%
Provide information about eligible equipment options/equipment specifications	29%
Provide updates on the application status	24%
Resolve problems with applications	18%
Calculate payback/estimate return-on-investment	12%
Help with budgeting/project scoping/resource planning	0%

* Multiple responses accepted; n=17.

Respondents tended to work with trade allies more frequently than they worked with account managers. Forty-three of the 54 respondents reported that they worked with a trade ally during the scoping and application phases. Table 8 shows that respondents relied on the trade allies to acquire and install equipment, and for application assistance. Trade allies also provided help with calculating energy savings and payback, and with finding incentives.

Table 8. Trade Ally Assistance to Respondents

Response	Mentions*
Acquire and install equipment	65%
Complete rebate applications/paperwork	53%
Provide information about equipment options/equipment specifications	51%
Help finding and qualifying for rebates	37%
Calculate payback/estimate return-on-investment	35%
Help with budgeting/project scoping/resource planning	16%
Conduct energy modeling	2%

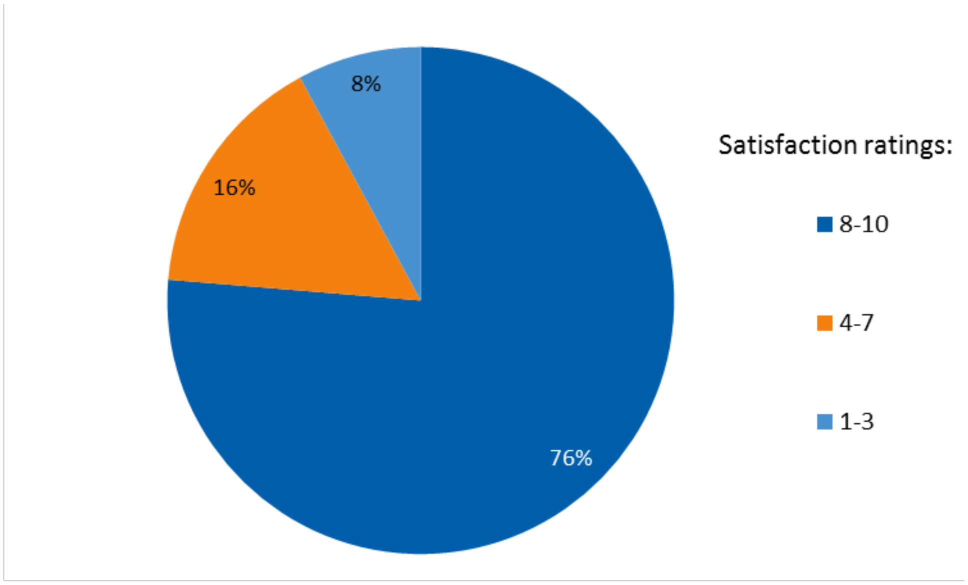
* Multiple responses accepted; n=43.

Table 7 and Table 8 show that the respondents lean heavily on the trade allies during the project scoping and application processes. Those with account managers contacted them for more programmatic questions. This data reflects customer practices prior to DEC's addition of the energy efficiency engineers, who are now available to assist customers with technical issues. This data can be used as a baseline for measuring the increasing role of the engineers during the project scoping and application process. Future surveys should specifically ask customers about the role of the energy efficiency engineer and their satisfaction with the engineers' assistance.

Twenty-six respondents reported that they contacted DEC staff for help during the application process. Of these, 18 said their request was handled satisfactorily. Of the eight who were not satisfied, three said DEC staff were not able to provide a specific enough answer, four said the response time could be faster, and one did not know.

When we asked specifically about their satisfaction with the technical expertise of DEC staff, participants rated this an average of 8.0 on a scale from 1 to 10, where 10 is most satisfied. Twenty-nine of the 38 respondents gave a satisfaction rating of 8 or higher, while nine gave a satisfaction rating of 7 or lower (Figure 7). When asked how DEC staff could have improved this rating, six respondents mentioned a range of issues. One wanted a single point of contact within DEC, another wanted faster responses, and a third wanted DEC to be more involved "so they could see what the company was doing." Two others wanted help with information; one who wanted technical consulting from DEC and one who wanted DEC's help matching addresses to meters. The last respondent was dissatisfied because they could not get help getting certification of certain lighting fixtures.

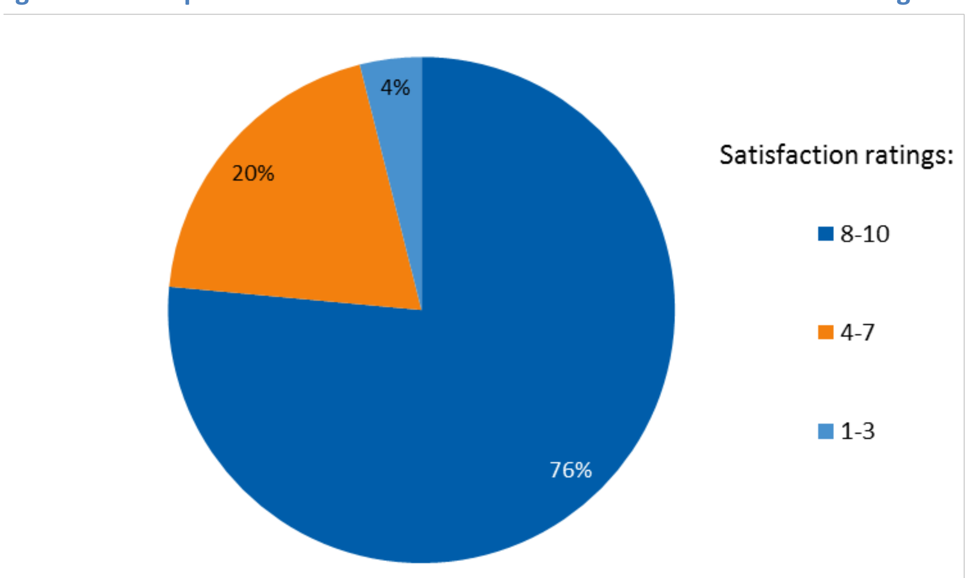
Figure 7. Participant Satisfaction with Technical Expertise of DEC Staff*



* n=38.

Respondents rated their satisfaction with the information provided about the program as an average of 8.2 (Figure 8). We asked respondents who rated their satisfaction as a 7 or lower for suggestions on improving the information. Six wanted a better explanation of the application and program requirements, two said the information was too vague, another two said there was too much technical information that was not relevant to their projects, two wanted more assistance or a webinar, and one wanted more information about the application timetable.

Figure 8. Participant Satisfaction with Information Provided About the Program*



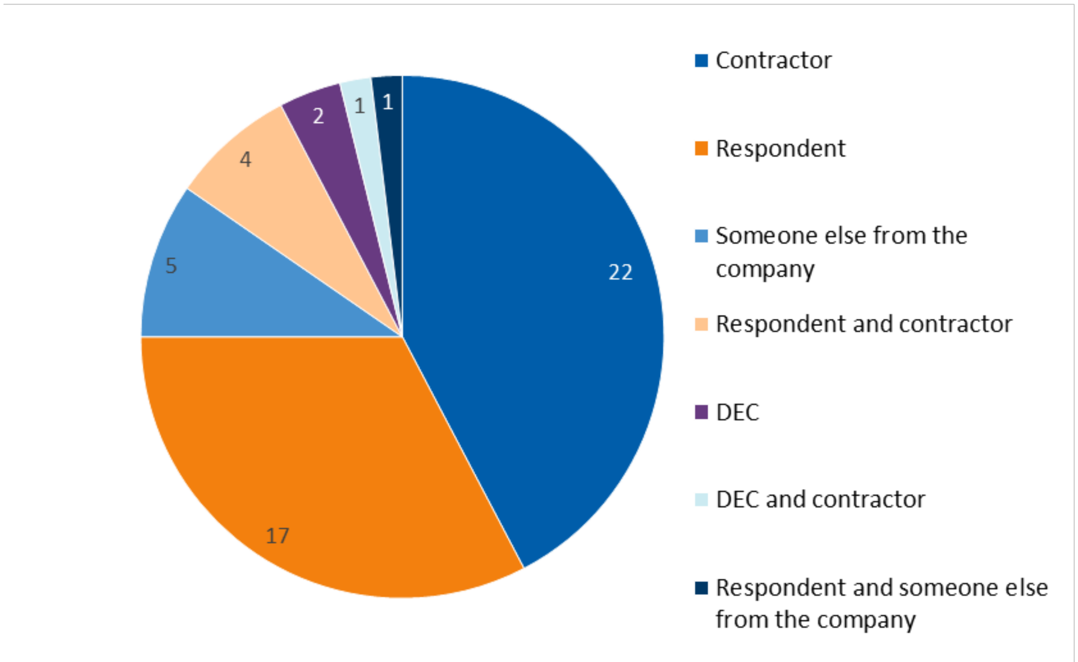
* n=51.

CADMUS

Application Process Satisfaction

The respondents reported that in 42% of projects, contractors filled out the application. In another one-third of projects, the respondent filled out the application themselves, and for 10% of projects someone from the respondent's company filled out the application (Figure 9). In the remaining cases, project applications were filled out jointly by a combination of staff, with DEC contributing in two cases.

Figure 9. Participant Responses to Who Filled Out Project Application*

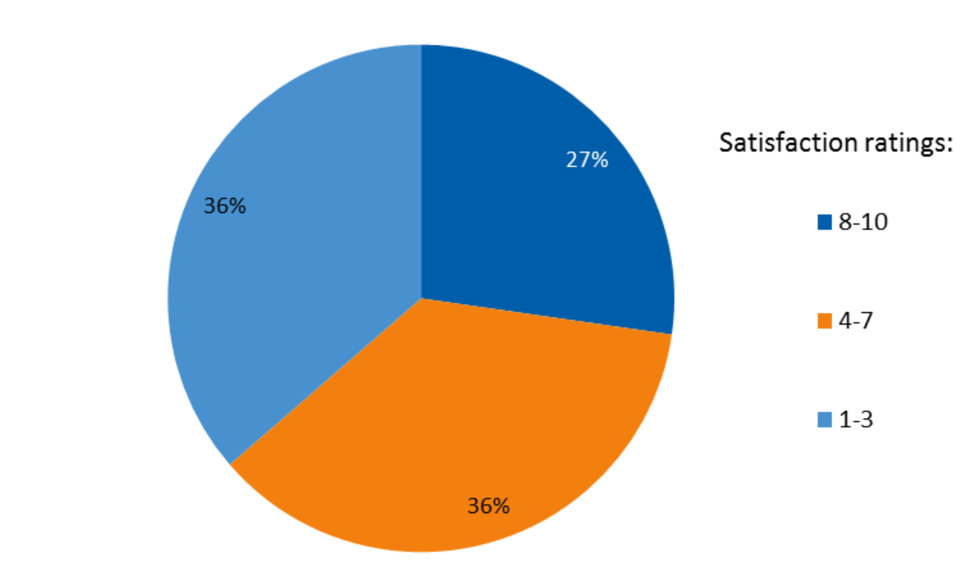


* n=52.

Ease of Understanding the Application

The 22 respondents who had a role in filling out their application rated the application as being difficult to understand (average rating of 5.0, using a scale of 1 to 10, with 1 indicating "extremely difficult" and 10 indicating "extremely easy;" see Figure 10).

Figure 10. Participant Ease of Understanding Program Application*



* n=22.

Table 9 shows the respondents' suggestions for improving the applications. Note that one respondent wanted an online application, and due to the multiyear survey efforts, this comment is out of date. DEC implemented an online application, and two respondents' comments reflect the online application: one who wanted the ability to save an unfinished application to complete later, and another who said the pull down menu on the site did not offer the combination of lamps and fixtures he wanted. The other comments align with the complexities of the Custom Program application, including the length and amount of technical information needed. The Custom Program managers are well aware of these issues, most of which are due to the amount of information required for DEC's rigorous review process.

Table 9. Suggestions to Make Application Easier to Understand

Response	Mentions*
Less technical information required	33%
Less cumbersome or lengthy	27%
Better communication of requirements, better examples	20%
Online app comment: Ability to save, change pull down menu	13%
Break form into technologies	13%
Create online application	7%

* Multiple responses accepted; n=15.

Five respondents had problems during their application approval process: four reported they had incorrect information, including one who had difficulty providing the correct name matching the account number. The last respondent was only approved for half of the incentive because the application did not offer the combination of equipment he wanted, as mentioned above.

Participation Drivers

Respondents reported that their primary motivation for undertaking their Custom Program projects was to reduce costs, both energy costs and repair and maintenance costs. Table 10 shows the drivers of participation from the 54 respondents. Forty-eight (89%) mentioned the need to reduce energy costs, followed by 33 (61%) who cited a need to reduce repair and maintenance costs. An equal number (21 each, or 39%) mentioned environmental concerns and the unreliability of old equipment as a motivator. Sixteen (30%) cited the attractiveness of the equipment cost, while 14 (26%) cited their need for modern equipment to integrate with an energy management system. Thirteen participants (24%) reported that they conducted their Custom Program project due to their contractor's recommendation.

This pattern suggests that the primary motivation for upgrading equipment was to reduce energy costs, with a secondary motivation to reduce repair and maintenance costs, with over half of the respondents citing one or both of these motivations. Non-energy benefits and environmental concerns formed an additional motivator, suggesting that DEC Custom Program staff may want to incorporate messaging around these motivators in marketing collateral.

Table 10. Participants' Reasons for Upgrading Equipment

Response	Mentions*
To reduce energy costs	89%
To reduce repair, maintenance, and other labor costs	61%
Due to environmental concerns	39%
Because old equipment was working poorly or was unreliable	39%
It was a good deal	30%
Needed more modern, smarter equipment (to integrate with energy manager systems or Smart Grid)	26%
Due to my contractor's recommendation	24%
Purchased as part of a broader remodel	9%
Wanted non-energy-related product features such as appearance, brand loyalty, decreased water use, and increased comfort	7%

* Multiple responses accepted; n=54.

Project Follow-Up and Payback

Of the 18 Closed Lost respondents, 10 said they completed their project even without an incentive, and eight of those 10 installed the equipment that was on their application. The remaining two reported installing equipment that was both less expensive and less efficient than the equipment on the Custom Program application. Of these 10, nine were able to report that it took them an average of just over five months to complete their projects. The fact that 10 of 18 Closed Lost respondents went ahead with their projects seems to confirm that the Custom Program criteria for incentive approval successfully filtered out projects that were likely to proceed without an incentive.

Five more of the Closed Lost respondents reported that their projects were cancelled, citing project costs. One of these five said their landlord was unwilling to upgrade their lighting. Three of the Closed Lost respondents reported that their projects had been postponed with no definite start date.

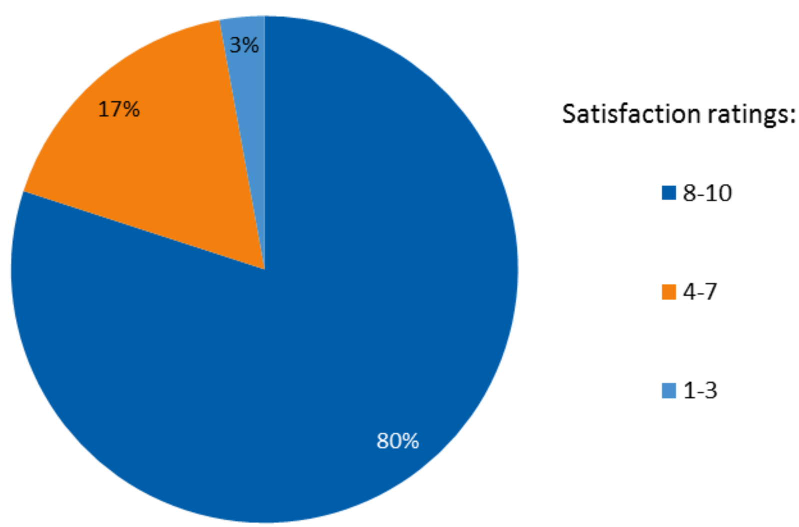
Nine Closed Lost respondents were able to share their project's estimated payback period, averaging 47 months, and ranged from 28 to 78 months.

Of the 33 Closed Won respondents whose projects were completed, 32 reported that it took them an average of 3.6 months to complete their projects (the last did not know). Twenty Closed Won respondents reported an average payback period of 42 months, ranging from 11 to 119 months (just under 10 years).

Satisfaction with Incentives

The evaluation team asked the 35 Closed Won respondents to rate their satisfaction with the amount of program incentives provided, using the same 1-to-10 scale as above, and they provided an average satisfaction rating of 8.1 (see Figure 11).

Figure 11. Participant Satisfaction with the Incentive Amounts*

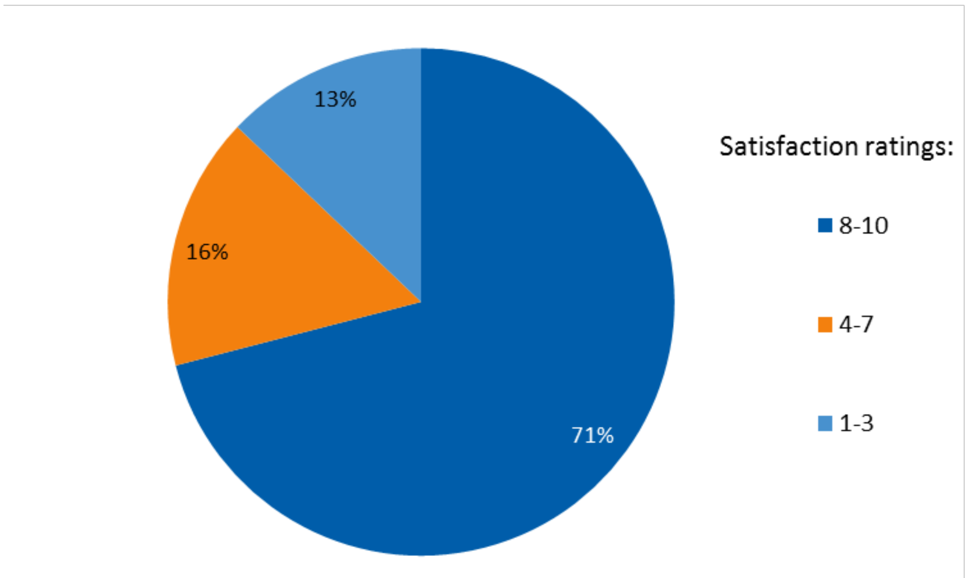


* n=35.

We asked respondents who gave a rating of 7 or lower to share the reason for their rating. Of six who shared their reasons, four wanted higher incentives, with two citing a need to decrease payback. The remaining two cited other reasons: one wanted the incentive to be paid upon installation, while the other wanted "more explanation of what fixtures gets what rebate," suggesting that they were expecting a different amount. This last respondent's concern may be met with the new Custom-to-Go applications, which may set a clearer expectation of the incentive that will be received.

Closed Won respondents rated their satisfaction with the time it took to receive their incentive, providing a mean rating of 7.5 (see Figure 12). We asked respondents who gave a rating of 7 or lower to share the reason for their rating. Of the five who shared, three mentioned that it took a long time, one mentioned that his paperwork was lost, and one said he was constantly asked to change or add information (though it was not clear whether this occurred in the same application effort.)

Figure 12. Satisfaction with Time to Receive Incentive*



* n=31.

Strengths and Challenges

The evaluation team asked respondents if they thought any part of the Smart $aver programs deserved mention for working particularly well. Table 11 shows the response from 27 participants, who most frequently cited the incentive itself.

Table 11. What Participants Said Worked Well in the Custom Program

Response	Frequency*
Incentive	14
All of it	4
Ease of use	3
Excellent staff	2
Payments timely	2
Using less energy	1
Quick turnaround/easy to apply	1
Communications	1
Like the equipment	1

* Multiple responses accepted; n=27.

Twenty-four respondents offered suggestions for improving the Custom Program (shown in Table 12). The predominant suggestion was to simplify the application (n=11). One respondent mentioned that communications could be timelier, as he did not realize until this evaluation survey that he was not offered an incentive for an application he submitted 15 months prior.

Table 12. Participant Suggestions for Program Improvement

Response	Frequency*
Simplify application	11
Timely communications	3
More assistance/provide audit	2
More marketing	2
Rider is too expensive	2
Savings were lower than expected	2
Less stringent application	1
Faster approval	1
Provide examples	1

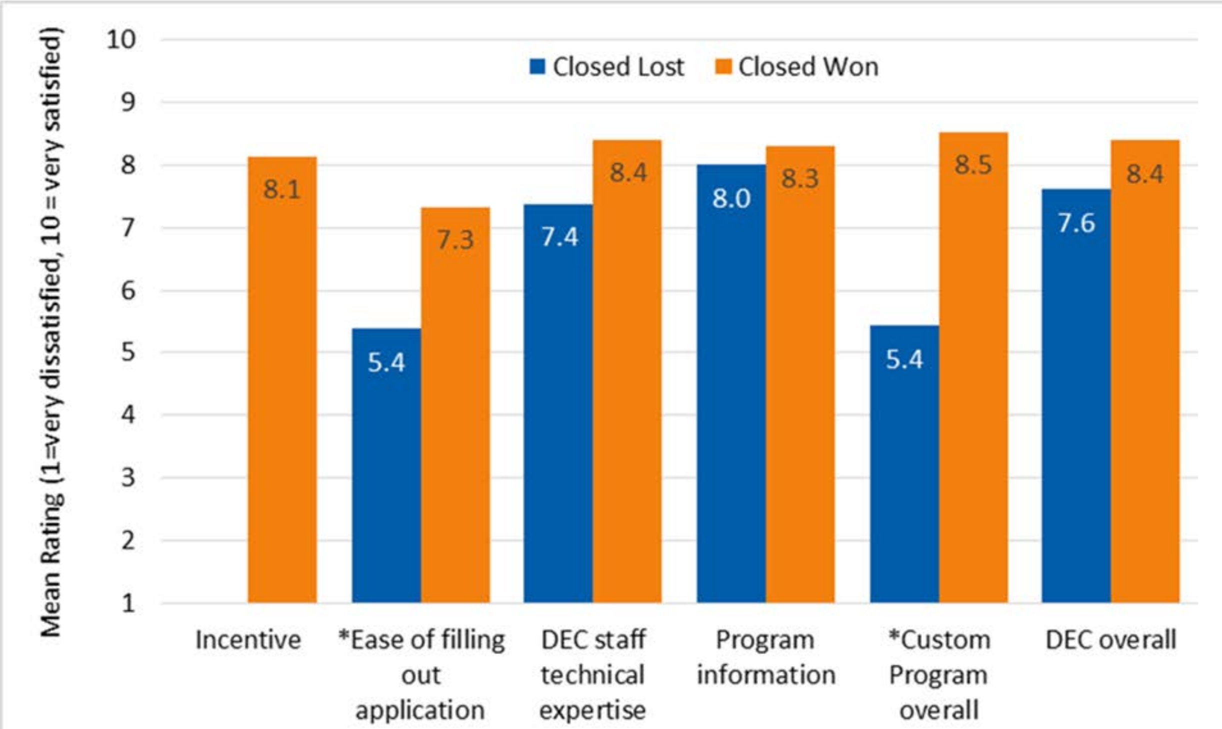
* Multiple responses accepted; n=24.

For some of these suggestions, the data may be too outdated to drive any recommendations for program changes. In future evaluations, the addition of the Custom-to-Go online calculators may decrease complaints about the difficulty of the application process.

In summary, Figure 13, copied from earlier in this report, shows the participant satisfaction ratings for a number of program elements (with asterisks on the labels that indicate a significant difference). Although Closed Lost respondents had low satisfaction with the Custom Program overall (mean rating of 5.4), their satisfaction rating with DEC itself was not significantly different from the Closed Won respondents. Also, the Closed Won respondents had high satisfaction for every element except their ease of filling out the application (mean rating of 7.3)

These ratings reflect the comments reported above, confirming what program managers already know: the Custom Program application is perceived as being complex and difficult to complete.

Figure 13. Participant Satisfaction with the Custom Program in the Carolinas System



Closed Lost (n)		16	16	12	7	18
Closed Won (n)	35	24	22	13	32	35

* Differences between groups are statistically significant at $p<0.05$ using a two-tailed t-test.

CADMUS

Appendix A. Closed Lost Applicant Status

Cadmus requested additional information from DEC about why the Closed Lost businesses that responded to the participant survey were not paid an incentive, shown in Table 13.

Table 13. Closed Lost Non-Payment Reason

State	Application ID	Applicant Went Ahead with Project	Reason
NC	13-1306653	No	Closed due to age. No activity on the application.
NC	13-1348464	Yes	Project scope was eligible via prescriptive; custom application therefore closed.
NC	no ID	Yes	This opportunity was created and closed by the economic development manager. This opportunity died prior to a formal application ever being submitted.
NC	13-1442961	Yes	Likely use of ineligible LED products that were not on the DesignLights Consortium (DLC) qualified products list. Numerous attempts to get clarification went unanswered and the application was eventually closed.
NC	13-1548075	Yes	Same project scope related to application ID 13-1544634. Applications were not mutually exclusive, so this one was closed.
NC	13-1425348	Yes	Project scope was eligible under the prescriptive program. Therefore, the custom application was closed.
NC	13-1310912	No	The customer cancelled project.
NC	11-330	Yes	Very aged application, archived files are not clear why this was closed, though age was likely a factor. Offer was successfully delivered in 2011.
SC	13-1612630	No	Customer cancelled project.
SC	no ID	No	This opportunity was created and closed by the Account Manager. This opportunity died prior to a formal application ever being submitted.
SC	12-346	No	Very aged application, archived files are not clear why this was closed, though age was likely a factor. Offer was successfully delivered in 2012.
SC	no ID	No	This opportunity was created and closed by the Account Manager. This opportunity died prior to a formal application ever being submitted.
SC	11-294	Yes	Customer committed prior to offer and closed application.

CADMUS

NC	13-1586579	Yes	Portion successfully paid, but remainder was not paid as invoices preceded offer date. Communication with applicants went cold and application was closed.
SC	14-1688761	Yes	Project was not completed at the time of the survey; it was successfully paid in 2014.
SC	14-1640144	Yes	Rejected as project simple payback was less than one year prior to any incentive.
SC	14-1699866	No	Customer cancelled project due to extremely long lead time (more than one year). They indicated they would re-apply at a later date.
NC	CSN15-1811370	Yes	Customer placed project on hold and requested application be closed.
NC	CSN15-0000052327	Yes	Non-DLC product chosen, but internal qualification documentation (LM-79, 80, etc.) could not be provided and application was closed.

CADMUS

Appendix B. Management Interview Guide

Name: ____

Title: ____

Position description and general responsibilities:

____

____

We are conducting this interview to obtain your opinions about and experiences with the Nonresidential Smart $aver Custom Program. We'll talk about the Smart $aver Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency. We will not identify you by name. However, you may provide some information or opinions that could be attributed to you by virtue of your position and role in this program. If there is sensitive information you wish to share, please warn me and we can discuss how best to include that information in the report.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

Program Background and Objectives (15 min)

1. Please describe your role and scope of responsibility in detail.
2. How long have you been involved with the Smart $aver Program?
3. Describe the evolution of the Smart $aver Program. Why was the program created, and has the program changed since it was it first started?
4. Have there been any recent changes been made to your duties since you started?
    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?
5. In your own words, please describe the Smart $aver Program's objectives (e.g., enrollment, energy savings, non-energy benefits).
6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?

a. Marketing/Targeting: How & Who

b. Enrollment/Participation

c. Application processing

d. Technical verification: How & Who

7. Are there any challenges that would affect your program's ability to meet its objectives?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

Vendors (10 min)

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

12. Are there any research issues you would like to suggest for our vendor interviews?

Rebates (15 min)

13. (PM only) Please describe for me how each Custom application is processed, and reviewed.

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

Contractor Training (5 min)

14. Do you have any suggestions for improving contractor effectiveness?

Improvements (10 min)

15. Are you currently considering any changes to the program's design or implementation?
    a. What are the changes?
    b. What is the process for deciding whether or not to make these changes?
16. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?
17. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?
18. Overall, what would you say about the Smart $aver program is working really well?
    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?
19. What area needs the most improvement, if any?
    a. (*If not mentioned before*) What would you suggest can be done to improve this?
20. Are there any other issues or topics we haven't discussed that you feel should be included in this report?
21. Do you have any further questions for me about this study or anything else?

Thank you!

Appendix C. Duke Energy Nonresidential Smart $aver Custom Trade Ally Survey

Researchable Questions	Item
Introduction	A1-6
Participating in the program	B1-13
Program participation experience	C1-19
Market impacts and effects	D1-5
Recommended changes	E1-2
Satisfaction with program	F1-5
Satisfaction with utility	G1-2
Closing	H1

Target Quota =

[Carolinas – ten completes for Phases 1, 2, 3 combined]
[Ohio – ten interview completes for Phases 1 and 2 combined]
[Indiana – ten interview completes for Phases 1 and 2 combined]
[Kentucky – As many as possible, no minimum number of completes required in this state]

General Instructions

- Interviewer instructions are in green **[LIKE THIS]**.
- CATI programming instructions are in red [**LIKE THIS**].
- Items that should not be read by the interviewer are in parentheses like this ( ).

Variables to be pulled into survey from sample (return all information from sample in the final data file)

- State
  - INDIANA
  - OHIO
  - KENTUCKY
  - SOUTH CAROLINA
  - NORTH CAROLINA
- Name
- Title
- Company
- Customer Company
- Measure
- Date the customer incentive was paid

A. Introduction

A1. Hello, my name is [INTERVIEWER NAME], and I'm calling from [SURVEY FIRM] on behalf of Duke Energy. May I speak with [NAME] please?

1. (Continue) [IF PERSON TALKING, PROCEED.]
2. (No or not a convenient time) [IF PERSON IS CALLED TO THE PHONE REINTRODUCE. IF NOT FREE TO TALK, ASK WHEN WOULD BE A GOOD TIME TO CALL AND SCHEDULE THE CALL-BACK]

98. (Don't know) [ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]
99. (Refused) [THANK AND TERMINATE]

A2. We had a call scheduled for this time to ask about your opinions about Duke Energy's Nonresidential Smart $aver Custom Incentive program. [IF NEEDED: WE'LL TALK ABOUT YOUR UNDERSTANDING OF THE SMART $AVER CUSTOM INCENTIVE PROGRAM AND ITS OBJECTIVES, YOUR THOUGHTS ON IMPROVING THE PROGRAM, AND THE TECHNOLOGIES THE PROGRAM COVERS.] The interview will take about 30 minutes to complete. May we begin?

1. (Yes)
2. (No or no understanding of the Smart $aver program)

   A2a. Is there someone else at your company who might be more appropriate for me to talk to?

   1.(Yes) [RECORD NEW CONTACT INFO FOR SCHEDULING]
   2.(No) [THANK AND TERMINATE]
   98.(Don't know) [THANK AND TERMINATE]
   99. (Refused) [THANK AND TERMINATE]

3. (No or not a good time)

   A2b. Is there a better time for us to have this call?

   4.(Yes) [RECORD NEW SCHEDULED TIME FOR CALL-BACK]
   5.(No) [THANK AND TERMINATE]
   98.(Don't know) [THANK AND TERMINATE]
   99. (Refused) [THANK AND TERMINATE]

CADMUS

A3. We would like to start by first asking about your company. What kind of business is it? **[DO NOT READ LIST; RECORD ONE RESPONSE]**

1. (Manufacturer)
2. (Distributor)
3. (Wholesalers)
4. (Retailer)
5. (General Contractor)
6. (Installer)
7. (Consulting/Engineering)
8. (Other) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

A4. What is your job title and what are your responsibilities at your company?
[RECORD RESPONSE]

A5. How long have you been in this profession?
[RECORD RESPONSE]

A6. Do you help customers make decisions about what type of equipment to install?

1. (Yes)
2. (No) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]

98. (Don't know) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]
99. (Refused) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]

CADMUS

B. Participating in the Program

B1. Let's move on to program participation. How did you first learn about the Smart $aver Program? [RECORD ALL THAT APPLY]

1. (Past experience with Smart $aver Custom Program)
2. (Past experience with another Duke Energy program)
3. (Duke Energy sent me a brochure or e-mail)
4. (A Duke Energy representative told me about it)
5. (Duke Energy website)
6. (Recommendation of a dealer/contractor)
7. (Recommendation of the customer)
8. (Word of mouth: colleague/friend/neighbor)
9. (Saw an advertisement in the newspaper)
10. (Saw an advertisement on television)
11. (Saw an advertisement online)
12. (Heard an advertisement on the radio)
13. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

B2. Have you participated as a trade ally in the Smart $aver Prescriptive incentive program only, Smart $aver Custom incentive program only, or both? [PROBE FOR CLARIFICATION IF NEEDED – ONE OR THE OTHER OR BOTH?] [IF NEEDED, TRADE ALLY IS AN ADVISOR, VENDOR, CONTRACTOR, DESIGNER OR ENGINEER]

1. (Prescriptive only)
2. (Custom only)
3. (Both Custom and Prescriptive)
4. (Neither program) [ASK IF THERE IS SOMEONE AT THE COMPANY WHO KNOWS MORE ABOUT SMART SAVER AND BEGIN AGAIN WITH THEM] [IF RESPONDENT INSISTS THAT THEY HAVE NOT SUBMITTED APPLICATIONS FOR EITHER PROGRAM THEN THANK AND TERMINATE]
5. (Other response) [RECORD RESPONSE]
98. (Don't know) [IF RESPONDENT SAYS THAT THEY HAVE NO KNOWLEDGE OF EITHER PROGRAM THEN THANK AND TERMINATE]
99. (Refused)

B3. How long have you been a partner in the Smart $aver Custom Program? [PROBE IF NEEDED]: When did you first submit a Smart $aver Custom application?
[RECORD RESPONSE]

B4. Typically, what is your company's role on a project?
[RECORD RESPONSE]

B5. Are you or your company signed up in the Trade Ally list on Duke Energy's website?
1. (Yes)
2. (No)
3. (Other response) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF B5=1]
B6. Have you gotten any leads from the Duke Energy website?
1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

B7. When you are talking with a prospective customer, what percentage have already heard of Duke Energy's Smart $aver Program? Would you say...? [READ LIST, CHECK ONE]
1. Almost None
2. About 25%
3. About 50%
4. About 75%
5. Almost all
98. (Don't know)
99. (Refused)

B8. When you are talking with a customer, at what point in the discussion do you usually bring up the incentive? [IF NEEDED, PROMPT: "DURING THE INTRODUCTORY MEETING, AFTER YOU'VE SCOPED THE PROJECT, ONLY IF THE CUSTOMER ASKS?"]
1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

B9. Have your customers expressed any complaints about the program to you?

1. (Yes)

    B9a. What were these complaints? [RECORD RESPONSE]

2. (No)
3. (Other response) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

B10. Please give me an estimate: What percentage of your 2014 projects include equipment that received a Smart $aver Custom incentive? [IF THEY CAN'T REMEMBER PRESCRIPTIVE SEPARATE FROM CUSTOM, HAVE THEM ESTIMATE TOGETHER AND RECORD THAT THE PERCENTAGE IS COMBINED]

1. (Response given) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

B11. Are the incentive levels high enough to motivate customers to install high efficiency equipment?

1. (Yes)
2. (No)
3. (Other response) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

[ASK IF B11=2]

B12. What types of equipment should have a higher incentive, and how much higher should it be?

1. (Response given) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

B13. Why do you think some of your competitors do not participate in this program?

1. (Response given) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

CADMUS

C. Custom Program Participation Experience

The next few questions ask about the process for submitting application forms to the Custom Program and the incentive approval process.

C1. Do you ever submit applications to the Custom Program on behalf of your customer?

1. (Yes)
2. (No) [SKIP TO C7]
98. (Don't know) [SKIP TO C7]
99. (Refused) [SKIP TO C7]

[ASK IF 0=1]

C2. Do you think this process could be streamlined in any way?

1. Yes [RECORD RESPONSE]
2. No
98. (Don't know)
99. (Refused)

[ASK IF 0=1]

C3. How long does it typically take between the time you send in a Custom application and the time you or your customer learns whether or not the project qualifies for an incentive?

1. (Response given) [RECORD RESPONSE IN DAYS, WEEKS OR MONTHS]
98. (Don't know)
99. (Refused)

[ASK IF C3=1]

C4. On a scale of 1 to 10, with 1 indicating not satisfied at all and 10 indicating highly satisfied, how satisfied are you with the amount of time it typically takes between the time you send in the application and the time you learn whether your project qualifies for an incentive,?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF C4 <= 7]

C5. Why do you say that?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF C4 <= 7]

C6. How long do you think it should take between submitting an application and learning if your project qualifies for an incentive?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

C7. Have you attended any presentations made by Duke Energy's Smart $aver Program staff?

1. (Yes)
2. (No) [SKIP TO C11]
98. (Don't know) [SKIP TO C11]
99. (Refused) [SKIP TO C11]

[ASK IF C7=1]

C8. How did you hear about these presentations?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF C7=1]

C9. Can you please rate the usefulness of the presentation you most recently attended, on a scale of 0 to 10, where zero indicates "Not useful at all" and 10 indicates "always useful".

1. (Rating given) [RECORD NUMBER 0-10]
98. (Don't know)
99. (Refused)

[ASK IF C7=1]

C10. Is there any information you would like Duke to provide at these presentations, that they are not currently providing about the Custom program?

1. (Response given) [RECORD RESPONSE]
2. (No suggestions)
98. (Don't know)
99. (Refused)

C11. This next question asks about the people you interact with at Duke Energy, during the course of a custom project. Do you interact with…? **[READ LIST, CHECK ALL THAT APPLY]**

1. Large Account Managers
2. Smart $aver Outreach Representatives
3. The Smart $aver Custom program managers (SMART $AVER PROGRAM MANAGER ARE FOLKS WHO ADMINISTER THE PROGRAM)
4. Duke Energy's Energy Efficiency Engineers? (EE ENGINEERS ARE FOLKS WHO PERFORM THE TECHNICAL ANALYSIS WHEN THE APPLICATION IS TURNED IN)
5. Any other Duke Energy employees?
   C11a. Who were they? [RECORD RESPONSE]
6. (None of the above) [SKIP TO C13]

98. (Don't know) [SKIP TO C13]
99. (Refused) [SKIP TO C13]

[ASK C12 ONCE FOR EACH RESPONSE 1-5 THAT WAS CHECKED IN C11]

C12. What was the purpose of your interaction with [RESPONSE(S) 1-5 FROM C11]? [RECORD RESPONSE]

C13. On a scale of 1 to 10, with 1 indicating not satisfied at all and 10 indicating highly satisfied, please rate how satisfied you are with the communication between you and Duke Energy on Smart $aver-related issues.

1. (Rating given) [RECORD NUMBER 1-10]

98. (Don't know)
99. (Refused)

[ASK IF C13 <=7]

C14. How can Duke Energy improve the way they communicate on Smart $aver related issues? [RECORD RESPONSE]

C15. Do you use any information or technical tools from the Smart $aver website when making proposals to customers?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

C16. Have you directed any customers to materials on Duke's website?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF C15=1 OR C16=1]

C17. How would you rate the usefulness of the materials at the Duke Energy website on a scale of 0 to 10 where zero indicates "Not useful at all" and 10 indicates "always useful"?

1. (Rating given) [RECORD NUMBER 0-10]
98. (Don't know)
99. (Refused)

[ASK IF C17<= 7]

C18. How can Duke Energy improve the usefulness of these materials?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

C19. Are there any other materials you would like to have when discussing the project with customers?

1. (Yes)
   C19a. What materials? [RECORD RESPONSE]
2. (No)
98. (Don't know)
99. (Refused)

D. Market Impacts and Effects

D1. What percent of Smart $aver buyers do you think are replacing older equipment that is still functioning, but less efficient?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

D2. What percent of Smart $aver buyers do you think are replacing failed units?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

D3. If the program were not offered, do you think customers would change their project scope in any way?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF D3=1]

D4. In what way would they change the scope of their projects?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF D3=1]

D5. What would they change with regards to the start date of the project?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

E. Recommended Changes

E1. Is there anything about the Smart $aver Program that you would say is working exceptionally well?

1. (Yes,) [RECORD RESPONSE]
2. (No comments)
98. (Don't know)
99. (Refused)

[ASK IF E1=1]

E2. What program change or improvement should be Duke Energy's number one priority?

1. [RECORD RESPONSE]
2. (No suggestions)
98. (Don't know)
99. (Refused)

F. Satisfaction with program

[ASK IF STATE="OHIO"]

F1. I'm now going to ask you to rate your satisfaction with the program two different ways. If you were rating your overall satisfaction with the Smart $aver Custom Program, would you say you were . . . [READ LIST AND SELECT ONE RESPONSE]

1. Very Satisfied
2. Somewhat Satisfied
3. Neither Satisfied nor Dissatisfied
4. Somewhat Dissatisfied
5. Very Dissatisfied
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF H85=1, 2, 3, 4 OR 5]

F2. Why do you give it that rating?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF STATE="OHIO"]

F3. And what numerical rating would you give for your overall satisfaction with the Smart $aver Custom Program, using a scale of 1 to 10 where 1 means "not satisfied at all" and 10 means "extremely satisfied"?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF STATE="NC", "SC", "IN" OR "KY"]

F4. Considering all aspects of the program, what numerical rating would you give for your overall satisfaction with the Smart $aver Custom Program, using a scale of 1 to 10 where 1 means "not satisfied at all" and 10 means "extremely satisfied"?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF H96 <= 7]

F5. What would you recommend to improve the program, or have we already covered it?

1. (Response given) [RECORD RESPONSE]
2. (We have already covered it / no additional comments)
98. (Don't know)
99. (Refused)

G. *Satisfaction with Utility*

G1. Using the same numerical scale, how would you rate your overall satisfaction with Duke Energy?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF H98 IS <= 7]

G2. What, if anything, could Duke Energy do to increase your satisfaction, or have we already covered it?

1. (Response given) [RECORD RESPONSE]
2. (We have already covered it / no additional comments)
98. (Don't know)
99. (Refused)

H. Closing

H1. That concludes this survey, thank you very much for taking the time to help Duke Energy improve this program. Your response is very important to us.

CADMUS

Appendix D. Nonresidential Smart $aver Custom Participant Survey

Researchable Questions	Item
Introduction / screening	A1-3
Screening questions: Closed Won and Closed Lost	B1-7, C1-8
Program awareness and information	D1-11
Decision making: Closed Won and Closed Lost	E1-17
Application process	F1-10
Spillover: Closed Won and Closed Lost	G1-14, H1-7
Program improvements	I1-6
Satisfaction with program	J1-13
Satisfaction with utility	K1-2
Closing	L
Thank and Terminate	M

Target Quota = [20 Closed Won and 20 Closed Lost in IN, NC, SC, and OH. No minimum target in KY]

General Instructions

- Interviewer instructions are in green **[LIKE THIS]** (the style is "Survey: Interviewer Instructions").
- CATI programming instructions are in red [LIKE THIS] (the style is "Survey: Programming").
- Items that should not be read by the interviewer are in parentheses like this ( ).

Variables to be Pulled into Survey from Sample (return all information from sample in the final data file)

- State
    - INDIANA
    - OHIO
    - KENTUCKY
    - SOUTH CAROLINA
    - NORTH CAROLINA
- Measure(s)
- Year of application
- Status
    - Closed Won
    - Closed Lost
- Name
- Title
- Company
- Email Address
- [SERVICE CITY]
- [SERVICE STATE]

CADMUS

[EMAIL ADDRESS]
[COMPANY]
[NAME]

Email Invitation

To: [EMAIL ADDRESS]
From: Rose Stoeckle (Rose.Stoeckle@duke-energy.com)
Subject: Duke Energy Smart $aver® Custom Incentive Program Survey

Dear [Name]:

You recently submitted an application to participate in the Smart $aver® Custom Program. Duke Energy is actively seeking opinions about this program from customers like you through an online survey. Your participation in this short survey is important so that Duke Energy can include your perspectives in how their energy efficiency programs are offered. Duke Energy has asked The Cadmus Group to administer this survey.

Please click on the link below to begin the survey. The survey will take about 10-15 minutes to complete and will have no impact on the status of the incentive you have received or will receive. Please complete the survey by [date varied by evaluation phase] . The survey is designed for appearance on a computer screen rather than a mobile or tablet device.

As a token of our appreciation we would like to offer you a $10 gift card for completing the survey. Instructions for accepting the gift card or donating the funds to the United Way charity are provided at the end of the survey.

[INSERT LINK]

If you cannot complete the survey at one time, you can go back into the survey using the link provided in the email and it will resume the survey at the last question that you answered.

If you are not the best person to respond to a survey about this program, please forward this email to the person who is.

If you have any technical problems, please contact David Ladd (David.Ladd@CadmusGroup.com).

If you have any questions about the program or this survey, please contact Frankie Diersing (Frankie.Diersing@duke-energy.com), or your account manager, or the Business and Industry group at Duke Energy:

Midwest Business Assistance: 800-774-1202
Duke Energy Carolinas: 800-653-5307
Duke Energy Progress: 800-636-0581

Thank you,
Rose Stoeckle
M&V Operations Manager at Duke Energy Corporation
Rose.Stoeckle@duke-energy.com

Introduction

Welcome! We are following up with participants of Duke Energy's Smart $aver® Custom Program to help Duke Energy understand opinions that will help improve the Program. This survey will take approximately 15 minutes to complete. **Please complete the survey by [date varied by evaluation phase].** Thank you in advance.

Please click **Next** to enter the survey.

This survey is administered by The Cadmus Group, an independent consulting firm. If you experience technical difficulties completing the survey, please email The Cadmus Group at David.Ladd@CadmusGroup.com.

As a token of our appreciation we would like to offer a $10 gift card for completing the survey. Instructions for accepting the gift card or donating the funds to the United Way charity are provided at the end of the survey.

If you have any questions about the purpose of this study, or its use, please contact your account manager or the Business and Industry group at Duke Energy:
Midwest Business Assistance: 800-774-1202
Duke Energy Carolinas: 800-653-5307
Duke Energy Progress: 800-636-0581.

H2. Please describe your company - What kind of business is it?

1. (Non-profit: church, temple, community service)
2. **(NON-PROFIT: SCHOOL DISTRICT, COLLEGE, UNIVERSITY)**
3. **(NON-PROFIT: GOVERNMENT, MUNICIPALITY, MILITARY)**
4. **(INDUSTRIAL: ELECTRONICS, MACHINERY, MANUFACTURING)**
5. **(INDUSTRIAL: PETROLEUM, PLASTIC, RUBBER, CHEMICALS)**
6. **(INDUSTRIAL: MINING, METALS, STONE, GLASS, CONCRETE)**
7. **(INDUSTRIAL: OTHER) [RECORD RESPONSE]**
8. **(COMMERCIAL: WAREHOUSE, STORAGE FACILITY)**
9. **(COMMERCIAL: OFFICE SPACE)**
10. **(COMMERCIAL: PROPERTY MANAGEMENT, CONDO ASSOCIATION)**
11. **(COMMERCIAL: RETAILER, NON-FOOD)**
12. **(COMMERCIAL: GROCERY OR CONVENIENCE STORE)**
13. **(COMMERCIAL: RESTAURANT, CATERING, FOOD SERVICE)**
14. **(COMMERCIAL: TRANSPORTATION, AUTOMOTIVE)**
15. **(COMMERCIAL: HOSPITALITY – HOTEL, RESORT, CASINO)**
16. **(COMMERCIAL: HEALTHCARE, HOSPITAL)**
17. **(COMMERCIAL: OTHER) [RECORD RESPONSE]**
98. **(DON'T KNOW)**
99. (Refused)

H3. What is your role within your company?

1. **(PROPRIETOR OR OWNER)**
2. **(PRESIDENT, CEO, COO, VP OR GM)**
3. **(REAL ESTATE OR PROPERTY MANAGER)**
4. **(OPERATIONS MANAGER, OPERATIONS DIRECTOR)**
5. **(FACILITIES MANAGER, FACILITIES DIRECTOR)**
6. **(OTHER FACILITY MANAGEMENT OR MAINTENANCE POSITION)**
7. **(ENERGY MANAGER, ENERGY COORDINATOR)**
8. **(CHIEF FINANCIAL OFFICER)**
9. **(OTHER FINANCIAL OR ADMINISTRATIVE POSITION)**
10. **(OTHER MANAGER, DIRECTOR OR SUPERVISOR)**
11. **(ENGINEER, ARCHITECT, ELECTRICIAN, INSPECTOR OR RESEARCHER)**
12. **(GOVERNMENT POSITION)**
13. **(OTHER POSITION) [RECORD RESPONSE]**

H4. Do you have an assigned account manager at Duke Energy?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

CADMUS

Screening Questions (Closed Won)

[ASK IF STATUS="CLOSED WON"]

H5. Our records indicate that you participated in the Smart $aver® Custom Program, by installing energy efficient technologies in a project located in [SERVICE CITY], [SERVICE STATE]. You received an incentive for your purchase of those technologies. Do you recall participating in this program?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused) **[THANK AND TERMINATE]**

[ASK IF STATUS="CLOSED WON" AND (H5=2 OR H5=98)]

H6. This program was provided through Duke Energy. In this program, your company installed **[MEASURE(S)].** In exchange for purchasing the energy efficient option, Duke Energy provided your company with an incentive. Do you remember participating in this program?

1. (Yes)
2. (No) [THANK AND TERMINATE]

98. (Don't know) [THANK AND TERMINATE]
99. (Refused) [THANK AND TERMINATE]

[ASK IF H5=1 OR H6=1]

H7. Please confirm that the following information is correct. If the information is incorrect, please edit it below. If it is correct, please hit the next button to continue:

In the year **[APPLICATION YEAR]** your company submitted an application for an incentive for installing **[MEASURE(S)].**

[ASK IF STATUS="CLOSED WON"]

H8. Is the project completed?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H8=1]

H9. How many months did it take to complete?

1. (Response given) **[RECORD RESPONSE IN MONTHS]**

98. (Don't know)
99. (Refused)

[ASK IF H8=2]

H10. What stage is the project in right now?

1. (Project has been postponed with no definite start date)
2. (Project has a scheduled start date)
3. (Project has just begun / is just beginning)
4. (Project is underway)
5. (Project is nearly complete)
6. (Other) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H11. What is the payback on this project (or how long will it take for this project to "pay for itself")?

1. (6 months)
2. (1 year)
3. (18 months)
4. (2 years)
5. (3 years)
6. (4 years)
7. (5 years or more)
8. (Other) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

Screening Questions (Closed Lost)

[ASK IF STATUS="CLOSED LOST"]

H12. Our records indicate that you submitted an application to the Smart $aver® Custom Program in **[APPLICATION YEAR]** and that you either did not or were not able to participate in the program. Do you recall submitting an application for this program?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused) **[THANK AND TERMINATE]**

CADMUS

[ASK IF H12=2 OR H12=98]

H13. This program was provided through Duke Energy. The Smart $aver® program provides a financial incentive to motivate companies to purchase qualifying equipment. Your company planned to install **[MEASURE(S)]**. Do you recall submitting an application for this program?

1. (Yes)
2. (No) **[THANK AND TERMINATE]**

98. (Don't know) **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

[ASK IF H12=1 OR H13=1]

H14. Please confirm that the following information is correct. If the information is incorrect, please edit it below. If it is correct, please hit the next button to continue:
In the year **[APPLICATION YEAR]** your company submitted an application for an incentive for installing **[MEASURE(S)].**

[ASK IF STATUS="CLOSED LOST"]

H15. Did you go ahead with the project?

1. (Yes)
2. (No)
3. (Other response) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H15=1]

H16. Has this project been completed?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H16=1]

H17. How many months did it take to complete?

1. (Response given) **[RECORD RESPONSE IN MONTHS]**

98. (Don't know)
99. (Refused)

CADMUS

[ASK IF H15=1]

H18. What is the payback on this project (or how long will it take for this project to "pay for itself")?

1. (6 months)
2. (1 year)
3. (18 months)
4. (2 years)
5. (3 years)
6. (4 years)
7. (5 years or more)
8. (Other) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H16=2]

H19. Please tell me what stage it's in right now?

1. (Project has been cancelled)
2. (Project has been postponed with no definite start date)
3. (Project has a scheduled start date)
4. (Project has just begun / is just beginning)
5. (Project is underway)
6. (Project is nearly complete)
7. (Other) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

Program Awareness and Information

[ASK EVERYONE]

H20. How did you first become aware of the Smart $aver® Custom Program? [RECORD ALL THAT APPLY]

1. (Past experience with Smart $aver® Prescriptive Program)
2. (Past experience with another Duke Energy program)
3. (Duke Energy sent me a brochure or email)
4. (A Duke Energy representative told me about it)
5. (Duke Energy website)
6. (Recommendation of dealer/contractor)
7. (Word of mouth: colleague/friend/neighbor)
8. (Saw an advertisement in the newspaper)
9. (Saw an advertisement on television)
10. (Saw an advertisement online)
11. (Heard an advertisement on the radio)
12. (Other) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

H21. At the time you were learning about the program did you need additional information about the program's requirements and benefits so that you could make a decision to participate?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H21=1]

H22. What information did you look for before you could make your decision to participate in the program?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H21=1]

H23. Where did you look for information? [RECORD ALL THAT APPLY]

1. (Went to the Duke Energy web site)
2. (Called or emailed assigned Account Manager or Duke Energy representative)
3. (Called or emailed a contractor)
4. (Called or emailed an equipment salesperson)
5. (Other response) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H21=1]

H24. Were you able to get the information you needed about the program's participation requirements and benefits?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

H25. Have you submitted other applications in the past, to either the Smart $aver® Custom or Prescriptive programs?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H25=1]

H26. Which program(s) have you applied to in the past?

1. (Smart $aver® Custom only)
2. (Smart $aver® Prescriptive only)
3. (Both Custom and Prescriptive)
98. (Don't know)
99. (Refused)

H27. Did your company work with a trade ally, such as a contractor or engineer, during this project?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H27=1]

H28. What did the contractor, engineer or vendor assist with? [RECORD ALL THAT APPLY]

1. (Acquiring and installing equipment)
2. (Providing information about equipment options / equipment specs)
3. (Payback calculations / return on investment)
4. (Budgeting / resource planning)
5. (Finding and qualifying for rebates)
6. (Rebate applications / paperwork)
7. (Other) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

CADMUS

[ASK IF H4=1]

H29. Did your company work with your assigned Duke Energy account manager during this project?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H29=1]

H30. What did the account manager assist with? **[**RECORD ALL THAT APPLY**]**

1. Provided general program information
2. (Providing information about eligible equipment options / equipment specs)
3. (Payback calculations / estimating return on investment)
4. (Budgeting / project scoping / resource planning)
5. (Verify completeness of Rebate applications / paperwork)
6. (Providing updates on the application status)
7. (Resolving problems with applications)
8. (Other assistance and/or additional details about the above) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

Decision Making

H31. What are the major reasons your company wanted to purchase the **[MEASURE(S)]**? [RECORD ALL THAT APPLY]

1. (To reduce energy costs)
2. (To reduce repair, maintenance and other labor costs)
3. Needed more modern, smarter equipment (to integrate with energy manager systems or Smart Grid).
4. Because old equipment was working poorly or was unreliable
5. (Wanted non-energy related product features such as appearance, brand loyalty. decreased water use, increased comfort)
6. It was a good deal.
7. Due to my contractor's recommendation
8. (Due to environmental concerns)
9. (Purchased as part of a broader remodel)
10. (Other [SPECIFY])

98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED LOST"]

H32. Once you learned you were not able to participate in Smart Saver, what did you decide to do? [Choose One]

1. (Installed the equipment at the same time anyway)
2. (Installed the equipment but at a later time)
3. (Delayed the installation indefinitely)
4. (Cancelled the project)

98. (Don't know)
99. (Refused)

[ASK IF H32=4]

H33. Why did you cancel the project?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H32=2]

H34. How much later did you install the equipment?

1. (Within 3 months of originally planned installation date)
2. (3 to 6 months after originally planned installation date)
3. (6 months to 1 year after originally planned installation date)
4. (1 to 2 years after originally planned installation date)
5. (More than 2 years after originally planned installation date)

98. (Don't know)
99. (Refused)

[ASK IF H32=3]

H35. When do you realistically expect the project to start?

1. (Within 3 months of originally planned installation date)
2. (3 to 6 months after originally planned installation date)
3. (6 months to 1 year after originally planned installation date)
4. (1 to 2 years after originally planned installation date)
5. (More than 2 years after originally planned installation date)

98. (Don't know)
99. (Refused)

[ASK IF H32=3 and H35=1, 2, 3, 4 or 5]

H36. Why do you expect the project to start then, rather than sooner?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H32=1 OR H32=2]

H37. What new equipment did you install?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H32=1 OR H32=2]

H38. Is this the same equipment on your Smart $aver® application?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H38=2]

H39. Was the upfront cost of the equipment you installed higher or lower than the equipment on your Smart $aver application?

1. (Higher)
2. (About the same)
3. (Lower)
98. (Don't know)
99. (Refused)

[ASK IF H38=2]

H40. Was the efficiency level of the equipment you installed higher or lower than the equipment on your Smart $aver® application?

1. (Higher)
2. (About the same)
3. (Lower)
4. (Not applicable)
98. (Don't know)
99. (Refused)

[ASK IF H38=2]

H41. Were there other differences?

1. (Yes, response given) **[RECORD RESPONSE]**
2. (No other differences)
98. (Don't know)
99. (Refused)

[ASK IF H32=1 OR H32=2]

H42. Did you install anything else?

1. (Yes)
2. (No) **[SKIP TO H48]**

98. (Don't know) **[SKIP TO H48]**
99. (Refused) **[SKIP TO H48]**

[ASK IF H42=1]

H43. What did you have installed?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H42=1]

H44. Is this the same equipment on your Smart $aver® application?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H44=2]

H45. Was the upfront cost of the equipment you installed higher or lower than the equipment on your Smart $aver® application?

1. (Higher)
2. (About the same)
3. (Lower)

98. (Don't know)
99. (Refused)

[ASK IF H44=2]

H46. Was the efficiency level of the equipment you installed higher or lower than the equipment on your Smart $aver® application?

1. (Higher)
2. (About the same)
3. (Lower)
4. (Not applicable)

98. (Don't know)
99. (Refused)

[ASK IF H44=2]

H47. Where there other differences?

1. (Yes, response given) **[RECORD RESPONSE]**
2. (No other differences)

98. (Don't know)
99. (Refused)

Application Process

[ASK EVERYONE]

H48. Who filled out the program application forms for your company? [RECORD ALL THAT APPLY]

1. (I did)
2. (Someone from my company did)
3. (The contractor)
4. (The salesperson)
5. (Someone from Duke Energy)
6. (Other response) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H48=1]

H49. On a scale of 1 to 10, please rate how easy it was for you to understand the application form. Please rate 1 for extremely difficult and 10 for extremely easy.

1. (Rating given) **[RECORD NUMBER 1-10]**

98. (Don't know)
99. (Refused)

[ASK IF H49 IS 7 OR LOWER]

H50. What could have been done to make this better?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H51. Did you have any problems with having the application approved?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

CADMUS

[ASK IF H51=1]

H52. What was the problem with having the application approved?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H51=1]

H53. Was the problem with having the application approved resolved to your satisfaction?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H54. Did you have any problems receiving the incentive?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H54=1]

H55. What was the problem with receiving the incentive?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H54=1]

H56. How was the problem with receiving the incentive resolved?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H54=1]

H57. Was this problem resolved to your satisfaction?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

Spillover (Closed Won)

[ASK IF STATUS="CLOSED WON"]

H58. When firms have experience with energy efficiency programs or products they may sometimes make similar decisions to continue the energy savings in other parts of their business. Would you say your experience with Smart $aver Custom has led you to participate in any other subsequent Duke Energy efficiency programs?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H58=1]

H59. Which programs have you subsequently participated in since your experience with Smart $aver Custom?

1. (Other program) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF H58=1]

H60. What did your company do, with the help of these subsequent programs?

1. (Replaced existing equipment)
2. (Maintenance or upgrades to existing equipment)
3. (Added "smart" control technology to existing systems)
4. (Installed new equipment that did not replace existing equipment)
5. (Joined a demand response program)
6. (Other) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF 0H58=1]

H61. Has your company estimated the energy or money it saved from these subsequent projects?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H61=1]

H62. What was your estimate of how much money or energy you saved annually from those subsequent programs?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)

99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H63. Have you participated in any other Duke Energy energy-efficiency programs, which were NOT motivated by your participation in Smart $aver Custom?

1. (Yes)
2. (No)

98. (Don't know)

99. (Refused)

[ASK IF H63=1]

H64. Which programs?

1. (Other program) **[RECORD RESPONSE]**

98. (Don't know)

99. (Refused)

[ASK IF H63=1]

H65. What did your company do, with the help of these other programs?

1. (Replaced existing equipment)
2. (Maintenance or upgrades to existing equipment)
3. (Added "smart" control technology to existing systems)
4. (Installed new equipment that did not replace existing equipment)
5. (Joined a demand response program)
6. (Other) **[RECORD RESPONSE]**

98. (Don't know)

99. (Refused)

[ASK IF H63=1]

H66. Has your company estimated the energy or money it saved from these other projects?

1. (Yes)
2. (No)

98. (Don't know)

99. (Refused)

[ASK IF H66=1]

H67. What was your estimate of how much money or energy you saved annually from these other projects?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H68. As a result of your participation in Duke Energy's Smart $aver Custom program, have you made any other electric energy efficiency improvements that did not qualify for any kind of incentive or rebate, whether from Duke or state or federal sources?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H68=1]

H69. What did you do? [RECORD AS MUCH DETAIL AS POSSIBLE]

98. (Response given) **[RECORD RESPONSE]** (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED WON"]

H70. Have you made any other electric energy efficiency improvements that did not qualify for any kind of incentive or rebate, that were NOT motivated by your experience with Smart $aver projects?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H70=1]

H71. What did your company do? [RECORD AS MUCH DETAIL AS POSSIBLE]

1. (Other) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

Spillover (Closed Lost)

[ASK IF STATUS="CLOSED LOST"]

H72. Has your company taken advantage of any other Duke Energy energy efficiency programs?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H72=1]

H73. Which programs?

1. (Other program) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H72=1]

H74. What did your company do, with the help of these other programs?

1. (Other) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF H72=1]

H75. Has your company estimated the energy or money it saved from these other projects?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H75=1]

H76. What was your estimate of how much energy or money you saved annually from these other projects?

1. (Response given) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

[ASK IF STATUS="CLOSED LOST"]

H77. Have you made any other electric energy efficiency improvements that do not qualify for any kind of incentive or rebate, whether from Duke or state or federal sources?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF H77=1]

H78. What did you do?

1. (Other) **[RECORD RESPONSE]**
98. (Don't know)
99. (Refused)

Program Improvements

[ASK EVERYONE]

H79. One of the objectives that the program would like to see over the next year is increased participation of businesses like yours. Other than increasing the level of marketing, can you think of things that Duke Energy can do to increase interest in the program, from companies such as yours?

1. (Response given) **[RECORD RESPONSE]**
2. (no suggestions)

98. (Don't know)
99. (Refused)

H80. At any time during your application process, did you need to contact Duke Energy to obtain information, ask about progress on the application, or to obtain any other help or assistance?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF H80=1]

H81. On a scale of 1 to 10, please rate how satisfied you are with the way Duke Energy handled your questions or needs. Please rate 1 for extremely dissatisfied and 10 for extremely satisfied.

1. (Rating given) **[RECORD NUMBER 1-10]**

98. (Don't know)
99. (Refused)

[ASK IF H81 IS 7 OR LOWER]

H82. How might this be improved?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

H83. Overall, is there something about the Smart $aver® Program that you would say is working exceptionally well?

1. (Yes, response given) **[RECORD RESPONSE]**
2. (No comment)

98. (Don't know)
99. (Refused)

H84. Is there something that's not working well that you would say should be prioritized for improvement?

1. (Yes, response given) **[RECORD RESPONSE]**
2. (No comment)

98. (Don't know)
99. (Refused)

Satisfaction with Program

[ASK IF STATE="OHIO"]

H85. If you were rating your overall satisfaction with the Custom Program, would you say you were . . . [SELECT ONE 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 H85=1, 2, 3, 4 OR 5]

H86. Why do you give it that rating?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

H87. We would like to ask you a few questions about your satisfaction with specific areas of the program. For these questions we would like you to rate your satisfaction using a 1 to 10 scale where a 1 means that you are very dissatisfied with the program and a 10 means that you are very satisfied. How would you rate your satisfaction with:

H88. The amount of the incentives provided by the program.

1. (Rating given) **[RECORD NUMBER 1-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

H89. The ease of filling out the participation and incentive forms.

1. (Rating given) **[RECORD NUMBER 1-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

H90. The time it took for you to receive your incentive.

1. (Rating given) **[RECORD NUMBER 1-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

H91. The technical expertise of Duke Energy staff.

1. (Rating given) **[RECORD NUMBER 0-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

H92. The information provided by your vendor or contractor about the Smart $aver® Custom Program.

1. (Rating given) **[RECORD NUMBER 1-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

H93. The information provided on the website about the Smart $aver® Custom Program.

1. (Rating given) **[RECORD NUMBER 1-10]**
2. Not Applicable

98. (Don't know)
99. (Refused)

[ASK Once for any Rating in H88,H89,H90,H91,H92,H93 of 7 OR LOWER]

H94. You noted your satisfaction with [H88, H89 or H90 or H91 or H92 or H93] was 7 or less. What could have been done to make this better?

1. (Response given) **[RECORD RESPONSE]**

98. (Don't know)
99. (Refused)

[ASK IF STATE="OHIO"]

H95. You were asked a similar question earlier, but please bear with us: Considering all aspects of the program, what **numerical** rating would you give your overall satisfaction with the Smart $aver® Custom Program?

1. (Rating given) **[RECORD NUMBER 1-10]**

98. (Don't know)
99. (Refused)

[ASK IF STATE="NC", "SC", "IN" OR "KY"]

H96. Considering all aspects of the program, what numerical rating would you give your overall satisfaction with the Smart $aver® Custom Program?

1. (Rating given) **[RECORD NUMBER 1-10]**

98. (Don't know)
99. (Refused)

[ASK IF H96 IS 7 OR LOWER]

H97. What could have been done to make this better, or have we already covered it?

1. (Response given) **[RECORD RESPONSE]**
2. (We have already covered it / no additional comments)

98. (Don't know)
99. (Refused)

Satisfaction with Utility

H98. Using the same numerical scale, how would you rate your overall satisfaction with Duke Energy?

1. (Rating given) **[RECORD NUMBER 1-10]**

98. (Don't know)
99. (Refused)

[ASK IF H98 IS 7 OR LOWER]

H99. What could have been done to make this better, or have we already covered it?

1. (Response given) **[RECORD RESPONSE]**
2. (We have already covered it / no additional comments)

98. (Don't know)
99. (Refused)

Closing

That concludes this survey, thank you very much for taking the time to help Duke Energy improve this program.

As a token of our appreciation we would like to offer you a $10 gift card for completing the survey.

Please provide a contact name and address to receive the gift card, or if you would like us to donate this amount to the United Way charity organization on your behalf please indicate so:

3. Send my gift card to: [RECORD RESPONSE]
4. Donate $10 to the United Way charity organization.

Thank and Terminate

Thank you for responding to the survey. You have indicated that you did not participate in Duke Energy's Smart $aver® Custom program.

If you have reached this page by error or if you are having technical problems with the survey, please contact David Ladd (David.Ladd@CadmusGroup.com).

If you are not the best person to respond to a survey about your company's participation in the Smart $aver® Custom program, please forward the survey's email invitation to another person that you believe is the best person to respond to the survey.

If you have any questions about the program or this survey, please contact Frankie Diersing (Frankie.Diersing@duke-energy.com), or your account manager, or the Business and Industry group at Duke Energy:

Midwest Business Assistance: 800-774-1202
Duke Energy Carolinas: 800-653-5307
Duke Energy Progress: 800-636-0581

Process Evaluation of the 2013-2014 Smart $aver® Nonresidential Prescriptive Incentive Program in the Carolinas System

Final Report, April 15 2016

Evaluation, Measurement, & Verification for Duke Energy Carolinas

This page left blank.

Prepared by:

Cadmus

Yinsight, Inc.

This page left blank.

Table of Contents

Evaluation Summary

This report presents findings from the process evaluation of the Smart $aver Nonresidential Prescriptive Incentive Program (Prescriptive Program) covering program participation from January 2012 through December 2014 in the Duke Energy Carolinas (DEC) jurisdiction (North Carolina and South Carolina). Two different evaluation teams completed the process evaluation in two phases. TecMarket Works completed the first phase of the process evaluation in 2013 and 2014. Following the transfer of evaluation work in 2015, Cadmus, along with a subcontractor, Yinsight, Inc., (the evaluation team) completed the final phase of the process evaluation.

Program Description

The Prescriptive Program is designed to motivate Duke Energy's commercial and industrial customers to install high-efficiency equipment by offering incentives up to 75% of the project cost on selected equipment. Customers must apply for the incentive within 90 days of installing the equipment and provide invoices with model numbers as proof. The Prescriptive Program is offered in conjunction with the Smart $aver Nonresidential Custom Incentive Program (Custom Program), which is being evaluated in a separate study. The measures offered through the Prescriptive Program have pre-calculated *ex ante* energy savings, while participants must submit energy savings calculations when applying for the measures eligible through the Custom Program. The combination of Prescriptive and Custom Programs allows Duke Energy customers a flexible range of options to meet their individual needs for energy-efficient equipment.

Evaluation Objectives

The evaluation documented program operations, identified areas for potential improvement during future program implementation, and assessed customer and trade ally satisfaction with the program. Key research questions included the following:

- *What level of satisfaction do participants and trade allies have with the Prescriptive Program?*
- *What role does the Prescriptive Program play in customer decisions to install energy-efficient equipment? (What are the drivers of, and barriers to, program participation?)*
- *What recent challenges has the Prescriptive Program faced, and how have they been addressed by Duke Energy program staff?*
- *Can any improvements be made to the application process?*
- *Does the Prescriptive Program, including the various stakeholders involved in the implementation of the program, provide adequate information to facilitate participation?*
- *What can be done to increase participation from both customers and trade allies?*
- *Are customers aware of, and purchasing from, the Duke Energy Savings Store?*
- *Are changes to Prescriptive Program design or operations warranted?*

Evaluation Parameters

The evaluation team used in-depth interviews, participant surveys, and trade ally interviews to conduct this process evaluation. Table 1 lists these activities' parameters, along with estimated confidence and precision levels (confidence/precision).

Table 1. Evaluated Parameters with Value, Units, and Confidence/Precision

Program	Parameter	Value	Units	Confidence/ Precision
Smart $aver Prescriptive	Participant survey responses	Varies by question	Varies by question	±9.8% precision at the 90% confidence interval

Table 2 lists the start and end dates for activities conducted for the process evaluation. The evaluation team collected data in two phases: Phase 1 surveys covered participation from 2012 and 2013, while Phase 2 covered participation from 2014. Participants surveyed during these phases received their rebate during the time period mentioned, while surveyed trade allies assisted customers with installations rebated through the program during the time period for that phase.

Table 2. Sample Period Start and End Dates

Evaluation Component	Sample Period	Dates Conducted	Total Conducted
Management Interviews	–	October 17, 2014 December 11, 2014 December 15, 2014 May 27, 2015	4
Participant Surveys	Phase 1: January 2012 – April 2014 Phase 2: May 2014 – December 2014	Phase 1: November 3, 2014 – November 19, 2014 Phase 2: October 8, 2015 – October 26, 2015	67
Trade Ally Interviews	Phase 1: January 2012 – April 2014 Phase 2: May 2014 – December 2014	Phase 1: January 16, 2015 – January 19, 2015 Phase 2: October 20 – October 27, 2015	15

High-Level Process Findings

This section summarizes the evaluation team's key process findings for the evaluation period.

Management Interviews

The evaluation team conducted focused interviews with program management and implementation staff on elements of program process, delivery, and future program changes. The program's fundamental operations have remained unchanged since the previous evaluation, and Duke Energy continues to rely primarily upon their trade ally network to promote participation in the program.

The product managers reported a sound understanding of program challenges and they have implemented a number of improvements to overcome these challenges. Duke Energy expanded program staffing and brought most aspects of program implementation in-house so that they no longer relied upon third parties to develop their trade ally management or outreach strategies. Duke Energy also switched to a new customer database to improve tracking of customer data and program outcomes. While the product managers reported that some of the new processes and systems initially caused delays in application processing time, they also reported they had resolved these problems.

Trade Ally Feedback

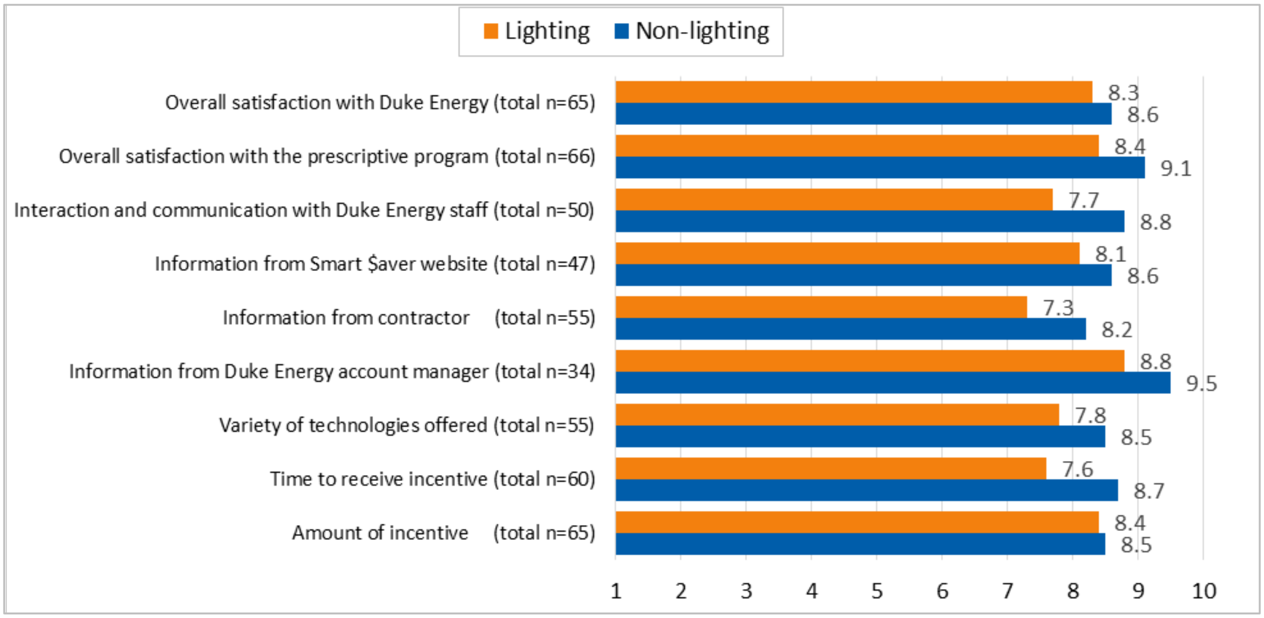
As found in past evaluations, trade allies report that they value this program as an important influence on customer decisions to install high-efficiency equipment. Trade allies (n=15) rated their overall satisfaction with the Prescriptive Program at 7.7 (on a scale of 1 to 10, with 1 indicating "very dissatisfied" and 10 indicating "very satisfied") and their overall satisfaction with Duke Energy at 8.0. Due to the small sample size, these ratings cannot be considered representative of the larger trade ally population. The trade allies' feedback only provides a glimpse into the range of issues they encountered, but does not reveal prevalence of those issues. Some trade allies reported minor areas of dissatisfaction with program implementation. A minority expressed concern that new direct install program aimed at small businesses, Small Business Energy Saver, may be negatively affecting their businesses.

Participant Feedback

Participants learned about the Prescriptive Program primarily through a trade ally (43%, n=65) or through their Duke Energy account manager (42%). The primary driver of participation was energy cost savings (43%, n=67). Participants receive application forms for the Prescriptive Program primarily online (40%, n=65), from trade allies (32%), and Duke Energy staff (21%). Most participants reported that they fill out the application forms themselves (61%, n=67) or with trade allies (28%). During the application process, participants directed some program and application-related questions to Duke Energy staff, while they directed both program questions and technical questions to the trade allies. While participants have high satisfaction with the Prescriptive Program overall (an average rating of 8.8 on a 10-point scale; n=66), as well as with Duke Energy (an average rating of 8.4; n=65), some have complaints about the application process and related delays in receiving incentive payments due to delayed acceptance of applications.

Figure 1 shows participant satisfaction ratings, on a scale of 1 to 10, with 1 indicating "very dissatisfied" and 10 indicating "very satisfied."

Figure 1. Participant Satisfaction with the Smart $aver Prescriptive Program in the Carolinas System



Conclusions and Recommendations

Overall, the Prescriptive Program is well-integrated into Duke Energy's nonresidential sector offerings, and trade allies and participants have high satisfaction with the program and Duke Energy itself. However, the evaluation revealed a few areas for potential improvements. This section summarizes conclusions resulting from the process evaluation and provides areas for Duke Energy to explore and further refine program operations or expand program benefits.

Conclusion 1: Although trade allies generally have high regard for the Smart $aver Prescriptive Program, trade ally response indicates that the new direct install program for small business customers may be perceived by some trade allies as confusing or a threat to their existing business models.

Recommendation 1: Conduct focused research to determine whether the marketplace confusion reported by some of the surveyed trade allies is widely perceived across the trade ally network. A quantitative study will allow Duke Energy to gauge whether trade allies are satisfied or dissatisfied with their position in the new landscape of Duke Energy's commercial and industrial energy efficiency programs, and, if so, the extent to which they are satisfied or dissatisfied.

Conclusion 2: While the variety of new delivery channels may appeal to a broader range of nonresidential customers, the proliferation of new channels for promoting Smart $aver Prescriptive Program may create confusion among nonresidential customers and make it more challenging to select the most suitable channel or program. Product managers said they are planning to revisit the strategy for all Smart $aver Prescriptive Program channels.

Recommendation 2: Investigate methods to increase customers' and trade allies' understanding of program options so that participants engage the program through the most appropriate channel. For example, develop a categorization scheme to help customers understand the offerings. Clear categorization will help customers and trade allies minimize confusion that may be caused by similar-sounding channel names. Potential categorization options include target segment (e.g., distributors or small business), or level of assistance ("do it yourself" for the online assessments to "one stop shop" for the Small Business Energy Saver).

Conclusion 3: Two participant survey respondents who received rebates for CFL installations said that, were it not for the Prescriptive Program incentive, they would have installed LEDs instead. This suggests that the program incentive influenced these participants to make a less efficient choice than they would have otherwise. Improper incentive levels may have counterproductive effects on customers' decision-making process.

Recommendation 3: Update technology offerings and monitor their relative prices carefully to ensure incentive levels motivate participants to install the most efficient options.

Introduction

Program Description

The Nonresidential Smart $aver® Prescriptive Program influences business customer energy decisions by providing incentives to install qualifying high-efficiency measures such as lighting, HVAC, and motors. Duke Energy's commercial and industrial customers fund this program by paying an energy efficiency rider based upon their kWh usage. In the Prescriptive Program, customers may install selected energy-efficient measures and then send in an application for rebates.

The Prescriptive Program offers incentives up to 75% of the project cost on selected equipment. Customers must apply for the incentive within 90 days of installing the equipment and provide invoices with model numbers as proof. The Prescriptive Program is offered in conjunction with the Smart $aver Nonresidential Custom Program, which is being evaluated in a separate study. Energy efficiency measures that are not part of the Prescriptive Program may still qualify for an incentive through the Nonresidential Smart $aver Custom Program. Duke Energy must approve the eligibility of the custom measures through a separate application process prior to installation. The measures offered through the Prescriptive Program have pre-calculated *ex ante* energy savings, while the Custom Program requires customers to submit project-specific energy savings calculations with each application for eligible measures. The combination of both programs allows Duke Energy customers a flexible range of options to meet their individual needs for energy-efficient equipment.

The Smart $aver programs achieve their objectives through a multipronged approach. First, Duke Energy's large account management team provides a channel by which Duke Energy is able to communicate to their large customers about any programs that may help with individual customers' current needs. Second, trade allies promote the programs to distributors and contractors offering high efficiency equipment. Third, Duke Energy conducts outreach directly to small and medium business (SMB) customers. This SMB outreach channel was first implemented in 2013, in coordination with Duke Energy's market segmentation strategy team. Fourth, Duke Energy offers an online store where customers can purchase a selection of equipment with the incentive factored into the product price.

Duke Energy offers the Prescriptive Program across all five states in their service territory, and the program is managed by two product managers. Though nominally assigned to either the Midwest states or to the Carolinas, these two product managers report that they run the Prescriptive Program jointly across jurisdictions, with shared decision-making. The only differences between the states stem from the different measures on the Prescriptive Program incentive list.

Program Background and Recent Changes

Duke Energy began offering the Prescriptive Program in the Carolinas system in 2009. With the program's growth since the last evaluation of the Prescriptive Program in 2013, Duke Energy has moved away from relying on third-party vendors to implementing the program primarily with in-house staff. Duke Energy has also been sharing practices between the Duke Energy legacy programs and the Duke

Energy Progress[1] Programs offered in the Carolinas system; this has led to a number of implementation changes as well as new offerings for DEC customers.

Program Design and Goals

The Prescriptive Program is marketing primarily through two channels: Duke Energy's extensive network of trade allies, including vendors, distributors, and contractors, who are able to share their expertise in energy-efficient technologies and leverage the Prescriptive Program incentive to increase their own businesses. Duke Energy large account managers also market the program to their assigned large customers (>500 kW).

In the most recent DEC rider filing, the Prescriptive Program contributed 44% of the total system energy reduction achieved by nonresidential energy efficiency programs in 2014, and it is forecasted to contribute 34% in 2016.[2] Duke Energy combined the contribution targets for prior program years for the Custom and Prescriptive Programs. Table 3 shows the most recent reported gross savings for the Prescriptive Program for 2013 and 2014 based on the evaluation team's review of the Prescriptive Program tracking database.

Table 3. Duke Energy Carolinas Smart $aver Program Performance

Goal	Duke Energy Carolinas 2013- 2014	
Technology Group[1]	**Number of Participants**	**Gross Savings (kWh)[2]**
Food Service	597	4,643,232
HVAC	744	28,193,375
Information Technology	5	164,791
Lighting	5,507	163,509,922
Process Equipment	26	1,645,383
Pumps	11	80,865

[1] The HVAC technology group includes measures identified as HVAC and Chiller/Thermal Storage. VFD measures are included under either the HVAC or process equipment technology groups based on the equipment served by the VFD. In Phase 1, 10 applications with motor measures were categorized under the process equipment technology group.

[2] The reported impacts do not include losses.

[1] Duke Energy completed its merger with Progress Energy on July 2, 2012.

[2] North Carolina Utilities Commission. Duke Energy Carolinas' Application for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider Pursuant to N.C. Gen. Statute. 62-133.9 and Commission Rule R8-69, Docket Number E-7 Sub 1073. Date Opened: February 10, 2015.

Evaluation Methodology

Overview of the Evaluation Approach

The evaluation team collected data from in-depth telephone interviews with product managers, and participant surveys that were fielded by phone and online, and trade ally phone interviews. The team analyzed the data by coding open-ended responses and reporting descriptive statistics when warranted by the number of responses. Other than filtering questions designed to assure that a person knowledgeable about the Prescriptive Program project was located, no other questions in the surveys or interviews were mandatory. This resulted in responses to some questions that may not tally with the total number of responses.

Table 4 lists the start and end dates for activities conducted for the process evaluation.

Table 4. Sample Period Start and End Dates

Evaluation Component	Sample Period	Dates Conducted	Total Conducted
Management Interviews	–	October 17, 2014 December 11, 2014 December 15, 2014 May 27, 2015	4
Participant Surveys	Phase 1: January 2012 – April 2014 Phase 2: May 2014 – December 2014	Phase 1: November 3, 2014 – November 19, 2014 Phase 2: October 8, 2015 – October 26, 2015	67
Trade Ally Interviews	Phase 1: January 2012 – April 2014 Phase 2: May 2014 – December 2014	Phase 1: January 16, 2015 – January 19, 2015 Phase 2: October 20 – October 27, 2015	15

Management Interviews

In 2014, the evaluation team conducted a joint interview with the two Duke Energy product managers responsible for Prescriptive Program in the Midwest and in the Carolina System, due to the close coordination of program delivery across Duke Energy's service territory. The evaluation team also interviewed the trade ally outreach manager and the Duke Energy manager of all customer-facing operations. In 2015, the evaluation team conducted a brief interview to obtain updates about program operations with the two Prescriptive Program product managers. The team interviewed the following product managers as part of this evaluation:

- Two product manager interviews
- One trade ally outreach manager interview
- One customer-facing operations manager interview

Trade Ally Interviews

The evaluation team conducted interviews with 15 trade allies who had worked on or submitted applications for the Prescriptive Program. Five interviews were completed in early 2015 with trade allies involved in applications during the 2012 and 2013 program years, and ten interviews were completed in late 2015 with trade allies involved in 2014 applications.

Participant Surveys

Sixty-seven Prescriptive Program participants agreed to answer questions about their experiences with the program, representing 52 companies in North Carolina and 15 companies in South Carolina. Thirty-eight surveys were completed in 2014 with participants who received rebates from the Prescriptive Program in 2012 and 2013, and 29 surveys were completed in 2015 with participants who received rebates in 2014.

Study Methodology

Data Collection Methods, Sample Sizes, and Sampling Methods

Participant survey respondents were randomly selected from Duke Energy's database of customers who received Prescriptive Program incentive payments between May 2012 and April 2015. Participants were surveyed in two phases: Phase 1 surveys were completed by TecMarket Works in 2014, and Phase 2 surveys were completed by Cadmus in 2015. The evaluators administered the participant survey as a telephone survey in both phases.

Trade ally survey respondents were randomly selected from Duke Energy's database of participating trade allies. The trade ally surveys were administered by telephone in both Phase 1 and 2.

Number of Completed Surveys and Sample Disposition

In Phase 1, the evaluation team attempted to contact 131 participants by telephone and e-mail and completed 38 surveys. In Phase 2, the evaluation team attempted to contact 146 participants by telephone and e-mail and completed 28 surveys and obtained responses to one partially completed survey. Overall, the evaluation team surveyed 67 participants out of 277 attempted contacts.

In Phase 1, the evaluation team attempted to contact eight trade allies by telephone and e-mail and completed five surveys. In Phase 2, the evaluation team attempted to contact 84 trade allies by telephone and e-mail and completed ten surveys. Overall, the evaluation team surveyed 14 trade allies out of 92 attempted contacts.

Expected and Achieved Precision

The evaluation team surveyed 67 participants from a sample frame of 3,541 contactable organizations[3] that received rebates from the Prescriptive Program during the evaluation period. The precision based

[3] The sample frame for the survey is smaller than the participant population due to incomplete contact information in program application records.

on this sample size is ±9.8% at the 90% confidence interval. Table 5 summarizes the confidence interval and precision value achieved for the evaluated parameters.

Table 5. Evaluated Parameters with Value, Units, and Confidence/Precision

Program	Parameter	Value	Units	Confidence/ Precision
Nonresidential Smart $aver Prescriptive	Participant survey responses	Varies by question	Varies by question	±9.8% precision at the 90% confidence interval

Threats to Validity, Sources of Bias, and How Those Were Addressed

No causal relationships were being investigated, so threats to validity are not a concern. Participants may have exhibited the social desirability bias when answering a question relating to the customer's main motive for participating in the Prescriptive Program, and when answering questions about satisfaction with the Prescriptive Program. To counter this bias, these questions used neutral language wherever possible.

Process Evaluation Findings

This section presents the process evaluation findings for Duke Energy's Smart $aver Nonresidential Prescriptive Incentive Program in the states of North and South Carolina. The evaluation team organized its findings into three sections: management interviews, trade ally interviews, and participant surveys.

Management Interviews

The Prescriptive Program is jointly managed by two Duke Energy product managers, who share decision-making for all aspects of the program. The Prescriptive Program is also supported by a wider team of company experts in market segment strategy and outreach, the large account managers, and by other product and services managers who are responsible for implementing components of the program. The evaluation team designed the management interviews to document how the different activities of the Prescriptive Program help nonresidential customers select and use energy-efficient equipment. The sections below detail the operations and processes of the different components of the Prescriptive Program in the Carolinas, as reported by Duke Energy management.

Measure Development

Duke Energy periodically reviews Prescriptive Program measures, working with consultants to determine which technologies to add to the measure list. The overarching criterion for new measures is that they are cost-effective for the program. Reviews of the program also include incentives and how those compare in the market. Duke Energy uses feedback from customers and trade allies on what measures they would like to see. As one interviewed product manager said, "[the trade allies] always have lots of ideas for us." The program staff follows up on these suggestions with further research. An interviewed product manager explained that while there is no cost associated with offering Prescriptive Program measures that are not widely installed, their trade allies would and do question incentives for what they perceive as irrelevant technologies. Duke Energy product managers report that Prescriptive Program offerings can stay relevant to customers and trade allies by aligning the Prescriptive Program measures with market interests.

In February 2014, Duke Energy added new information technology measures, including energy-efficient power strips to the program. Duke Energy also added other measures within existing categories. In a follow-up interview in May 2015, the product managers reported that the consultants who originally recommended information technology measures had revised their recommendation and now recommended removing these measures from the program. When asked why, the product managers reported that, in some cases, the incremental cost of the high-efficiency measure was not much greater than the standard-efficiency measure, and in some other cases the kWh savings were not enough to justify an incentive. The product managers reported that they plan to review the marketing and may start specifically targeting data-center customers.

The product managers also said that they intend to review one technology group every few months in the future, rather than review all of them biannually.

The product managers also reported that the incentives are at the appropriate levels to motivate customer participation. While trade allies, during evaluation interviews, frequently provide feedback that an incentive needs to be higher on a measure that is more expensive, the product managers said they are constrained by cost-effectiveness and their need to be good stewards of ratepayer money.

Application Process

Duke Energy provides an application that customers can fill out online and then print for submission. Customers can mail, fax, or e-mail applications to Duke Energy and must submit incentive applications and product invoices within 90 days after installation (or after project is completed and the qualifying measures are operable). Duke Energy product managers are currently developing an online application due for release in 2016.

The Prescriptive Program product managers reported that the Prescriptive Program application processing times have recently been reduced to a one-week turnaround. They also said that the backlog of applications had increased up to four to six weeks in the recent transition from an interim database to the new customer tracking system. They said they are confident that the new, permanent system will allow greater accuracy and transparency of the application process.

The product managers reported that the new tracking system has the ability to send out e-mails at the time the incentive checks are cut, so that both customers and trade allies receive an e-mail prior to receiving the checks. The change to the new system also meant that the product managers could not send a letter along with the check. Now they rely on the e-mail and some identifying information on the check stub to remind customers of the source of the incentive.

Quality Assurance and Verification of Applications

Prescriptive Program product managers report that they review incentive applications to make sure that they include invoices and specification sheets that match the measures in the application. Model numbers are required on the invoices. The product managers stated that the most common errors in the application are usually a mismatch between the quantities listed in the application and the quantities on the invoices. In these cases, Duke Energy will either pay the amount it can verify or contact the customers and ask them to produce the remaining invoices.

Prescriptive Program product managers report that trade ally outreach representatives conduct verification site visits on a random sample of customer sites to verify measure installations. Outreach representatives conduct these visits after the incentive is paid (to avoid a delay payment to the customers). The outreach representatives verify a total of 5% of all Prescriptive Program applications in each state. After each site visit, the outreach representatives create a report on how many measures they found compared to the measures listed in the incentive application. These same outreach representatives conduct on-site verifications for measures purchased through the online store as well.

During the random inspections, product managers report that they occasionally find that customers have not installed the equipment. In these cases, Duke Energy gives the customer a reasonable period of time to complete the installation. If the equipment is still not installed by that deadline, Duke Energy will request that the incentive be returned. However, these situations are rare; the product manager reported that this may have happened only three times in the last four years.

Marketing and Outreach

This evaluation focused on the trade ally marketing channel, but touches upon the other channels as well. Duke Energy uses the following multipronged approach to achieve its objectives for the Prescriptive Program:

- Duke Energy's large account management team provides a channel by which Duke Energy is able to communicate to their large customers about any programs that may help with individual customers' current needs.
- For other customers who are not assigned to a large account manager, the Prescriptive Program has traditionally relied upon their trade allies, a network of distributors, retailers and contractors offering high-efficiency equipment.
- Duke Energy conducts outreach directly to small and medium business (SMB) customers through their new Business Energy Advisor channel.
- Duke Energy offers an online store where customers can purchase a selection of equipment with the Prescriptive Program incentive factored into the product price.
- Duke Energy has developed a midstream channel to partner with distributors to offer Prescriptive Program incentives with less paperwork.
- The Duke Energy website supports all these channels by providing a repository of the most recent Prescriptive Program information and contact information for customers interested in each of the channels.

Large Account Managers

Prescriptive Program product managers report that Duke Energy has an account management team with approximately 60 to 70 representatives assigned to the large commercial customers across the five states. These account managers are in regular communication with the large customers about their needs and actively recruit them to participate in the Smart $aver Prescriptive Program as well as the other energy efficiency and demand response programs.

Business Energy Advisors

Duke Energy has established the Business Energy Advisors channel for business customers who are not large enough to have an assigned large account manager, but consume more than 100 kW (with a single account or single meter and spend less than $60,000 annual energy costs).

Duke Energy first launched this outreach approach for the SMB market in January 2013. During the two phases of this evaluation study, Duke Energy hired -a full team of advisors, including two advisors who are dedicated to reaching out to the SMB customers in North and South Carolina. These advisors represent Duke Energy's products and services. A Duke Energy product manager reports that the advisors address the needs of the nonresidential customers, in much the same way that the trade ally representatives address the needs of the trade allies.

The advisors are available for one-on-one consultations with the customer to help identify energy savings opportunities and to educate customers about Duke Energy's nonresidential incentive programs. They are tasked with driving customers to Prescriptive Program projects. The manager of customer-facing operations reports that the advisors are assigned a portfolio of approximately 1,000 customers, and at the time of the interviews in December 2014, they had already contacted over 400 customers. The manager of customer-facing operations said, "We identified a gap in how we deliver programs, and this is a channel to serve them."

Business Savings Store

Duke Energy opened the Business Savings Store, modeled after the Residential Savings Store, in April 2013. A vendor implements the online store. They provide a list of products that Duke Energy then qualifies, and a predetermined incentive is built into the price of the measure. Nonresidential customers can purchase CFLs, LEDs, occupancy sensors, programmable thermostats, faucet aerators, low-flow showers, pre-rinse sprayers, and other self-installable measures from the online store. The product managers reported that the self-installation option is designed to allow more flexibility for the customer. The product managers also noted that verification activities had revealed a few nonresidential customers had purchased measures from the online store but installed them in their residences.

Midstream Channel

The product managers reported that Duke Energy has begun to offer nonresidential customer incentives through a new midstream channel. The midstream channel is designed to work with distributors who are interested in partnering with Duke Energy to streamline the application process. This channel was designed to allow distributors to prequalify their customers and the measures they would like to offer those customers. The trade ally outreach manager for the Carolinas system reports that interested distributors are asked to sign a nondisclosure agreement and a midstream channel agreement that is similar to the Prescriptive Program trade ally agreement. The distributor provides a list of their customers and a list of the products. Program staff reviews the measures and determines the correct incentive to accompany each measure. The distributor then tracks and reports their sales of the qualified measure to these customers on a participation template, submitted to Duke Energy once a month. Duke Energy then reimburses the distributor with the incentive.

The trade ally outreach manager said the Midstream Channel allows distributors to use the prequalification to upsell more energy-efficient products. Customers would receive an invoice from the distributor with the incentive amount already applied. The trade ally outreach manager reported that it is required that the Prescriptive Program incentive be clearly listed on the invoice with the dollar amount and Duke Energy's name, in part to make it clear to customers that they are getting the incentive from Duke Energy.

According to the trade ally outreach manager, there has been "a lot of interest" in the midstream channel. The trade ally outreach manager also said that Duke Energy intends to target lighting and food service first. At the time of the Phase 2 interviews in May 2015, the product managers reported that one distributor had signed up for the midstream channel in the Carolinas. Duke Energy has also hired a manager dedicated to running the midstream channel. The outreach manager reported that they have already worked together to deliver a webinar to the trade allies about the midstream channel. The same trade ally outreach team that supports the Prescriptive Program also conducts outreach for the midstream channel.

Website

The product managers report that the Duke Energy website serves as the primary means of disseminating updated information about the program to both the customers and the trade allies. During the May 2015 update interview, the product managers reported that the entire Duke Energy website was being redesigned. Currently, the website includes lists of qualifying measures, their associated incentives, updated applications that need to be filled out, and other tools on the benefits of energy efficiency, including some clever video clips. The website also includes a phone number and e-mail for customer questions. In the beginning of the program, a third-party call center responded to customer phone calls. However, Duke Energy now asks customers to leave voicemail or send e-mail, and then directs customers to the most appropriate in-house staff for follow up within a short period of time.

Trade Allies

The Smart $aver Prescriptive and Custom Programs are primarily marketed through a network of trade allies including vendors, distributors, and contractors. This network is managed by Duke Energy staff directly, and is designed to enable Duke Energy to position the Smart $aver Program as an option to customers who directly contact vendors when faced with urgent or early replacement equipment replacement needs, and/or who may not have assigned account representatives at Duke Energy. All Duke Energy staff interviewed in this and past Smart $aver evaluations credit their strong Smart $aver trade ally network as being the key to Smart $aver's success in the Carolina system.

There are two trade ally outreach managers, one for the Carolina System and one for Duke Energy's Midwest service territories. The two trade ally outreach managers coordinate and outline goals for the trade ally outreach representatives. One trade ally outreach manager reported that there are five trade ally outreach representatives for the Carolina system. The trade ally outreach representatives are Duke Energy contractors, working from Duke Energy offices, and serve as the point of contact for questions on the applications. They are responsible for educating trade allies about the program, the application process, and the incentives offered by the Smart $aver programs, both Prescriptive and Custom. The trade ally outreach representatives participate in trade association meetings and trade shows.

The trade ally outreach manager reports that the trade ally outreach representatives typically will meet with trade allies to tell them how the Prescriptive Program works. At the beginning of each year, the representatives will discuss measures that have been added (reminding trade allies that the latest measure updates will always be on the Duke Energy website). The trade ally outreach representatives also provide training seminars and webinars. They may also discuss specific projects on which the trade allies are working and talk about the relevant incentives that Duke Energy offers. The interviewed trade ally outreach manager reported, "They would essentially give the trade allies all the information they would need to successfully fill out an application."

The trade ally outreach manager said that most of the trade ally outreach representatives who serve the Carolina system have been in their positions since the beginning of the Smart $aver programs and have strong relationships with the trade allies.

Trade Ally Listings

Trade allies can sign up to be listed on the Duke Energy website. They provide their contact information, geographical area, services, and areas of expertise. Customers can then search for trade allies according to the technologies and services they are interested in. As noted on the website, this listing is not an endorsement of these vendors, but it facilitates the customer's initial research into finding a suitable trade ally.

Trade allies are not required to sign up in order to participate in the program. However, the trade ally outreach manager reports that Duke Energy is considering requiring all trade allies who receive a Smart $aver incentive check to sign the trade ally agreement.

Trade Ally Outreach Strategy

In recent years, the product managers report that they have been working with the trade ally outreach manager to direct the strategy for trade ally outreach. The product managers have also worked with an internal team within Duke Energy that is responsible for designing the strategy for a particular market segment. The product managers reported that implementation of the outreach strategy seems to be moving slowly, in part due to difficulties with tracking outcomes with the interim customer participation database.

The trade ally outreach manager reported that the trade ally outreach representatives have quarterly goals, and have streamlined outreach activities to focus on certain strategies around specific measures. The trade ally outreach manager reported that if Duke Energy does not see an increase in incentive activity around those measures, the trade ally outreach representatives intensify efforts in those areas. The trade ally outreach representatives also have quarterly goals to meet new trade allies.

The trade ally outreach manager uses a tracking worksheet showing trade ally interactions to ensure that the trade ally outreach representatives are not going to the same regions repeatedly. The trade ally outreach manager reports that Duke Energy surveys the trade allies twice a year, working with their internal market research teams to track trade ally satisfaction.

The trade ally outreach manager reported that one strategy that was implemented at the end of 2014 was an effort to move trade allies up a continuum from "not interested" to "partner." The trade ally outreach manager reported that partners generally do not require much help from the trade ally outreach representatives. The trade ally outreach representatives rely on their relationships with the trade allies to identify those trade allies who have high potential yet have low participation. The trade ally outreach manager shared an example where a trade ally who is interested but does not want to fill out the paperwork may be identified as well-suited for the midstream channel and stated, “Our trade ally outreach team members are our eyes and ears.”

Program Successes and Future Improvements

The product managers reported that they have successfully completed the transition to the new customer database, lowered the application processing time to one week, and are on track to meet their program objectives. They also reported seeing a lot of lighting applications, as well as some food service and IT applications, which they have not seen in other states.

To help prepare for increased goals in the future, the product managers report that Duke Energy has recently increased marketing efforts for the Prescriptive Program, and that the newly assigned marketing manager has been bringing a lot of creative ideas. Together, they plan to develop an entire marketing plan that would include trade ally outreach.

According to the product manager, the entire Duke Energy website will be revamped in the future, including the Prescriptive Program sections. In anticipation of the changes, the marketing manager has been reviewing content and identifying videos that may need updating. The product managers also plan to provide videos to educate customers on the new online application, which is due to be released by the end of 2015.

Trade Ally Interviews

Trade Ally Sample Characteristics

The evaluation team conducted surveys with 15 trade allies who had worked on or submitted applications for the Prescriptive Program during the evaluation period. These trade allies included contractors, distributors, retailers and consulting engineers. Seven trade allies provided lighting solutions, five provided HVAC/process solutions, and the remainder provided both types of solutions.

The interviewed trade allies had an average of over 20.8 years of experience in their field, ranging from 2.5 to 41 years in their industry. Two were from South Carolina and the rest from North Carolina. When asked how they had first learned of the Prescriptive Program, six of the trade allies identified Duke Energy’s websites or trade ally outreach efforts, four mentioned a boss or coworker, one mentioned hearing about the program from a customer, and the remainder did not remember. Nine trade allies had previous experience with both the Custom and Prescriptive Programs, and five only had experience with the Prescriptive Program. A total of nine trade allies said their company was listed as a trade ally on the Duke Energy website, but only two of those reported getting any leads from that listing.

Recognition of Smart $aver's Influence

When trade allies were asked to rate the influence of the Prescriptive Program on the customer's choice of equipment efficiency, respondents reported an average rating of 6.7 on a scale of 0 to 10, where a zero meant that the program had no influence, and a 10 meant that the program had major influence.

The evaluation team asked trade allies how frequently their customers had already heard of the Prescriptive Program[4] . They reported customer awareness that was evenly distributed, with only two respondents reported that their customers had "almost never" heard about the program in the past.

Without the Prescriptive Program incentive, 12 of the 15 trade allies reported that their customers would change their scope in some way. Some reported that projects would not be done (n=6), and that customers may look for less expensive and less efficient options (n=4), or delay the project (n=1).

Incentive levels

The interviewed trade allies generally thought the incentives were sufficiently high enough to motivate customers to install high-efficiency lighting equipment, with five of the trade allies indicating "Yes", and one of the trade allies indicating "No". Three of the interviewed trade allies gave qualified responses: two thought that the incentives were too low for high-efficiency HVAC equipment and the other thought that incentives were too low for LED tubes and screw-in lamps. On average, the interviewed trade allies estimated that approximately 50% of their projects included equipment that received a Prescriptive Program incentive.

Application Process

Ten trade allies reported that they sometimes submitted applications on behalf of their customers. When asked for ways to streamline the application process, two suggested less paperwork, and two others suggested an online application process. In addition, one trade ally mentioned that information on older equipment is often no longer legible, and another said that there was not enough space on the application form when the submission includes many lighting measures. The remaining did not have suggestions to offer.

Six trade allies were able to give estimates of the time from application to incentive payment; these ranged from 14 to 60 days. Due to the timing of this evaluation, these trade allies may have participated prior to process improvements that the product managers reported reduced application backlogs. The remaining could not give estimates, with one trade ally reporting he didn't know because customers did not report when they received their checks.

Communications with Duke Energy

Nine trade allies were able to provide details about their communications with Duke Energy:

[4] Trade Ally Survey Question D1. When you are talking with a new prospective customer, what percentage have already heard of Duke Energy's Smart $aver program? Would you say...? A) Almost never, B) About 25% of the time, C) About 50% of the time, D) About 75% of the time, E) Almost always.

- Two interacted with large account managers;
- One interacted with their account manager and the energy efficiency engineers;
- Three interacted with outreach representatives;
- One interacted with the Prescriptive Product manager; and
- One interacted with other Duke Energy staff by calling the business customer service phone number.
- One had not interacted with any Duke Energy staff.

The interviewed trade allies reported that they reach out to Duke Energy staff members for application and product-related questions. On average, the interviewed trade allies rated their satisfaction with these communications at 7.4, with 0 indicating "not satisfied at all" and 10 indicating "highly satisfied." Of the four who rated their satisfaction at 7 or below, one wanted more collaboration, two said they were not being kept updated, and one said he was not getting notifications.

Marketing Smart $aver

The interviewed trade allies generally do not use any special materials to promote the Prescriptive Program incentive, but all incentives figure prominently in their sales process. Of the 15 trade allies, 14 reported that they did not use any information or technical tools from the Smart $aver website when making proposals to customers, and the last trade ally said he didn't know. When asked what additional collateral they would like to have during their sales, seven of the interviewed trade allies were able to answer. Of these seven, four trade allies said they would like some printed materials on Smart $aver to share with customers, one trade ally wanted help from Duke Energy when talking to customers about projects, one trade ally wanted a phone app that calculated savings, and one trade ally suggested a lighting calculator. Despite not using program materials, 13 of the 15 responding trade allies all reported that they mentioned the Smart $aver incentive early in their sales presentation, if not as the first item of their sales presentation. The remaining two did not respond.

Increasing Participation from Trade Allies

In order to identify barriers to participation by other trade allies, the evaluation team asked respondents why they thought some of their competitors may not be participating in the Prescriptive Program. Five trade allies thought it was because participation required too much paperwork, and another four thought it was simply because their competitors were not aware of the program. One thought others did not participate because there was no need, saying, "There are not enough projects that are worth it." The remaining respondents were not able to provide answers.

Program Successes

When asked whether there were any aspects of the Prescriptive Program that they thought were working particularly well, three reported they thought the overall program worked well. Two reported that the incentives were generous. Others mentioned that the program process was clear, the application processing was fast, that there were a wide variety of measures, and that a direct mail campaign successfully led them to new customers.

Trade Ally Feedback

When trade allies who were interviewed during Phase 1 (n=5) were asked if customers had reported any problems with the Smart $aver program, two of the five mentioned customer problems related to the incentive check, with one saying it took too long, and the other saying he was not notified when the check was sent. However, when trade allies who were interviewed in Phase 2 were asked if they had heard any customer complaints, none of the trade allies provided responses related to their customers. Instead, one said the website was not easy to navigate and he could not find the forms, and another said that Duke Energy's incentives seemed lower than those of other utilities. Additionally, one respondent mentioned that a project included fixtures that thought to be coded incorrectly by the DesignLights Consortium[5] and suggested that lighting measures needed to be coded for more locations.

When asked if there were any areas that should be a top priority for improvement, 10 trade allies expressed a range of suggestions. This included Duke Energy offering financing options for projects, providing an easier-to-use website and forms, increasing incentives on some of the lighting measures, calculating energy savings based on wattage saved, and collaborating more on projects. Two trade allies provided suggestions for the Custom Program, instead of the Prescriptive Program. Two trade allies suggested that Duke Energy stop giving unfair advantage to one contractor.

When asked if they could identify any new measures should be added to the list of approved Prescriptive Program measures, four trade allies responded: two suggested more LED measures, including LED tubes. One wanted Duke to add more cold-start metal halide retrofits and 8ft T-12s. Another suggested that adding controls and other technology to ventilation hoods might make them suitable for the Prescriptive Program.

Two trade allies stated that a separate direct install program, Duke Energy's Small Business Energy Saver (SBES), is negatively affecting their business, and reported that the designated SBES contractor may be creating some confusion within the marketplace about the validity of the Prescriptive Program itself. These trade allies felt that the SBES contractor was misrepresenting themselves as Duke Energy staff and that may cause the SBES contractor to have an "unfair advantage" over other contractors. One trade ally said that the presence of the Duke Energy branded SBES contractor causes doubt that other trade allies are legitimate: "People think that we're in there to rip them off. It causes confusion. I hear it on a weekly basis…Duke is undermining the [Prescriptive] program." SBES is not being evaluated in this study.

5 The DLC administers the [Qualified Products List] that distinguishes quality, high-efficiency LED products for the commercial sector.

Overall, trade allies gave the Prescriptive Program a satisfaction rating of 7.7, using a scale of 1 to 10 where 1 means "not satisfied at all" and 10 means "extremely satisfied." They rated Duke Energy an 8.07 on the 1 to 10 scale.

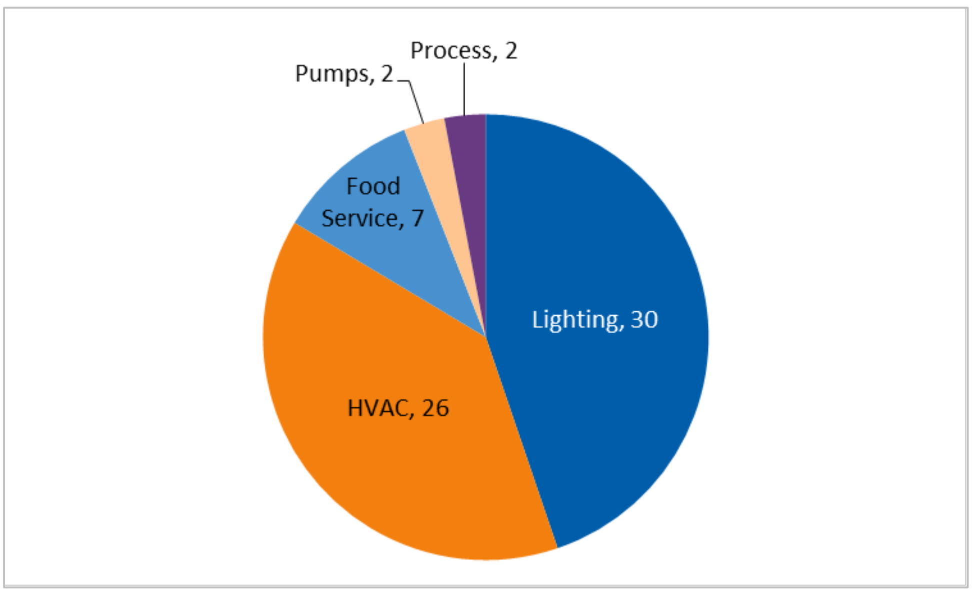
Participant Surveys

Participant Sample Characteristics

Sixty-seven Prescriptive Program participants from the Carolina system agreed to answer questions about their experience with the program; of those respondents, 52 represented businesses based in North Carolina and 15 represented business in South Carolina.

Survey respondents were asked about a specific measure for which they received a rebate from the Prescriptive Program; 30 answered questions about lighting measures (CFLs, LEDs, linear fluorescents, occupancy sensors), and 37 answered questions about non-lighting measures, including 26 HVAC measures, seven food service measures, two process measures (air compressors) and two pump motors (Figure 2).

Figure 2. Distribution of Survey Responses by Measure Category (n=67)



The evaluation team deliberately over-sampled participants with non-lighting measures from the population of participants in order to achieve reasonable precision for lighting and non-lighting surveys taken separately. As seen previously in Table 3, during 2012 and 2013 lighting measures accounted for 89% of Prescriptive Program savings and at least 77% of program applications.[6] The evaluation team

[6] Table 3 shows the number of participants in each measure category, however participants can receive rebates for measures in more than one category, therefore the total number of participants is less than the sum of participants in each measure category. The percentage of participants with lighting measures is at least 77%, based on 4,453 lighting participants out of 5,774 total participants shown in the table.

assessed and reported process results separately by measure category and for the entire group of survey respondents. For survey results used in impact calculations, the team will weigh the results according to the distribution of savings provided by measures rebated through the program.

The survey respondents held a variety of roles within their companies:

- 16 in general management or company officer roles
- 16 in facility/property manager roles
- Six with financial or administrative titles
- 15 with other types of management titles
- 10 in engineering or technical roles
- Four miscellaneous job titles.

In general, the respondents appeared to have been in positions where they would have participated in or been aware of the rationale for the equipment decisions made for their Prescriptive Program projects.

Table 6 shows the distribution of survey respondents across various commercial and industrial sectors; overall, 46% of respondents represented commercial businesses, 24% represented industrial businesses, and 30% represented nonprofit or public sector organizations. A larger percentage of participants with lighting measures were industrial, in particular light industrial manufacturing, while a larger share of those with non-lighting measures were nonprofit and public-sector organizations, primarily schools, government, and municipal facilities.

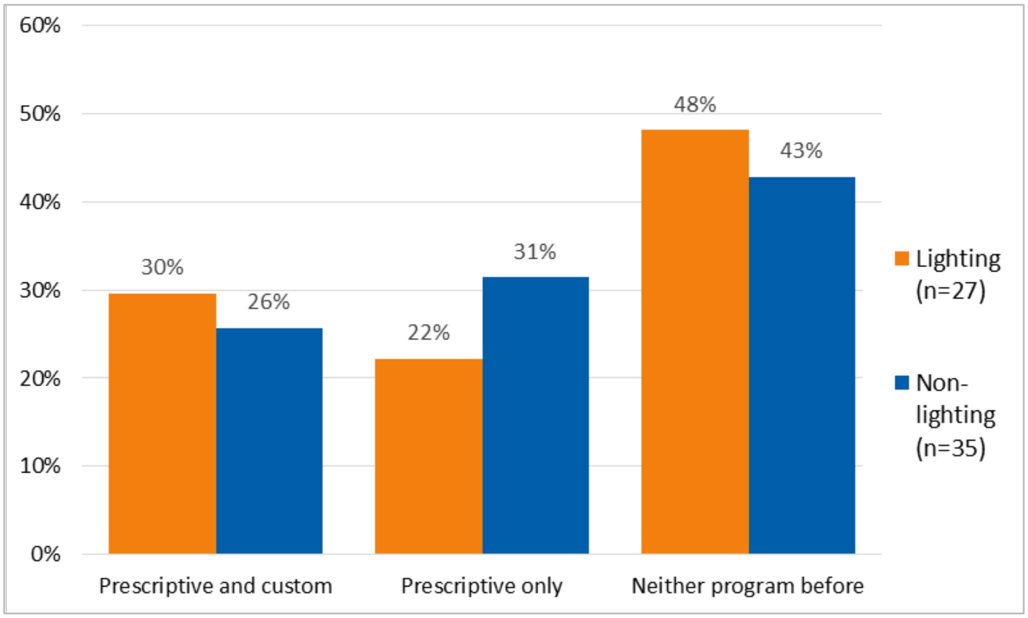
Table 6. Survey Respondent Organizations by Sector

Sector	Lighting (n=30)	Non-lighting (n=37)	All survey respondents (n=67)
Total Commercial	**50%**	**43%**	**46%**
Property management/real estate/condo association	10%	16%	13%
Restaurants	0%	11%	6%
Transportation/automotive	7%	3%	4%
Healthcare/hospitals	3%	5%	4%
Retail store (non-food)	7%	0%	3%
Offices	3%	3%	3%
Hotel/resort	3%	0%	1%
Convenience/grocery store	3%	0%	1%
Miscellaneous other commercial	13%	5%	9%
Total Industrial	**37%**	**14%**	**24%**
Light manufacturing/machine shops/assembly	20%	3%	10%
Industrial/heavy manufacturing	3%	3%	3%
Farming/agriculture	0%	5%	3%
Miscellaneous other industrial	13%	3%	7%
Total Nonprofit and Public Sector	**13%**	**43%**	**30%**
School district/private K-12/university/college	3%	22%	13%
Municipal facilities/government	3%	16%	10%
Community service/church/nonprofit	7%	5%	6%

About half of surveyed participants reported that their company had an assigned Duke Energy account manager (55%, n=67), though another 15% did not know whether they had an assigned account manager or not.

The respondents were an equal mix of those who had previous experience with nonresidential Smart $aver programs and those who had not. Almost half (45%, n=62) had not previously applied for either Custom or Prescriptive Program rebates. The other half were equally divided between those who had previously applied for Prescriptive Program rebates (27%) and those who had applied for both Custom and Prescriptive Program rebates (27%). Surveyed lighting and non-lighting participants had a very similar distribution of previous experience with Smart $aver programs (Figure 3).

Figure 3. Previous Participation in Smart $aver Prescriptive and Custom Programs

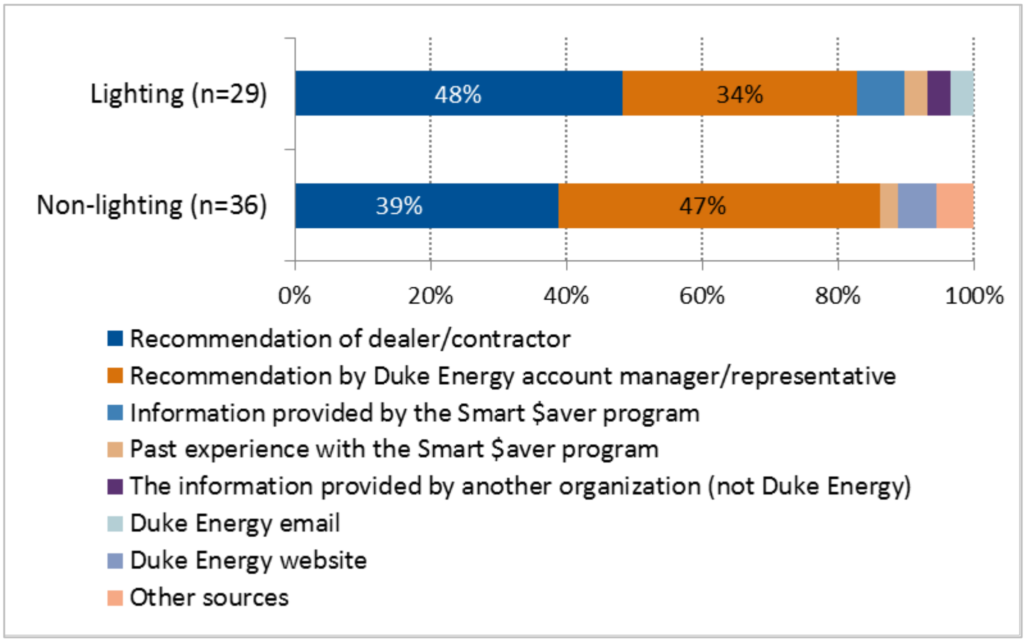


Prescriptive Program Outreach

Source of Prescriptive Program Awareness

Participants primarily learned about the Prescriptive Program from two sources: Duke Energy representatives and trade allies, which combined were the source of awareness for 85% of survey respondents (see Figure 4). Only three participants (5%, n=65) learned of the Prescriptive Program from Duke Energy's website or a Duke Energy e-mail.

Figure 4. How Participants Heard About the Prescriptive Program



Prescriptive Program Application Process

Application Paperwork

Overall, the largest share of respondents (40%, n=65) acquired their Prescriptive Program incentive applications from the Smart $aver website, and lighting and non-lighting respondents were equally likely to get their application forms this way. Trade allies (32%) and Duke Energy account managers (15%) also frequently provided forms to participants, though for lighting respondents it is much more likely to be the trade ally, and for non-lighting respondents it is about equally likely to be a trade ally or the account manager (Figure 5).

Figure 5. How Participants Got Their Prescriptive Program Application Forms

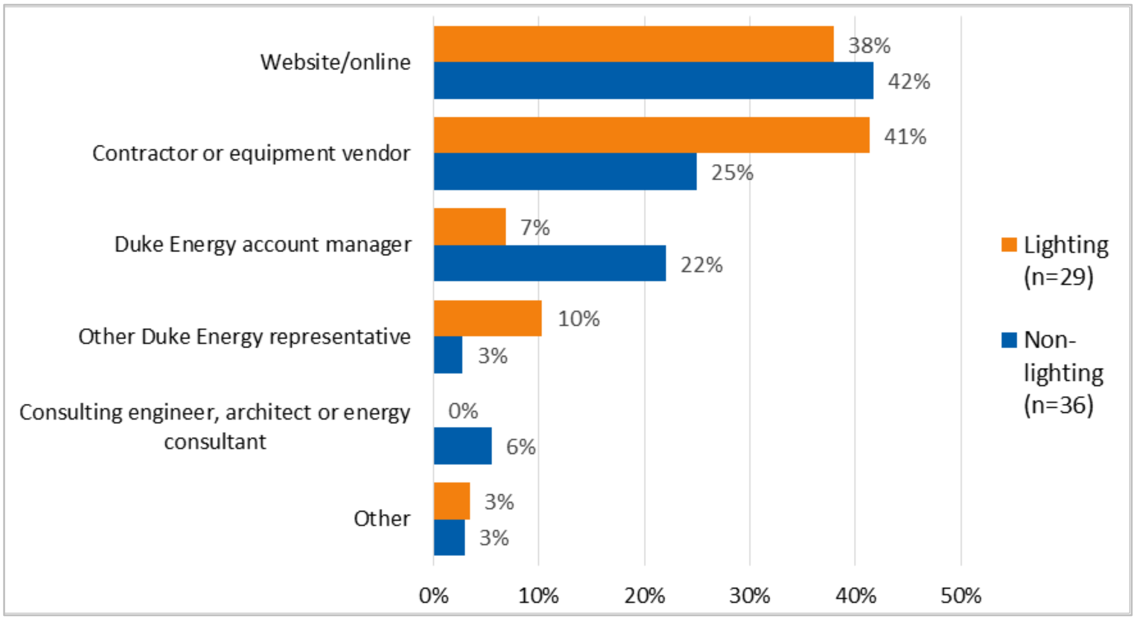
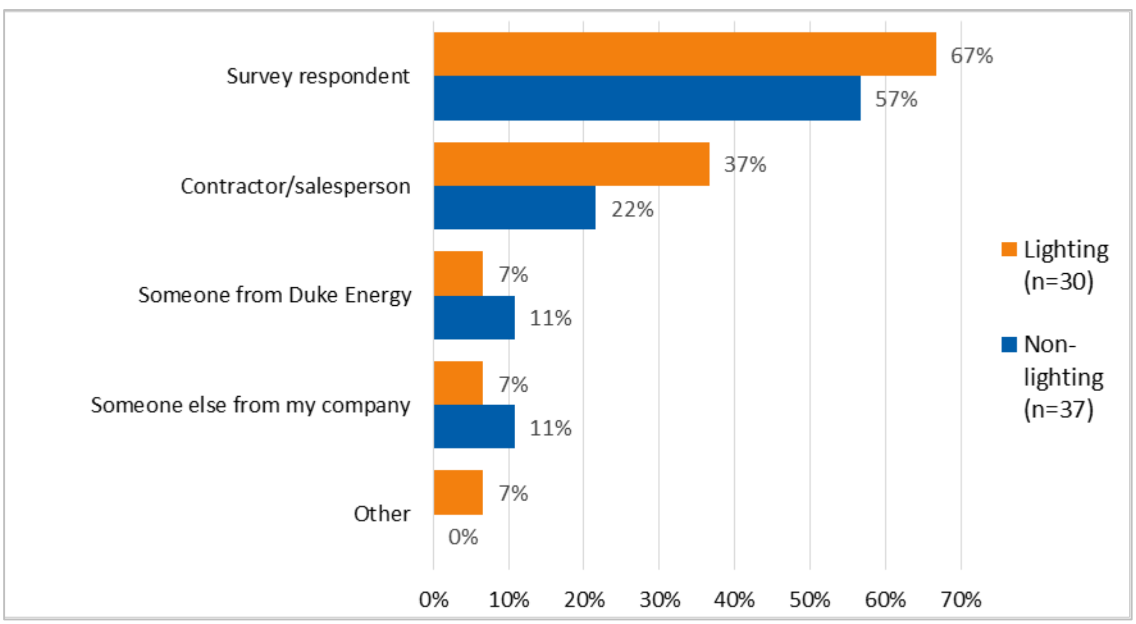


Figure 6 shows that survey respondents said they were involved in filling out most Prescriptive Program applications (61%, n=67), and trade allies were involved in about a quarter of applications (28%).[7] There are no significant differences between lighting and non-lighting respondents.

Figure 6. Who Filled Out Prescriptive Program Application Forms

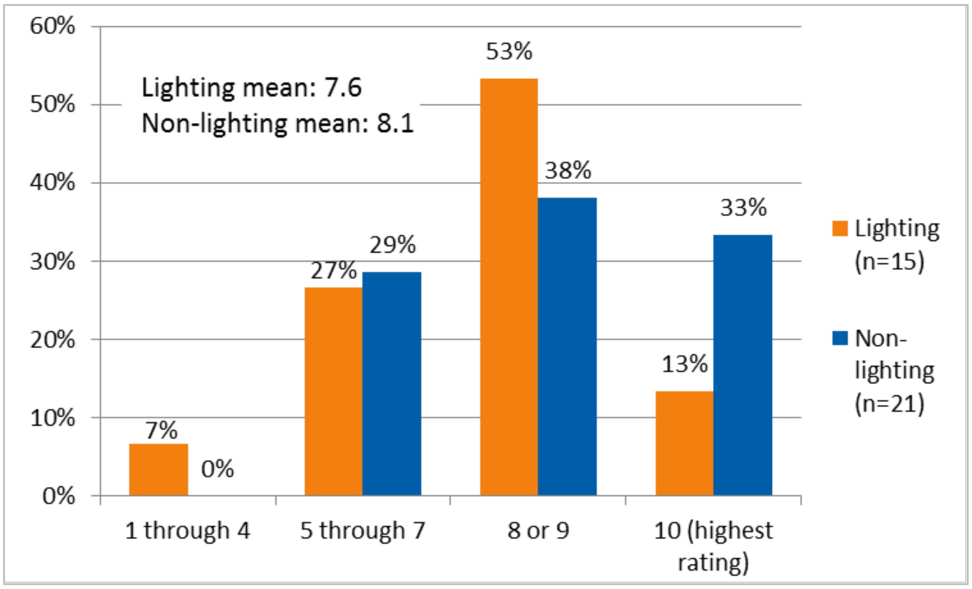


[7] Multiple responses were accepted, so percentages in Figure 5 total to more than 100%. Some respondents filled out applications with the assistance of trade allies or other employees.

Application Process Satisfaction

Participants who were involved in filling out application forms were asked to rate their satisfaction with the ease of filling out the form on a 10-point scale where "10" is the most satisfied. More non-lighting than lighting respondents gave the highest "10 out of 10" rating, though overall differences between measure groups are not statistically significant (see Figure 7).

Figure 7. Satisfaction with the Ease of Filling out Prescriptive Program Application Forms

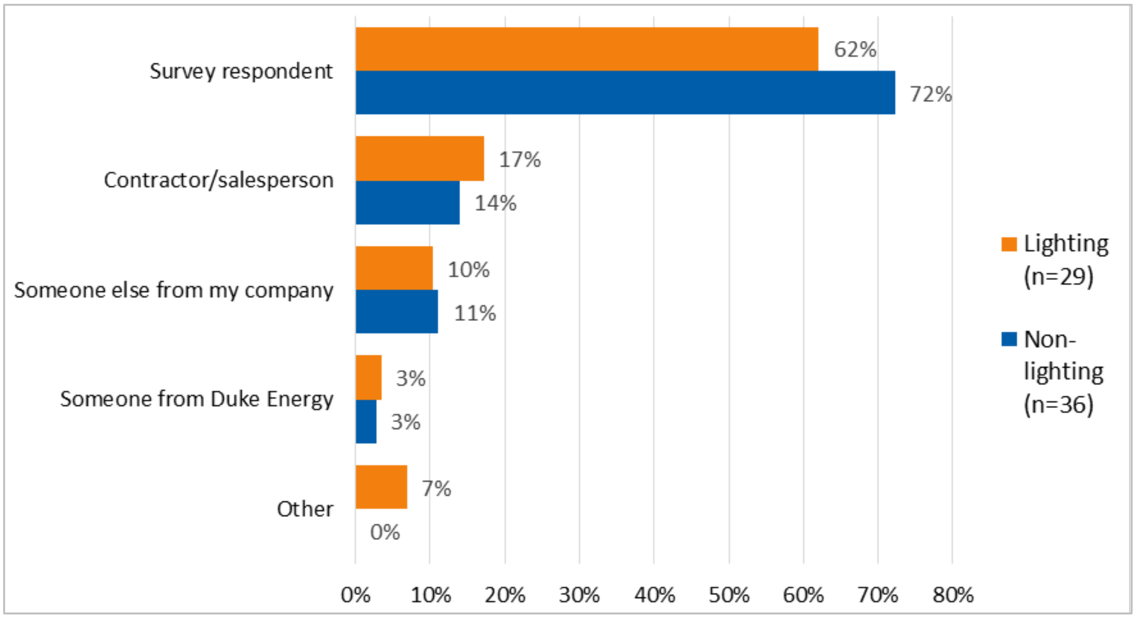


About a third of respondents (31%, n=36) gave ratings of 7 or lower for the ease of filling out applications, and were asked what could be done to improve this process. Most of these 11 respondents noted that the directions could be improved and the form streamlined, and that they often had to get additional information from trade allies and manufacturers, or contact Duke Energy staff in order to complete the forms. One respondent suggested that applications could be filled out and submitted online, while another suggested that copies of invoices should suffice instead of the original invoices.

Submitting Applications

Two-thirds of survey respondents (68%, n=65) submitted their Prescriptive Program application forms themselves, as seen in Figure 8. Fewer respondents mentioned trade allies or Duke Energy staff submitting the forms compared to helping fill out the forms (see Figure 6 above).

Figure 8. Who Submitted Prescriptive Program Application Forms



Problems Receiving Incentive Payments

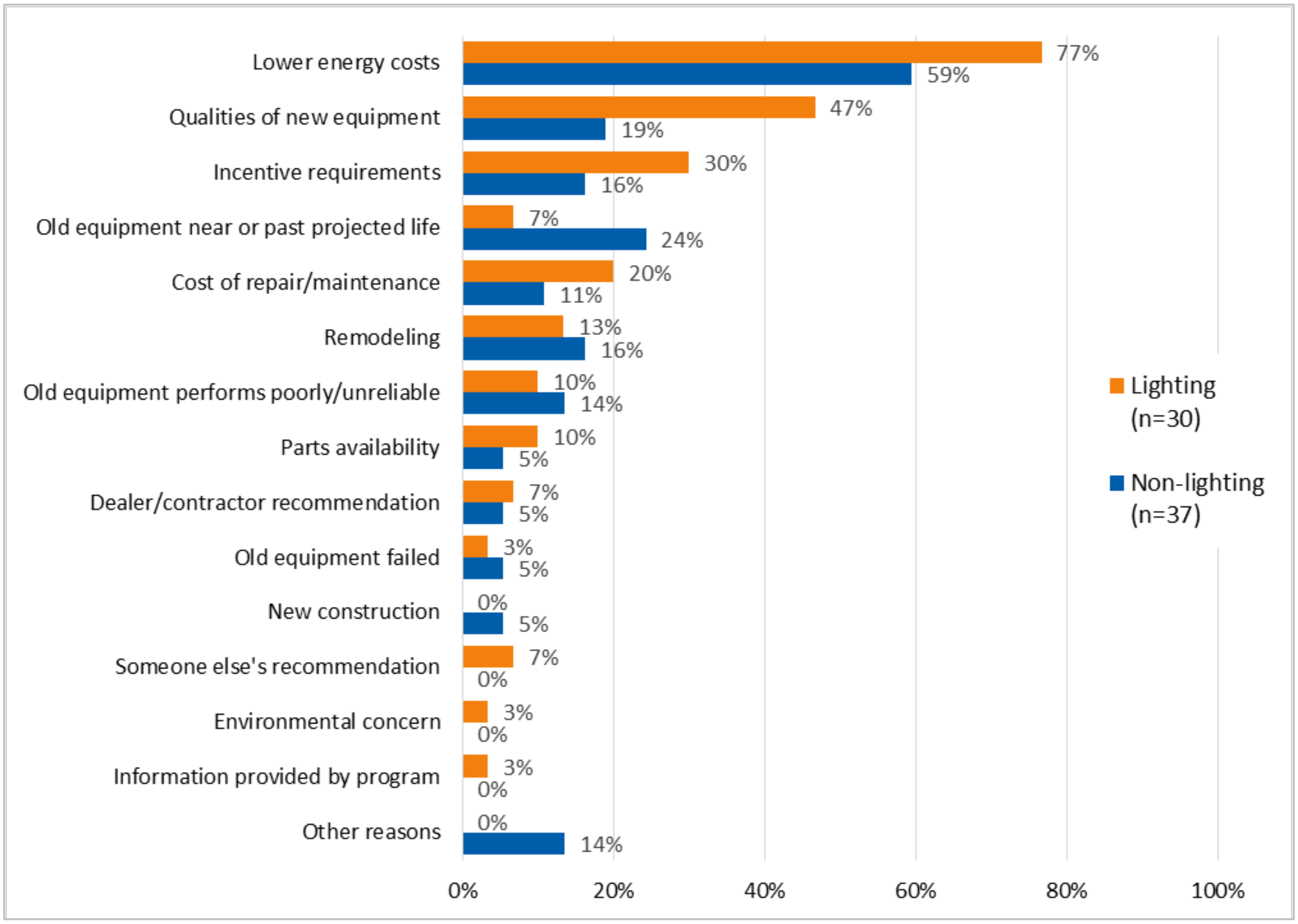
Six surveyed participants (9%, n=65) reported that they had problems receiving their incentive payments. Lighting respondents were more likely to report problems (17%, n=30) compared to non-lighting respondents (3%, n=35).[8] The problems described by these participants are generally about rebate payments being delayed, often because of delays in getting applications approved due to missing information on the application forms. One lighting respondent also reported that they never received their rebate check. Four of the six respondents who reported problems receiving incentives said that these problems have been resolved to their satisfaction. One participant said that they still have not received their rebate payment, and another said "I deemed the process too time-consuming and let a couple applications drop."

Participation Drivers

A majority of respondents reported that reducing energy costs was a motivation for undertaking their Prescriptive Program projects, mentioned by 77% of lighting and 59% of non-lighting respondents. Figure 9 summarizes all drivers of participation mentioned by survey respondents. About half of participants who installed lighting measures (47%) mentioned the qualities of their new equipment (better or brighter lights) compared to only 19% of those with non-lighting measures. Lighting participants also mentioned the program incentive (30%) and repair and maintenance costs (20%) more often, while non-lighting respondents were more likely to mention that their previous equipment was nearing the end of its expected useful life (24%).

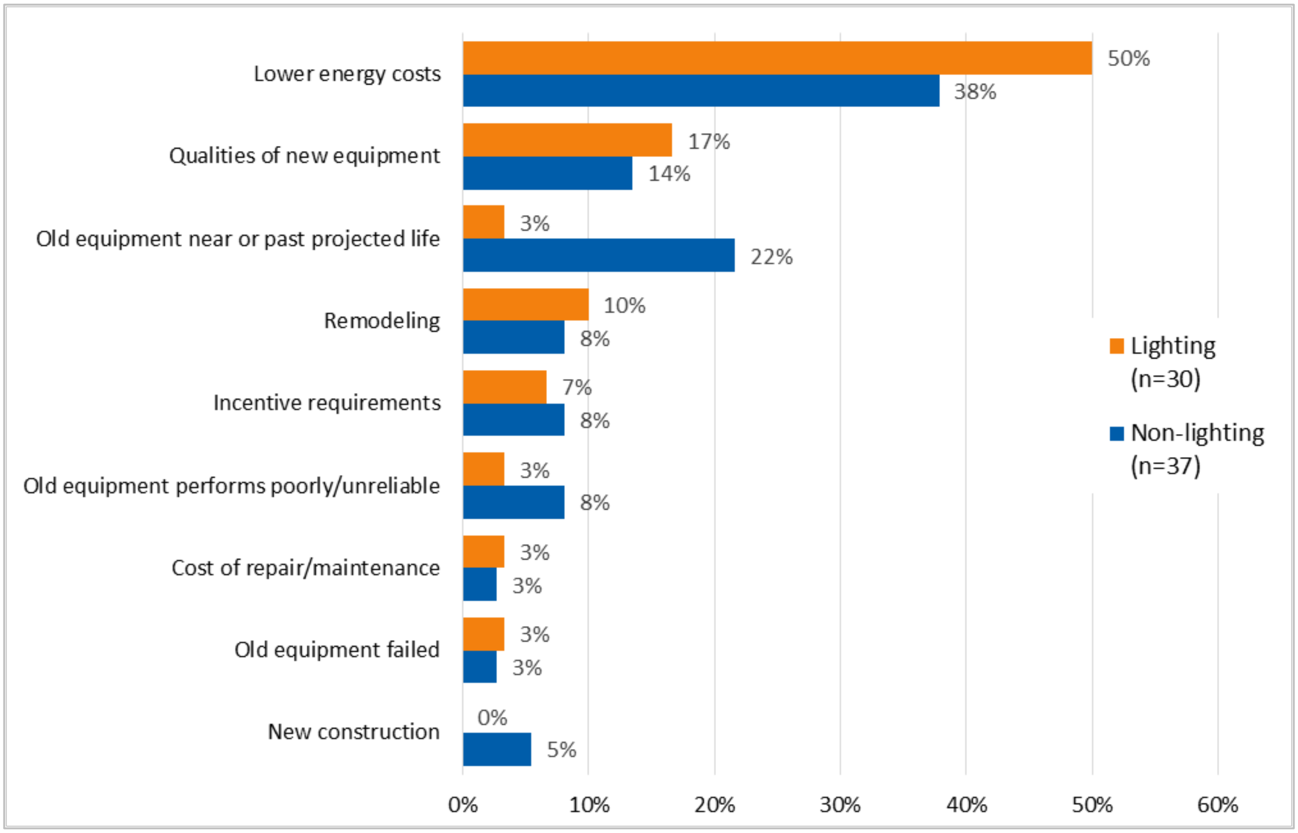
[8] This difference is statistically significant using Student's t-test (p=.065).

Figure 9. Participants' Reasons for Purchasing Equipment Rebated by the Prescriptive Program: Total Mentions



Survey respondents were also asked which of the reasons they mentioned for purchasing their new equipment was the primary, or most important, reason. Figure 10 shows that energy cost savings are the primary motivator for the largest share of participants, cited by 50% of lighting and 38% of non-lighting respondents. Old equipment nearing the end of its useful life was the second most-mentioned primary reason for non-lighting respondents (22%), while qualities of the new equipment was the second most-mentioned primary reason for lighting respondents (17%).

Figure 10. Participants' Primary Reason for Purchasing Equipment Rebated Through the Prescriptive Program



Note: percentages may total to more than 100% because respondents could say multiple reasons were "equally important". Unique responses (n=1) are not shown.

Replacing Old Equipment

Every lighting respondents surveyed (100%, n=30) was replacing previously installed equipment, while only half of non-lighting respondents (51%, n=37) were replacing old equipment. Figure 11 shows the condition of replaced equipment reported by program participants. Ninety percent of lighting participants replaced equipment that was in "good" or "fair" working condition, compared to only 27% of non-lighting respondents. Another 24% of non-lighting respondents replaced equipment described as being in "poor" working condition, or "not working," compared to just 10% of lighting respondents doing the same.

Figure 11. Condition of Previous Equipment Replaced by Equipment Rebated through the Prescriptive Program

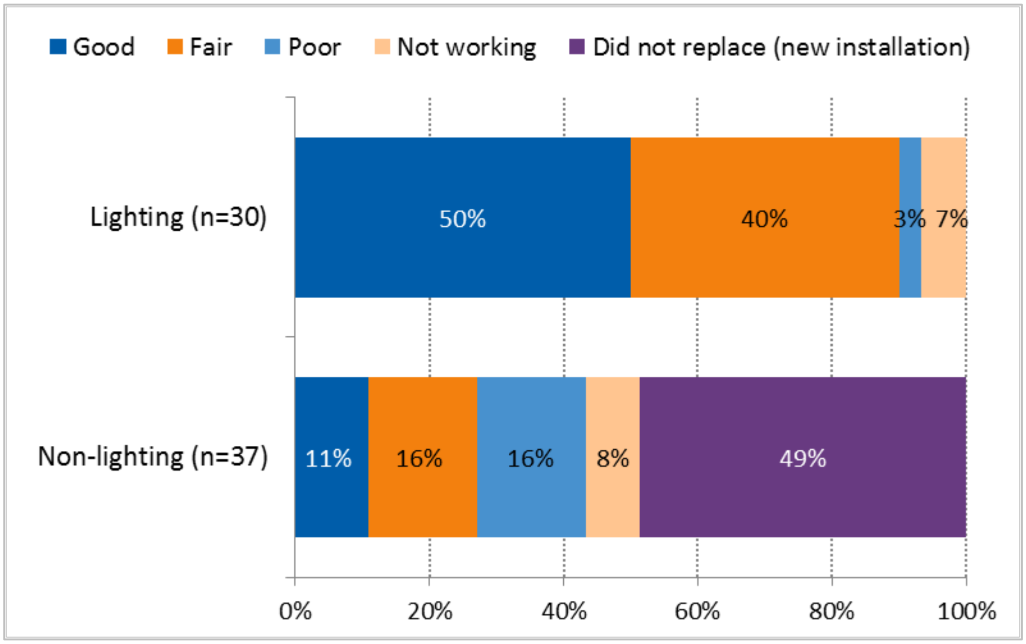
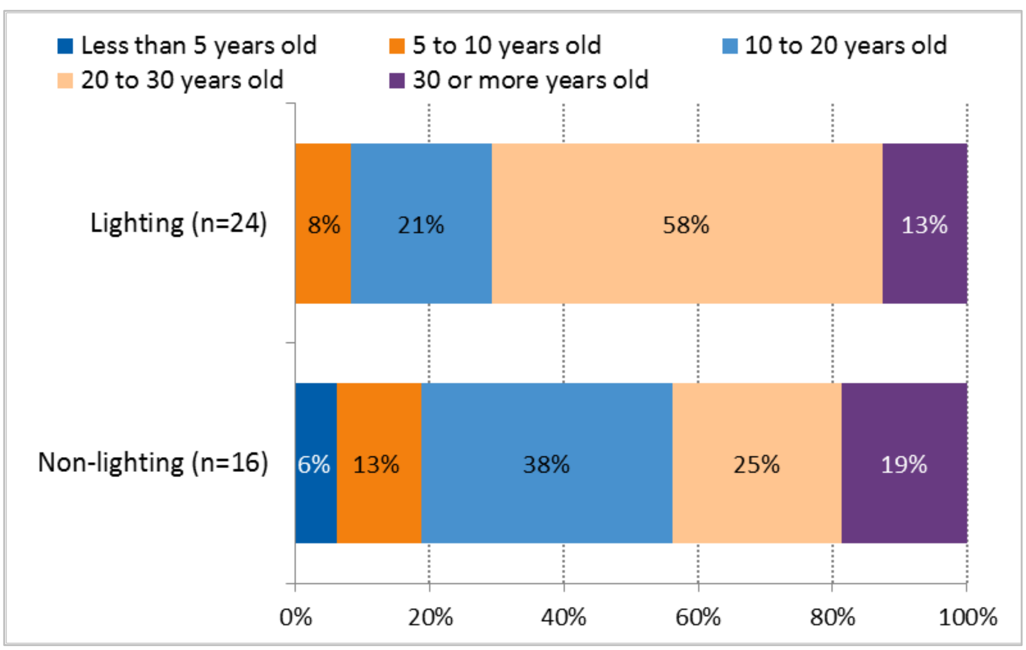


Figure 12 shows the ages respondents reported for previously-installed equipment; most replaced lighting equipment was more than 20 years old (71%, n=24), compared to about half of the replaced non-lighting equipment (44%, n=16) being that old.

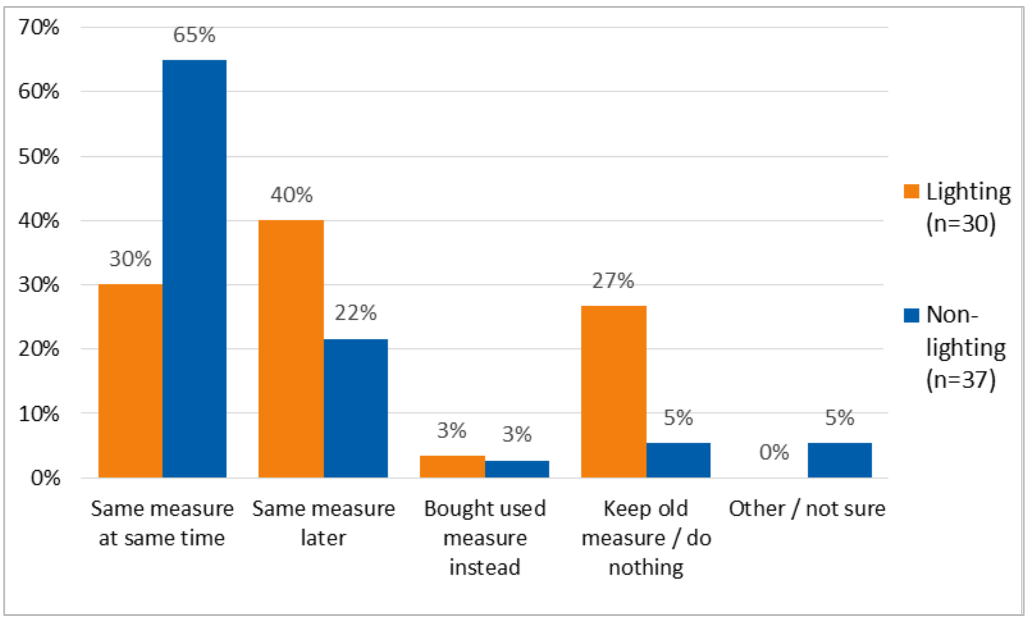
Figure 12. Age of Previous Equipment Replaced by Equipment Rebated through the Prescriptive Program



Program Influences

The survey asked respondents what they would have done if the Prescriptive Program had not been available, and how influential the program incentive, information, and technical assistance were on their decision to install energy-efficient equipment.[9] Two-thirds of non-lighting respondents said they (65%, n=37) would have installed the same equipment at the same time in the absence of the Prescriptive Program, compared to only a third (30%, n=30) of lighting respondents (Figure 13). Conversely, only 5% of non-lighting respondents say they would not have installed new equipment without the Prescriptive Program, compared to 27% of lighting respondents. Lighting respondents more frequently reported that they would have installed the same equipment without the program, but at a later time (40% for lighting, 22% for non-lighting).

Figure 13. What Participants Would Have Done Without the Prescriptive Program

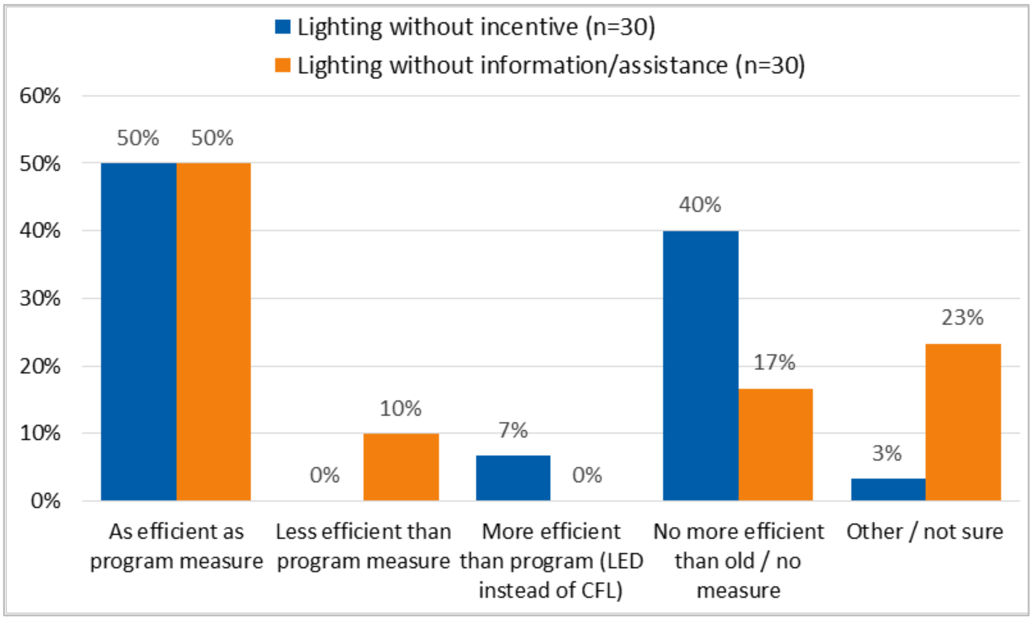


The evaluation team asked participants if they would have selected equipment with the same efficiency level as their program-rebated equipment if the incentive rebate, program information, and technical assistance had not have been available. Figure 14 and Figure 15 show responses separately for surveyed lighting and non-lighting participants. The largest difference is that 40% of lighting respondents reported they would not have installed more efficient equipment if there had not been a financial incentive, compared to just 17% of lighting respondents who said that they would not have installed more efficient equipment without the information and assistance. Two surveyed lighting respondents (7%, n=30) reported that they would have installed more efficient equipment than they did through the program if

[9] The evaluation team will use the results from these survey questions to estimate freeridership for impact calculations. The team will complete the impact report for this program in early 2017.

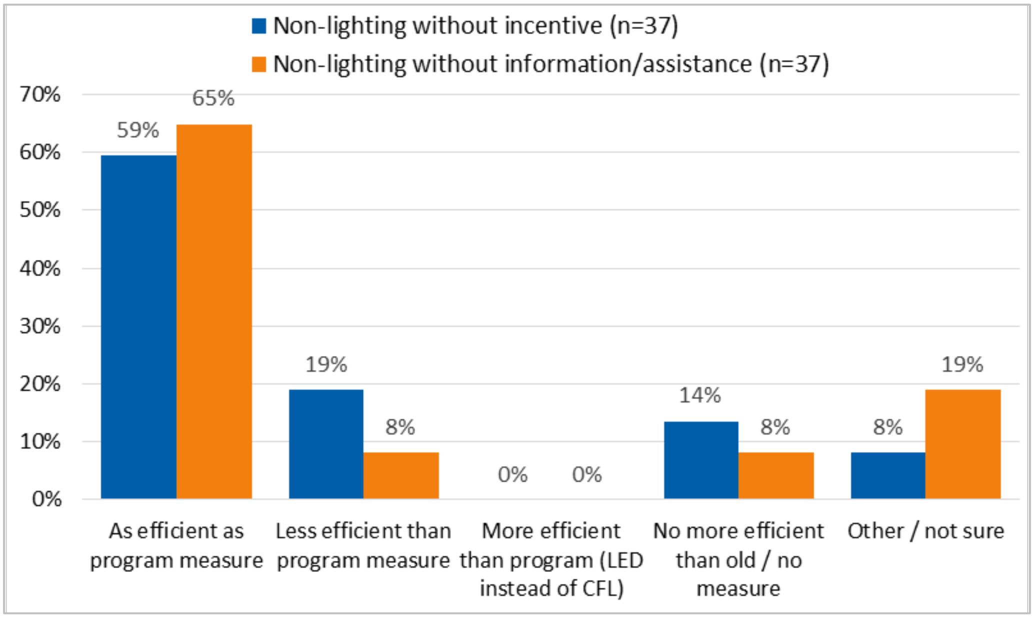
the incentive had not been available. Both of these participants stated that they would have preferred to install LEDs, but the incentive led them to purchase CFLs instead.

Figure 14. Relative Efficiency of Lighting Equipment Purchased Without the Incentive and the Program Information and Technical Assistance



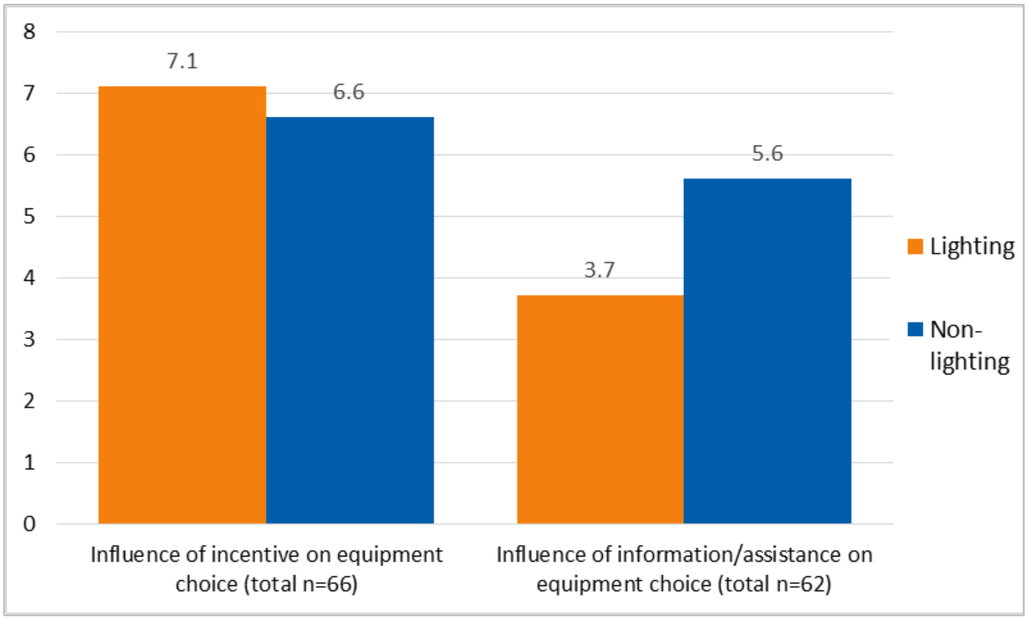
Compared to lighting respondents, non-lighting respondents more frequently reported they would have installed equipment of the same efficiency level without the incentive (59%) and information and assistance (65%), and less frequently reported that they would not have installed more efficient equipment (14% without incentive and 8% without information and assistance).

Figure 15. Relative Efficiency of Non-lighting Equipment Purchased Without the Incentive and the Program Information and Technical Assistance



The evaluation team also asked participants to rate the influence of the program's incentive payment and information and technical assistance on their choice of efficient equipment on an 11-point scale where 0 is "no influence" and 10 is a "major influence". Figure 16 shows that for both lighting and non-lighting respondents, the financial incentive received a higher influence rating than the program information and assistance, but the difference between these ratings was much larger for lighting respondents (7.4 versus 3.7, compared to 6.6 versus 5.6 for non-lighting).

Figure 16. Influence Ratings for the Incentive and the Program Information and Technical Assistance



Sources of Information

Respondents who gave the influence of program information and technical assistance a rating of 7 or lower were asked what information sources they considered to have been the most important. Half of these participants (51%, n=41) reported the trade ally they worked with as having been their most important source of information, while 12% reported referrals from colleagues or other companies, 10% said information from equipment manufacturers, and 10% said that the ROI was the most important piece of information. Other factors mentioned by less than 10% of participants included previous experience with Smart $aver programs, advice from engineers and other in-house experts, compatibility with existing equipment, and their organization's policies and dictates.

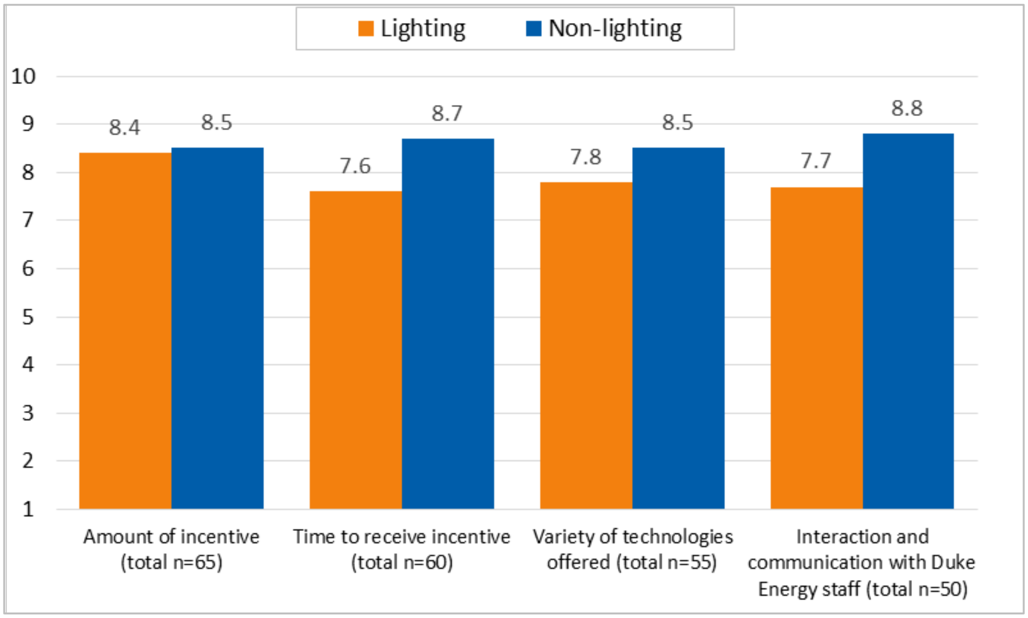
Satisfaction with the Program

Survey respondents gave the Prescriptive Program consistently high satisfaction scores, ranging from a high of 9.3 (n=34) for the information provided by Duke Energy account managers, to a low of 7.7 (n=55) for information provided by trade allies. Participants who installed non-lighting measures generally gave higher ratings than participants with lighting measures.

When respondents were asked to rate their satisfaction with four aspects of the Prescriptive Program (Figure 17), surveyed lighting and non-lighting participants were equally satisfied with the amount of the incentive they received, while non-lighting respondents gave higher ratings for the time it took to receive payment, variety of technologies covered, and interactions with Duke Energy staff.[10]

[10] Differences between groups are statistically significant using ANOVA for time to receive incentive (p=.047) and interactions with Duke Energy staff (p=.031), but not for variety of technologies.

Figure 17. Satisfaction Ratings for Aspects of the Prescriptive Program



Respondents who gave ratings of 7 or lower for satisfaction questions were about what could be done to improve those aspects of the program.

The 17 participants who gave ratings of 7 or lower for the size of the incentive generally said the incentives should be higher; two mentioned that higher incentives would have allowed them to complete more installations at once rather than doing piecemeal upgrades. Another suggested that the same items should be available at the same discount through the Duke Energy Business Savings Store, as this would allow customers to get the same equipment at the same price without having to submit an application.

Similarly, the 15 participants who gave ratings of 7 or lower related to the amount of time it took to receive their incentive payment generally want to receive their payments faster; two respondents also said that they had difficulty reaching a Duke Energy representative to answer application questions, and one suggested that Duke Energy should notify applicants within three days if there were any issues that could delay application processing.

Seventeen participants gave ratings of 7 or lower for the variety of technologies covered by the Prescriptive Program, and six of them gave specific suggestions and complaints, listed below:

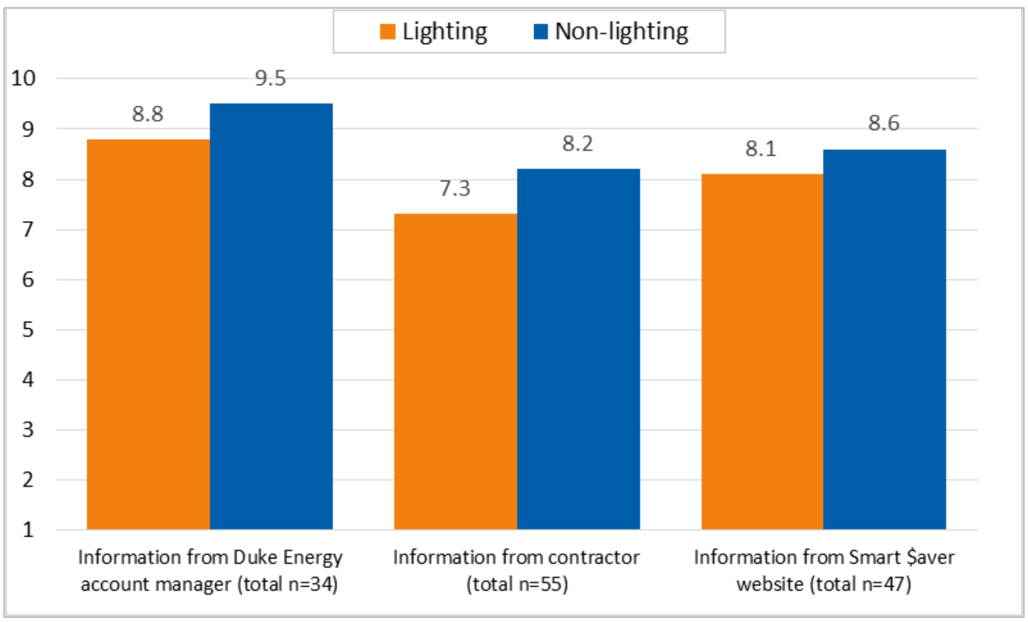
- *"I would like to see higher incentives for LEDs. The relative amounts of the incentives should correlate to the efficiency rating of the new equipment."*
- *"I would like to see more food and bar service equipment covered by the program; specialized refrigeration such as beer coolers, under counter sandwich stations, etc."*
- *"I would like to see manufacturing equipment with VFDs added to the list. Currently, just pumps and fans with VFDs qualify for the incentives."*

- *"I would like to see more industrial technologies included for possible incentives."*
- *"I've just eliminated a 200 horsepower motor from our waste removal system. If I had an incentive to offset that capital, I would have done this project a lot sooner."*
- *"Only half of the needed technologies are covered by this program."*

The 16 participants who gave ratings of 7 or lower for interactions with Duke Energy staff generally complained about a lack of timely response to inquiries and a desire for more direct contact. In particular, four participants said that they had difficulty reaching somebody by telephone to help them.

Participants also rated their satisfaction with three sources of program information: Duke Energy account managers, trade allies, and the Smart $aver website (see Figure 18). Although non-lighting respondents gave slightly higher ratings for all three, there are no statistically significant differences by measure category.

Figure 18. Satisfaction Ratings for Sources of Prescriptive Program Information



The evaluation team asked respondents who gave ratings of 7 or lower for satisfaction questions about what could be done to improve those aspects of the program. Only one survey respondent who gave a lower rating for information from Duke Energy account managers provided a suggestion for improvement: "E-mails are fine, but on-site visits from a Duke Energy representative would be nice too. The Duke Energy representative and I should on a first-name basis with each other."

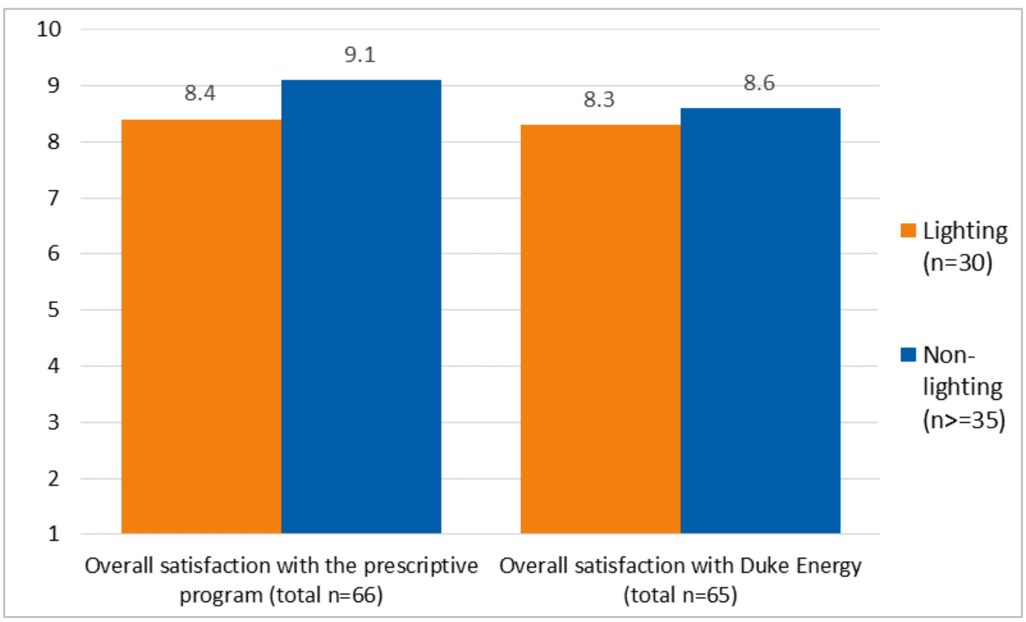
Participants who gave lower ratings for the information provided by their contractor often noted that the trade ally they worked with either was not aware of the Prescriptive Program, or did not mention it until the customer asked about it. The most frequent suggestions for improvement were to increase awareness of the program among trade allies and to better inform trade allies about the program. Three more specific suggestions from participants include the following:

- *"Contractors need to provide product spec sheets."*
- *"This can be improved by simplifying and clarifying the types of specifications and estimations that vendors are required to provide."*
- *"Provide vendors with a list of approved Energy Star-rated fixtures and equipment."*

Participants who gave lower ratings for the information provided on the Smart $aver website generally suggested that the site should be more "user friendly" and "less confusing." One respondent suggested, "Do not segregate applications by states. Make it easier to follow the applications for each state."

Finally, participants rated their overall satisfaction with the Prescriptive Program and with Duke Energy overall (Figure 19). Surveyed non-lighting participants gave significantly higher ratings for the program than surveyed lighting participants,[11] and they also rated Duke Energy slightly higher, though this difference is not statistically significant. Among all survey respondents, the average satisfaction ratings were 8.8 for the program and 8.4 for Duke Energy.

Figure 19. Satisfaction with the Prescriptive Program and Duke Energy Overall



The survey asked respondents who rated their satisfaction with the program overall or with Duke Energy at 7 or lower about what could be done to improve the situation. Only two participants provided

[11] The difference between groups is statistically significant using ANOVA for overall program satisfaction (p=.076).

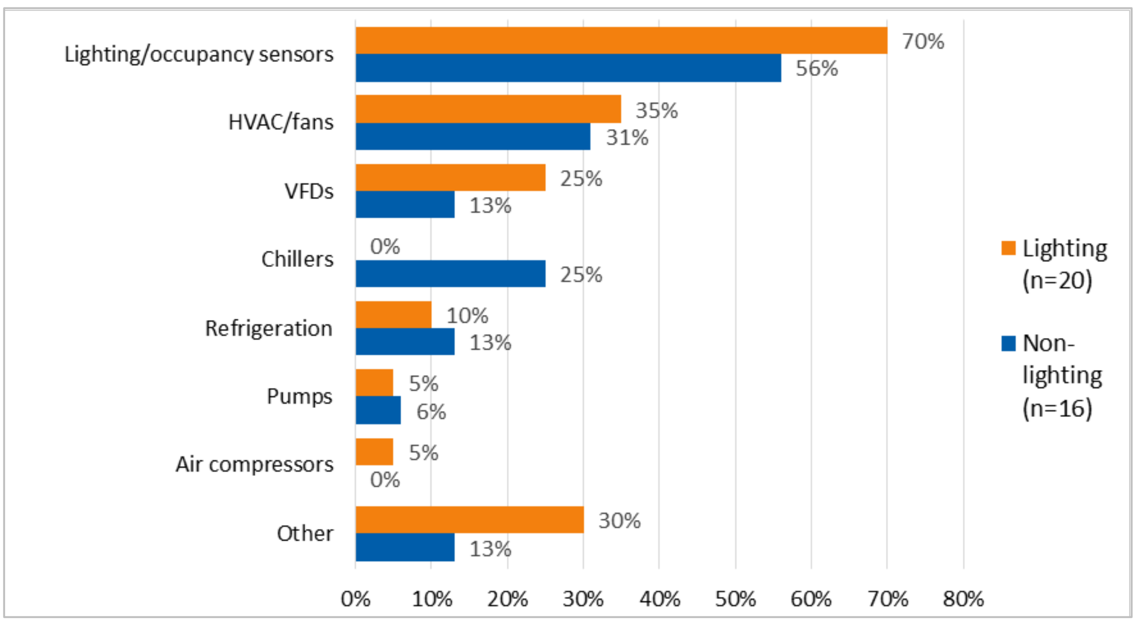
comments related to the program overall; one was related to LED incentive changes, and the other was related to the rebate process.

Three participants who rated their satisfaction with Duke Energy at 7 or lower suggested improving customer service, and one suggested making the website more "mobile friendly." There was also one participant who complained about power surges damaging their equipment, and one who mentioned the Dan River coal ash spill.

Gateway Effects

The evaluation team asked respondents whether participation in the Prescriptive Program led to any gateway effects (i.e., increased interest in other energy efficiency projects). Two-thirds of lighting respondents (67%, n=30) and nearly half of non-lighting respondents (44%, n=36) reported taking additional actions to save energy after participating in the program. Figure 20 shows that, of the 36 respondents who completed additional installations, most installed lighting measures, and about a third installed HVAC measures. These are also the most common types of measures installed through the Prescriptive Program.

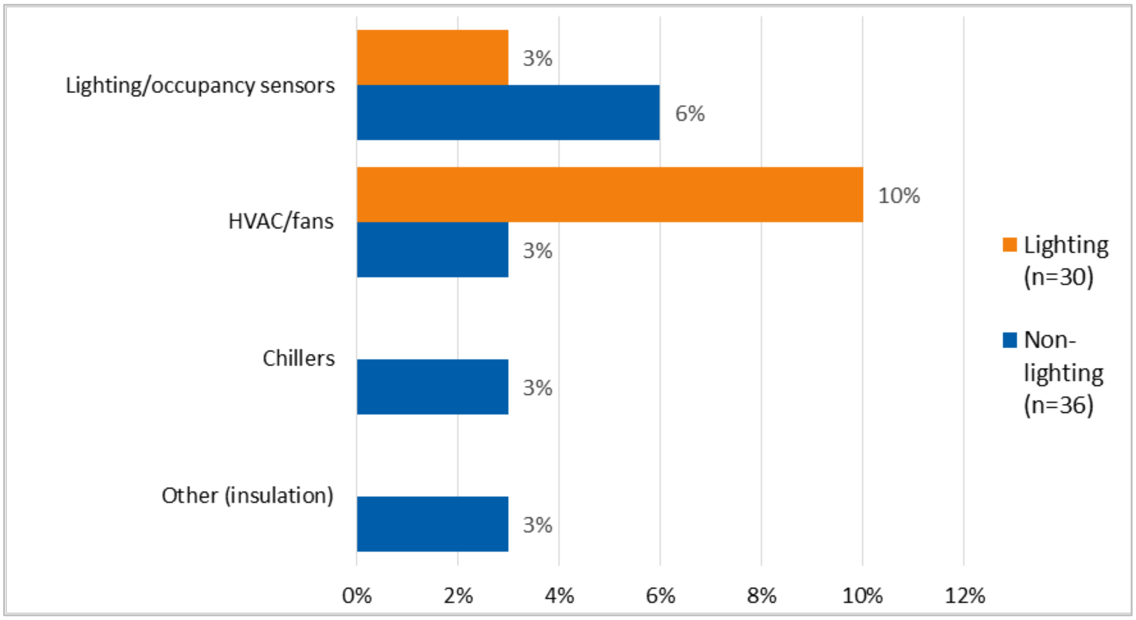
Figure 20. Additional Equipment Installed Since Participating in the Prescriptive Program by Participants with Additional Installations



Most of the additional installations by surveyed participants received incentives (64% of 69 installations described), and all but one of these incentives was paid by Duke Energy, indicating continued participation in Smart $aver nonresidential programs. The survey also asked participants to rate the influence of participating in the Prescriptive Program on their decision to install additional equipment.

Seven surveyed participants (11%, n=66) installed equipment for which they did not receive an incentive payment and rated the influence of the program at 7 or higher, indicating potential spillover effects.[12] A summary of these potential spillover measures is shown in Figure 21. Most of these installations are also lighting and HVAC measures.

Figure 21. Participants with Potential Spillover Installations since Participating in the Prescriptive Program



Business Savings Store

In 2013 Duke Energy launched a website called the Business Savings Store where residential and nonresidential customers can purchase efficient lighting at a discounted price. The evaluation team asked Prescriptive Program participants if they have ever visited the Business Savings Store or made a purchase there. Nearly half of survey respondents had visited the Savings Store, and both lighting (40%, n=30) and non-lighting respondents (44%, n=34) were equally likely to have done so. However, a larger percentage of lighting respondents (13%) had made a purchase from the Savings Store compared to non-lighting respondents (3%). None of the surveyed participants who made a purchase from the Business Savings Store reported having any problems with order.

[12] The evaluation team will estimate spillover as part of the net-to-gross ratio calculation in the impact evaluation for the Prescriptive program; the team will complete the impact evaluation in early 2017.

Strengths and Challenges

The evaluation team asked respondents what they liked most and least about participating in the Prescriptive Program. Table 7 shows that the incentive rebate is most often mentioned as the most-liked aspect of the program by both lighting (50%, n=30) and non-lighting (35%, n=37) respondents. For lighting respondents, the next most-mentioned favorite things about the program are upgrading to better equipment (27%) and the program helping them to gain support and approval for projects (20%). For non-lighting respondents, the second most-mentioned favorite thing is the ease and convenience of participation (16%), followed by support and approval for projects, reduced energy costs, and assistance from Duke Energy staff (all mentioned by 11%).

Table 7. What Participants Liked Most about the Prescriptive Program

Response	Lighting (n=30)	Non-lighting (n=37)	Total (n=67)
The incentive rebate/reduced cost of purchasing equipment	50%	35%	42%
More support from management for purchasing equipment/easier to get approval for projects	20%	11%	15%
Upgrades/better equipment	27%	3%	13%
Ease and convenience	7%	16%	12%
Payback period/ROI	13%	8%	10%
Reduced energy costs/long term savings	10%	11%	10%
Saving energy/energy efficiency	13%	8%	10%
Assistance from Duke Energy account manager/Duke Energy staff	0%	11%	6%
Assistance from trade allies	0%	5%	3%
Other responses (unique)	13%	8%	10%
No favorite thing	7%	24%	16%

About half of survey respondents were able to name a least favorite thing about participating in the Prescriptive Program (See Table 8). The most common complaints are about difficulties with paperwork and the application process (13%, n=67) and the process of participation taking too long (10%). There are no significant differences between lighting and non-lighting respondents.

Table 8 What Participants Liked Least about the Prescriptive Program

Response	Lighting (n=30)	Non-lighting (n=37)	Total (n=67)
Paperwork/application requirements	13%	14%	13%
Process takes too long/delays	10%	11%	10%
Reaching Duke Energy staff/lack of responsiveness	10%	5%	7%
Not enough information and outreach from Duke Energy	3%	5%	4%
Cost of energy efficiency rider	10%	0%	4%
Incentive amount	0%	5%	3%
Problems with Trade Ally	3%	3%	3%
Smart $aver website	3%	3%	3%
Other responses (unique)	13%	14%	13%
No least favorite thing	40%	54%	48%

The evaluation team asked participants if there were any additional services they would like to see added to the Prescriptive Program. More than a third of survey respondents made suggestions, summarized in Table 9. The most common suggestions were for the program to cover additional equipment, mentioned by about one respondent in 10 (12%, n=67). Measures that participants would like to see covered by the Prescriptive Program include: more LEDs, evaporator and chiller tune-ups, chillers and air handlers, insulation, shop lighting, and walk-in refrigerators with ECM motors. One respondent also mentioned that North Carolina companies had more options for tune-up measures than companies in South Carolina due to different rules in the two states.

Table 9 What Additional Services Participants Would Like to See Added to the Prescriptive Program

Response	Lighting (n=30)	Non-lighting (n=37)	Total (n=67)
Incentives for more types of equipment	13%	11%	12%
More information/education/updates about the program	10%	3%	6%
Make experts more available/phone support/on-site visits	7%	5%	6%
Improve application process	0%	8%	4%
More proactive recommendations from Duke Energy	3%	3%	3%
Other responses (unique suggestions)	10%	5%	7%
No suggestions	57%	68%	63%

Finally, the evaluation team asked participants if there were any other changes they would like to see in the Prescriptive Program. Table 10 summarizes these suggestions, which are similar to the results when participants were asked to suggest additional services for the program. Participants who suggested additional measures that the program could include mentioned LEDs, food and bar service equipment (specifically beer coolers and under-counter sandwich stations), and a request from a facility that uses both natural and electric lighting for "equipment that could automatically adjust our lighting intensity regardless of weather or time of day."

Table 10 Other Changes to the Prescriptive Program That Participants Would Like to See

Response	Lighting (n=30)	Non-lighting (n=37)	Total (n=67)
More information/education/updates about the program	10%	5%	7%
Incentives for more types of equipment	10%	0%	4%
Other responses (unique suggestions)	10%	11%	10%
No suggestions	70%	86%	79%

Appendix A. Management Interview Guide

Name: ____

Title: ____

Position description and general responsibilities:

____

We are conducting this interview to obtain your opinions about and experiences with the Non Residential Smart $aver® Prescriptive Program. We'll talk about the Smart $aver® Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The purpose of this study is to capture the program's current operations as well as help identify areas where the program might be improved. Your responses will feed into a report that will be shared with Duke Energy and the state regulatory agency.

The interview will take about an hour to complete. Do you have any questions for me before we begin?

(1) Program Background and Objectives (15 min)

1. Please describe your role and scope of responsibility in detail.
2. How long have you been involved with the Smart $aver program?
3. (PM only) Describe the evolution of the Smart $aver® Program. Why was the program created, and has the program changed since it was it first started?
4. Have there been any recent changes been made to your duties since you started?
    a. If YES, please tell us what changes were made and why they were made. What are the results of the change?
5. In your own words, please describe the Smart $aver® Program's objectives. (e.g. enrollment, energy savings, non-energy benefits)
6. (PM only) Can you please walk me through the program's implementation, starting with how the program is marketed and how you target your customers, through how the customer participates and finishing with how savings are verified?
    a. Marketing/Targeting: How & Who
    b. Enrollment/Participation
    c. Application processing

   d. Savings verification: How & Who

7. Of the program objectives you mentioned earlier, do you feel any of them will be particularly easy to meet, and why?

8. Which program objectives, if any, do you feel will be relatively difficult to meet, and why?

9. Are there any objectives you feel should be revised prior to the end of this program cycle? If yes, why?

(2) Vendors (10 min)

10. (PM only) Do you use any vendors or contractors to help implement the program?

    a. What responsibilities do they have?

    b. Are there any areas in which think they can improve their services?

11. *(If not captured earlier)* Please explain how activities of the program's vendors, customers and Duke Energy are coordinated.

    a. Do you think methods for coordination should be changed in any way? If so, how and why?

(3) Rebates (15 min)

12. (PM only) How do you determine which pieces of equipment are included in the program? For example, how do you determine what level of efficiency the rebated equipment should have?

    a. Do you use any outside vendors or experts to help with this process?

    b. What should be changed about this selection process?

13. Describe your quality control and process for tracking participants, rebates, and other program data.

14. Do you believe that the program currently offers rebates on enough energy-efficient products to meet your customers' needs?

    a. If not, what products would you like to add? Are these currently being considered?

15. Is the program offering enough of a rebate to motivate your customers to participate?

    a. If not, which rebates do you think should be changed, and why?

(1) Contractor Training (5 min)

16. Describe Smart $aver®'s contractor program orientation training and development approach.

a. How do you ensure that contractors are getting adequate program training and updated program information?

b. Can we obtain training materials that are being used?

c. Are there any new areas where you think contractors could be trained?

17. Do you have any suggestions for improving contractor effectiveness?

(2) Improvements (10 min)

18. Are you currently considering any changes to the program's design or implementation?

    a. What are the changes?

    b. What is the process for deciding whether or not to make these changes?

19. Do you have suggestions for improvements to the program that would increase participation rates, or is Duke Energy happy with the current level of participation?

20. Do you have suggestions for increasing energy impacts *per participant*, given the same participation rates, or is Duke Energy happy with the current per participant impact?

21. Overall, what would you say about the Smart $aver® program is working really well?

    a. Is there anything in this program you could highlight as a best practice that other utilities might like to adopt?

22. What area needs the most improvement, if any?

    a. (If not mentioned before) What would you suggest can be done to improve this?

23. Are there any other issues or topics we haven't discussed that you feel should be included in this report?

24. Do you have any further questions for me about this study or anything else?

Thank you!

Appendix B. Duke Energy
Nonresidential Smart $aver Prescriptive Trade Ally Survey 2015

Appendix C. Duke Energy
Nonresidential Smart $aver Prescriptive Participant Survey 2015

Appendix B. Duke Energy
Nonresidential Smart $aver Prescriptive Trade Ally Survey 2015

Researchable Questions	Item
Introduction	A1-2
Understanding the respondent	B1-4
Understanding the program	C1-C8
Customer motivation	D1-6
Reasons for participation	E1-2
Program design and assistance	F1-6
Program participation experience	G1-18
Recommended changes	H1-2
Satisfaction with program	I1-2
Satisfaction with utility	J1-2
Closing	K1

Target Quota =
[Carolinas – 10 interview completes]

General Instructions

- Interviewer instructions are in green **[LIKE THIS]**.
- CATI programming instructions are in red **[LIKE THIS]**.
- Items that should not be read by the interviewer are in parentheses like this ( ).

Variables to be pulled into Survey from Sample (return all information from sample in the final data file)

- Name
- Title
- Company
- Customer Company
- Date the customer incentive was paid

A. *Introduction*

A1. Hello, my name is _____, and I'm calling from [SURVEY FIRM] on behalf of Duke Energy. May I speak with [NAME ON CALL LIST] please?

1. (Continue) [IF PERSON TALKING, PROCEED.]
2. (No or not a convenient time) [IF PERSON IS CALLED TO THE PHONE REINTRODUCE. IF NOT FREE TO TALK, ASK WHEN WOULD BE A GOOD TIME TO CALL AND SCHEDULE THE CALL-BACK]

98. (Don't know) [ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]
99. (Refused) [THANK AND TERMINATE]

A2. Hello, my name is **[STATE YOUR NAME]** with **[INSERT COMPANY NAME]** on behalf of Duke Energy. Duke Energy is seeking your opinions about their Smart $aver Prescriptive program. According to Duke's records, your company recently helped a customer apply for an incentive. Would you have about 15 minutes to talk about the Smart $aver program, either now or sometime later? [IF NEEDED: WE ARE CONDUCTING THIS INTERVIEW TO OBTAIN YOUR OPINIONS DUKE ENERGY'S NON-RESIDENTIAL SMART $AVER PROGRAM. WE'LL TALK ABOUT YOUR UNDERSTANDING OF THE SMART $AVER PROGRAM AND ITS OBJECTIVES, YOUR THOUGHTS ON IMPROVING THE PROGRAM, AND THE TECHNOLOGIES THE PROGRAM COVERS. WE WOULD LIKE TO ASK YOU ABOUT YOUR UNDERSTANDING OF THE SMART $AVER PROGRAM.]

1. (Yes)
2. (No)

A2a. Is there someone else at your company who might be more appropriate for me to talk to?

1.(**YES**) [ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]
2.(No) [THANK AND TERMINATE]
98.(Don't know) [THANK AND TERMINATE]
99. (Refused) [THANK AND TERMINATE]

98. (Don't know) [ASK TO SPEAK WITH SOMEONE WHO KNOWS AND BEGIN AGAIN]
99. (Refused) [THANK AND TERMINATE]

B. Understanding the Respondent

B1. We would like to start by first asking about your company. What kind of business is it? [DO NOT READ LIST; RECORD ONE RESPONSE]

1. (Manufacturer)
2. (Distributor)
3. (Wholesalers)
4. (Retailer)
5. (General Contractor)
6. (Installer)
7. (Consulting/Engineering)
8. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

B2. What is your job title and what are your responsibilities in your company?
[RECORD RESPONSE]

B3. Do you help customers make decisions about what type of equipment to install?
1. (Yes)
2. (No) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]
98. (Don't know) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]
99. (Refused) [ASK TO SPEAK WITH A PROJECT OR SALES MANAGER INVOLVED WITH PROJECT ON CALL SHEET AND BEGIN AGAIN; THANK AND TERMINATE IF THEY CANNOT PROVIDE AN EMPLOYEE WHO HELPS CUSTOMERS WITH EQUIPMENT DECISIONS WHO KNOWS ABOUT SMART SAVER]

B4. How long have you been in this profession?
[RECORD RESPONSE]

C. Understanding the program

C1. How did you first learn about Smart $aver?
[RECORD RESPONSE]

C2. Have you submitted applications for Smart $aver Prescriptive incentives only, Smart $aver Custom incentives only, or both? [PROBE FOR CLARIFICATION IF NEEDED – ONE OR THE OTHER OR BOTH?]
1. (Prescriptive only)
2. (Custom only)
3. (Both Custom and Prescriptive)
4. (Other response) [RECORD RESPONSE]
5. (Neither program) [ASK IF THERE IS SOMEONE AT THE COMPANY WHO KNOWS MORE ABOUT SMART SAVER AND BEGIN AGAIN WITH THEM] [IF RESPONDENT INSISTS THAT THEY HAVE NOT SUBMITTED APPLICATIONS FOR EITHER PROGRAM THEN THANK AND TERMINATE]
98. (Don't know)
99. (Refused)

C3. How long have you been a partner in the Smart $aver Program? [PROBE IF NEEDED]: When did you first submit a Smart $aver Prescriptive application?
[RECORD RESPONSE]

C4. Before you began participating in the Smart $aver Prescriptive program, what other incentives were you able to offer your customers to install high efficiency equipment? **[IF NEEDED: FOR EXAMPLE DID YOU OFFER YOUR CUSTOMERS INCENTIVES FROM OTHER UTILITIES OR MANUFACTURERS?]**

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

C5. Are you or your company signed up in the Trade Ally list on Duke Energy's website?

1. (Yes)
2. (No)
3. (Other response) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF C5=1]

C6. Have you gotten any leads from the Duke Energy website?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

C7. When you are talking with a customer, at what point in the discussion do you usually bring up the incentive? [IF NEEDED, PROMPT: "DURING THE INTRODUCTORY MEETING, AFTER YOU'VE SCOPED THE PROJECT, ONLY IF THE CUSTOMER ASKS?"]

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

C8. Have your customers expressed any complaints about the program to you?

1. (Yes)

   C8b. What were these complaints? [RECORD RESPONSE]

2. (No)
3. (Other response) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

D. *Customer motivation*

D1. When you are talking with a new prospective customer, what percentage have already heard of Duke Energy's Smart $aver program? Would you say...? [READ LIST, CHECK ONE]

1. Almost None
2. About 25%
3. About 50%
4. About 75%
5. Almost all

98. (Don't know)
99. (Refused)

D2. If the program was not offered, do you think customers would change their project scope in any way?

1. (Yes)
2. (No)

98. (Don't know)
99. (Refused)

[ASK IF D2=1]

D3. In what way would they change the scope of their projects?

1. (Response given) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

D4. Are the incentive levels high enough to motivate customers to install high efficiency equipment?

1. (Yes)
2. (No)
3. (Other response) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

[ASK IF D4=2]

D5. What types of equipment should have a higher incentive, and how much higher should it be?

1. (Response given) [RECORD RESPONSE]

98. (Don't know)
99. (Refused)

D6. On a scale of 0 to 10, where a zero means that the program had zero influence and a 10 means that the program had a major influence, please rate the level of influence, on average, that the program incentive had on the level of energy efficiency of your customers' equipment decisions.
1. (Rating given) [RECORD NUMBER 0-10]
98. (Don't know)
99. (Refused)

E. TA Reasons for participation

E1. We would like to better understand why contractors become partners in the Smart $aver Program. Please give me an estimate: What percentage of your 2014 projects included equipment that received a Smart $aver Prescriptive incentive? **[IF THEY CAN'T REMEMBER PRESCRIPTIVE SEPARATE FROM CUSTOM, HAVE THEM ESTIMATE TOGETHER AND RECORD THAT THE PERCENTAGE IS COMBINED]**
1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

E2. Why do you think some of your competitors do not participate in this program?
1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

F. Program design and assistance

F1. Are there other technologies or energy efficient systems that you think should be included in the program?
1. (Yes)
2. (No others)
98. (Don't know)
99. (Refused)

[ASK IF F1=1]
F2. What technology or systems should be included?
1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF F1=1]

F3. Why should they be included?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

F4. Are there technologies that are now included in the program that you feel should not be included?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF F4=1]

F5. Which technologies should not be included?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF F4=1]

F6. Why should they not be included?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

G. Program participation experience

G1. The next few questions ask about the process for submitting incentive applications and obtaining the incentive payments. Have you ever submitted any applications to the Prescriptive program on behalf your customer?

1. (Yes)
2. (No) [SKIP TO G7]
98. (Don't know) [SKIP TO G7]
99. (Refused) [SKIP TO G7]

G2. Do you think this process could be streamlined in any way?

1. (Response given) [RECORD RESPONSE]
2. (No suggestions given)
98. (Don't know)
99. (Refused)

G3. How long does it typically take between the time that you apply for your incentive and the time that you or your customer receives the payment?

1. (Response given) [RECORD RESPONSE IN DAYS, WEEKS OR MONTHS]
98. (Don't know)
99. (Refused)

[ASK IF G3=1]

G4. On a scale of one to ten, how satisfied are you with the amount of time it typically takes between the time you apply for the incentive and the time you receive the payment, with 1 indicating not satisfied at all and 10 indicating highly satisfied?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF G4<= 7]

G5. Why do you say that?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF G4<= 7]

G6. How long do you think it should take between submitting an application and receiving payment?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

G7. Have you attended any presentations made by Duke Energy's Smart $aver program staff?

1. (Yes)
2. (No) [SKIP TO G11]
98. (Don't know) [SKIP TO G11]
99. (Refused) [SKIP TO G11]

[ASK IF G7=1]

G8. How did you hear about these presentations?

1. (email)
2. (Other Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

[ASK IF G7=1]

G9. Can you please rate the usefulness of the presentation you most recently attended, on a scale of 0 to 10, where zero indicates "Not useful at all" and 10 indicates "always useful".

1. (Rating given) [RECORD NUMBER 0-10]
98. (Don't know)
99. (Refused)

[ASK IF G7=1]

G10. Is there any information you would like Duke to provide at these presentations, that they are not currently providing about the Prescriptive program?

1. (Response given) [RECORD RESPONSE]
2. (No suggestions)
98. (Don't know)
99. (Refused)

G11. The next question asks about the people you interact with at Duke Energy, during the course of a prescriptive project. Do you interact with…? **[READ LIST, CHECK ALL THAT APPLY]**

1. Large Account Managers
2. Smart $aver Outreach Representatives
3. The Smart $aver Prescriptive program managers (Smart $aver program manager are folks who administer the program)
4. Duke Energy's Energy Efficiency Engineers? (EE Engineers are folks who perform the technical analysis when the application is turned in)
5. Any other Duke Energy employees?
   G11c. Who were they? [RECORD RESPONSE]
6. (None of the above) [SKIP TO G15]
98. (Don't know) [SKIP TO G15]
99. (Refused) [SKIP TO G15]

[ASK G12 ONCE FOR EACH RESPONSE 1-5 THAT WAS CHECKED IN G11]

G12. What was the purpose of your interaction with **[RESPONSE(S) 1-5 FROM G11]**?
[RECORD RESPONSE]

G13. On a scale of 0 to 10, please rate how satisfied you are with the communication between you and Duke Energy on Smart $aver-related issues, with 0 indicating not satisfied at all and 10 indicating highly satisfied?

[ASK IF G13<=7]

G14. How can Duke Energy improve the way they communicate on Smart $aver related issues?
[RECORD RESPONSE]

G15. Do you use any information or technical tools from the Smart $aver website when making proposals to customers?

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

[ASK IF G15=1]

G16. How would you rate the usefulness of these materials on a scale of 0 to 10 where zero indicates "Not useful at all" and 10 indicates "always useful"?

1. (Rating given) [RECORD NUMBER 0-10]
98. (Don't know)
99. (Refused)

[ASK IF G16<= 7]

G17. How can Duke Energy improve the usefulness of these materials?

1. (Response given) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

G18. Are there any other materials you would like to have when discussing the project with customers?

1. (Yes)
    G18d. What materials? [RECORD RESPONSE]
2. (No)
98. (Don't know)
99. (Refused)

H. *Recommended changes*

H1. Is there anything about the Smart $aver Program that you would say is working exceptionally well?

1. (Yes, response given) [RECORD RESPONSE]
2. (No comments)
98. (Don't know)
99. (Refused)

H2. What program change or improvement should be Duke Energy's number one priority?

1. (Response given) [RECORD RESPONSE]
2. (No suggestions)
98. (Don't know)
99. (Refused)

I. *Satisfaction with program*

I1. Considering all aspects of the program, what numerical rating would you give for your overall satisfaction with the Smart $aver Prescriptive Program, using a scale of 1 to 10 where one means "not satisfied at all" and ten means "extremely satisfied"?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF I1 <=7]

I2. What would you recommend to improve the program, or have we already covered it?

1. (Response given) [RECORD RESPONSE]
2. (We have already covered it / no additional comments)
98. (Don't know)
99. (Refused)

J. ***Satisfaction with Utility***

J1. Using the same numerical scale, how would you rate your overall satisfaction with Duke Energy?

1. (Rating given) [RECORD NUMBER 1-10]
98. (Don't know)
99. (Refused)

[ASK IF J1 <= 7]

J2. What, if anything, could Duke Energy do to increase your satisfaction, or have we already covered it?

1. (Response given) [RECORD RESPONSE]
2. (We have already covered it / no additional comments)
98. (Don't know)
99. (Refused)

K. Closing

K1. That concludes this survey, thank you very much for taking the time to help Duke Energy improve this program. Your response is very important to us.

CADMUS

Appendix C. Duke Energy
Nonresidential Smart $aver Prescriptive Participant Survey 2015

Intro

We are conducting this survey to obtain your opinions about Duke Energy's Smart $aver Prescriptive Program, in which your organization participated. We are not selling anything and your answers will be kept confidential. If you complete this survey, you will be entered into a drawing to win an Apple iPad Air. If you win the drawing, you will also have the option of donating the value of the prize to the United Way charity instead. This survey will take about 15 minutes; if right now is not a good time, we can schedule an appointment to do this survey later. May we begin the survey?

[ONLY CONTINUE IF THEY AGREE TO THE SURVEY. SCHEDULE CALL-BACK IF NECESSARY; IF THEY CANNOT DO THE SURVEY, RECORD THIS ON THE CALL SHEET AND DO NOT CONTINUE IN QUALTRICS.]

Measure

According to our records, your organization installed [SUMMARIZE EQUIPMENT FROM CALL SHEET] at a building located in [CITY AND STATE FROM CALL SHEET] and received a rebate from the Duke Energy Smart $aver program for this equipment in 2014. Do you recall participating in this program? [PROVIDE EXACT "DATE PAID" FROM CALL SHEET IF NEEDED]

CHECK MEASURE TYPE BELOW IF RESPONDENT CONFIRMS THAT THEY KNOW ABOUT THE INSTALLATION ON THE CALL SHEET. IF SOMEONE ELSE AT THE COMPANY WOULD BE BETTER TO TAKE THIS SURVEY, ASK FOR THEIR CONTACT INFO AND TRY TO SURVEY THEM INSTEAD. IF RESPONDENT CANNOT RECALL/CONFIRM OR MENTIONS DIFFERENT EQUIPMENT FROM A DIFFERENT YEAR, THEN RECORD AS DISQUALIFIED ON CALL SHEET AND DO NOT CONTINUE]

- Lighting (1)
- HVAC and Chillers (2)
- Pumps and Drives (VFD) (3)
- Food service (4)
- Process (air compressors) (5)

TAcheck

Was the rebated equipment installed at one of your company's locations or are you the vendor or contractor who sold or installed the equipment?

ONLY CONTINUE WITH SURVEY IF THE REBATED EQUIPMENT WAS INSTALLED AT RESPONDENT'S COMPANY (TERMINATE IF THEY ARE A CONTRACTOR / IVENDOR / NSTALLER.)

- Employee, Owner, end-user (CONTINUE) (1)
- Contractor, Vendor, installer (TERMINATE SURVEY, DO NOT CONTINUE - RECORD AS DISQUALIFIED ON CALL SHEET) (2)
- Both (CONTINUE) (3)
- Don't know (TERMINATE SURVEY, DO NOT CONTINUE - RECORD AS DISQUALIFIED ON CALL SHEET) (4)

State

According to our records this equipment was installed at a location in [CITY AND STATE FROM CALL SHEET]. Is this correct? INTERVIEWER: CHECK STATE FROM CALL SHEET

- North Carolina (1)
- South Carolina (2)

ID INTERVIEWER: RECORD COPY & PASTE ID FROM CALL SHEET HERE

Name

INTERVIEWER: RECORD SURVEY RESPONDENT'S FULL NAME HERE (ASK IF THEY HAVE NOT GIVEN IT YET - CONFIRM SPELLING IF NEEDED)

CADMUS

A1 Please describe your company: What does your organization do?

- Record response (1) ____________________
- Don't know (2)

A2 What is your job title or role within your company?

- Record response (1) ____________________
- Don't know (2)

A3 Do you have an assigned account manager at Duke Energy?

- Yes (1)
- No (2)
- Don't know (3)

C1 How did you first hear about the Smart $aver Prescriptive Program? (select one)

- The information provided by the Smart $aver Program (378)
- The information provided by another Duke Energy program (Which program?) (379) ____________________
- The information provided by another organization (not Duke Energy - what organization?) (380) ____________________
- Past experience with this Smart $aver Program (381)
- Because of past experience with another Duke Energy program (Which program?) (382) ____________________
- Recommendation by Duke Energy Account Manager or representative (383)
- Recommendation from other utility program (What program?) (384) ____________________
- Recommendation of dealer/contractor (385)
- Recommendation of someone else (Who?) (386) ____________________
- Advertisement in newspaper (387)
- Radio advertisement (388)
- Other, please describe in the text box below: (389) ____________________
- Don't know (390)

CADMUS

D1 Please think back to the time when you were scoping the project and deciding on the equipment, perhaps recalling things that occurred in your company shortly before and after your purchase. Let me give you a few seconds to think back to what else was affecting the scope of that project, and how you were planning to fund it. (Wait 5 sec). What kinds of factors motivated your company to purchase the ${q://QID192/ChoiceGroup/SelectedChoices} equipment? (select all that apply)

- The program incentive requirements (2761)
- Wanted to reduce energy costs (2762)
- The information provided by the Smart $aver Program (2763)
- Recommendation by Duke Energy Account Manager or representative (2764)
- Recommendation of dealer/contractor (2765)
- Recommendation of someone else (Who?) (2766) ____________________
- Old equipment had failed (2767)
- Old equipment was working, but performing poorly or was not reliable (2768)
- Equipment was near or past its projected life (2769)
- Part of a larger remodeling project (2770)
- Cost of repair or maintenance of old equipment (2771)
- Availability of parts for old equipment (2772)
- Environmental concerns (2773)
- Other factor(s), please describe in the box below: (2774) ____________________
- Don’t know (2775)

Answer If Please think back to the time when you were scoping the project and deciding on the equipment, pe... Don’t know Is Not Selected And Please think back to the time when you were scoping the project and deciding on the equipment, pe... q://QID32/SelectedChoicesCount Is Greater Than 1

D1rank Which of the factors that motivated your company to purchase the ${q://QID192/ChoiceGroup/SelectedChoices} was the primary, or most important, factor? (select one)

- Don't know (1)
- All are equally important (2)

D2 Did you get this ${q://QID192/ChoiceGroup/SelectedChoices} to replace existing ${q://QID192/ChoiceGroup/SelectedChoices} equipment?

- Yes (1)
- No, did not replace existing ${q://QID192/ChoiceGroup/SelectedChoices} (2)
- Don't know (3)

Answer If Did you get this ${e://Field/Measure} to replace existing ${e://Field/Measure} equipment? Yes Is Selected

D3 About how old was the ${q://QID192/ChoiceGroup/SelectedChoices} you replaced?

- Less than 5 years old (1)
- 5 to less than 10 years old (2)
- 10 to less than 20 years old (3)
- 20 years to less than 30 years old (4)
- 30 or more years old (5)
- Don’t know (6)

Answer If Did you get this ${e://Field/Measure} to replace existing ${e://Field/Measure} equipment? Yes Is Selected

D4 Was the old ${q://QID192/ChoiceGroup/SelectedChoices} in working condition, or not working?

- Yes, working (1)
- No, not working (2)
- Don't know (3)

Answer If Was the old ${e://Field/Measure} in working condition, or not working? Yes, working Is Selected

D5 Was the old ${q://QID192/ChoiceGroup/SelectedChoices} in good, fair, or poor working condition?

- Good (1)
- Fair (2)
- Poor (3)
- Don’t know (4)

E1 Where did you get your incentive application form?

- o Contractor or Equipment Vendor (151)
- o Website/on-line (152)
- o Duke Energy Account Manager (153)
- o Other Duke Energy representative (154)
- o Consulting Engineer, Architect or Energy Consultant (155)
- o Other, please describe in the text box below: (156) ____________________
- o Don't know (157)

E2 Who filled out the program rebate application form for your company?

- o I did / customer (1)
- o Someone from my company did (2)
- o Contractor (3)
- o Salesperson (4)
- o Someone from Duke Energy (5)
- o Other, please describe in the text box below: (6) ____________________
- o Don't know (7)

Answer If Who filled out the program rebate application form for your company? I did / customer Is Selected

E3 Using a 1 to 10 scale where a one means that you are very dissatisfied and a 10 means that you are very satisfied, please rate the ease of completing the incentive application form.

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10 (10)	Don't know (11)
Ease of understanding the application (1)	o	o	o	o	o	o	o	o	o	o	o

Answer If Using a 1 to 10 scale where a one means that you are very dissatisfied and a 10 means that you ar... Ease of understanding the application Is Less Than or Equal to 7

E4 How can Duke Energy make the incentive application form easier to complete?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

E5 Who submitted the application to Duke Energy?

- I did / customer (1)
- Someone from my company did (2)
- Contractor (3)
- Salesperson (4)
- Someone from Duke Energy (5)
- Other, please describe in the text box below: (6) ____________________
- Don't know (7)

E6 Did you have any problems receiving the incentive?

- Yes, please describe in the text box below: (1) ____________________
- No (2)
- Don't know (3)

Answer If Did you have any problems receiving the incentive? Yes, please describe in the text box below: Is Selected

E7 How was the problem with receiving the incentive resolved?

- Please respond in the text box below: (1) ____________________
- Don't know (2)

CADMUS

Answer If Did you have any problems receiving the incentive? Yes, please describe in the text box below: Is Selected

E8 Was this problem resolved to your satisfaction?

- Yes (1)
- No (2)
- Don't know (3)

E9 Aside from this application, have you submitted other applications in the past, to either the Smart $aver Custom or Prescriptive Programs?

- Yes, Prescriptive only (1)
- Yes, Custom only (2)
- Yes, both Prescriptive and Custom (3)
- No (4)
- Don’t know (5)

F-intro

Now, we’d like to ask you a few questions about what you would have done without the Duke Energy program.

F1 Please indicate from the following choices what action you would have taken if the program had not been available:

- I would have continued using the old ${q://QID192/ChoiceGroup/SelectedChoices}, or would not have installed anything (1)
- I would have bought a used ${q://QID192/ChoiceGroup/SelectedChoices} at the same time or later time (2)
- I would have bought a new ${q://QID192/ChoiceGroup/SelectedChoices} at the same time (3)
- I would have bought a new ${q://QID192/ChoiceGroup/SelectedChoices} at a later time (4)
- Other, please describe in the text box below: (5) ____________________
- Don’t know (6)

CADMUS

Answer If Please indicate from the following choices what action you would have taken if the program had not been available: I would have bought a used [MEASURE] at the same time or later time Is Selected Or Please indicate from the following choices what action you would have taken if the program had not been available: I would have bought a new [MEASURE] at a later time Is Selected

F2 How many months do you think you might have waited to make the purchase of new ${q://QID192/ChoiceGroup/SelectedChoices}?

- o Please note the number of months below (specific number or range, i.e. "6 to 12 months") (1) ____________________
- o Don't know (2)

F3 On a scale of 0 to 10, where a 0 means that the program had no influence and a 10 means that the program had a major influence, please rate the level of influence the program incentive had on the energy efficiency rating of your new equipment?

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	10 (11)	Don't know (12)
influence of program incentive (1)	o	o	o	o	o	o	o	o	o	o	o	o

F4 For the equipment that you did install, do you think that you would have selected the same level of energy efficiency that you did if the program's financial incentive would not have been available to you?

- o (No. We would not do the project at all) (82)
- o (No. We would make a somewhat different equipment selection) (83)
- o (No. We would not do the same project / different project instead) (84)
- o (Yes. We would make exactly the same equipment choice) (85)
- o (Not sure what we would do / don’t know) (86)
- o (Other, please describe in the text box below:) (87) ____________________

CADMUS

Answer If For the equipment that you did install, do you think that you would have selected the same level... (No. We would make a somewhat different equipment selection) Is Selected

F5 You indicated that without the program's financial incentive you would have bought ${q://QID192/ChoiceGroup/SelectedChoices} with a different level of efficiency. If the program were not available do you think you would have bought equipment that is. . .

- o Similar in efficiency to your previous model (1)
- o Somewhat higher efficiency than your previous model (2)
- o Significantly more efficient than your previous model but not as efficient as the one you bought (3)
- o Almost as efficient as the model you bought (4)
- o Other, please describe in the text box below: (5) ____________________
- o Don't know (6)

F6 Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means that the program had no influence and a 10 means that the program had a major influence, please rate the level of influence the program information and/or technical resources had on the level of energy efficiency of your new equipment?

	0 (1)	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	10 (11)	Don't know (14)
Influence of information and technical resources (1)	o	o	o	o	o	o	o	o	o	o	o	o

Answer If Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means t... - 8 Is Not Selected And Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means t... - 9 Is Not Selected And Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means t... - 10 Is Not Selected And Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means t... - Don't know Is Not Selected And Aside from the financial incentive, Duke Energy also provides information and technical resources on the benefits of using energy efficient equipment. On a scale of 0 to 10, where a 0 means t... - Not applicable Is Not Selected

F7 What information resource do you consider to be the most important influence on your choice to install this particular equipment?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

F8 Do you think that you would have selected the same level of energy efficiency if the Duke Energy Smart $aver Program information and technical resources would not have been available to you?

- (No. We would not do the project at all) (7)
- (No. We would make a somewhat different equipment selection) (8)
- (No. We would not do the same project / different project instead) (9)
- (Yes. We would make exactly the same equipment choice) (10)
- (Not sure what we would do / don’t know) (11)
- (Other, please describe in the text box below:) (12) ____________________

CADMUS

Answer If Do you think that you would have selected the same level of energy efficiency if the Duke Energy... (No. We would make a somewhat different equipment selection) Is Selected

F9 You indicated that without the program's information and technical resources you would have bought ${q://QID192/ChoiceGroup/SelectedChoices} with a different level of energy efficiency. If the program were not available do you think you would have bought a unit that is. . .

- Similar in efficiency to your previous model (1)
- Somewhat higher efficiency than your previous model (2)
- Significantly more efficient than your previous model but not as efficient as the one you bought (3)
- Almost as efficient as the model you bought (4)
- Other, please describe in the text box below: (5) ____________________
- Don't know (6)

F10 Prior to hearing about the incentive program, was the equipment included in your company's capital budget?

- Yes (1)
- No (2)
- Don't know (3)

F11 Did the incentive for the high efficiency equipment allow you to increase the project's Return on Investment (ROI) so that it met the company's internal ROI requirements for capital allocation, thereby allowing the project to receive implementation approval?

- Yes (1)
- No (2)
- Don't know (3)

CADMUS

G1 When firms have experience with energy efficiency programs or products, they sometimes make similar decisions to continue the energy savings in other parts of their business. Since the time you participated in the Smart $aver Prescriptive Program, have you purchased and installed on your own initiative any additional types of high efficiency equipment or made energy efficiency improvements at your company at this location or any other locations?

- o Yes, only at respondent's company location (59)
- o Yes, only at other locations (60)
- o Yes, at both respondent's company and other locations (61)
- o No (62)
- o Don't know (63)

Answer If When firms have experience with energy efficiency programs or products, they sometimes make simil... Yes, only at respondent's company location Is Selected Or When firms have experience with energy efficiency programs or products, they sometimes make simil... Yes, only at other locations Is Selected Or When firms have experience with energy efficiency programs or products, they sometimes make simil... Yes, at both respondent's company and other locations Is Selected

G2 What type of additional high efficiency equipment did your company install on its own?

	Quantity installed (2)	At what address was this installed? (3)
First item, please describe: (87)		
Second item, please describe: (88)		
Third item, please describe: (89)		
Fourth item, please describe: (90)		

Answer If What type of additional high efficiency equipment did your company install on its own? First item, please describe: Is Not Empty

G3.1 How do you know that ${q://QID135/ChoiceTextEntryValue/87} is high efficiency? (For example, was it Energy Star rated?)

- o Record reason below (1) ____________________
- o Don't know (2)

CADMUS

Answer If What type of additional high efficiency equipment did your company install on its own? Second item, please describe: Is Not Empty

G3.2 How do you know that ${q://QID135/ChoiceTextEntryValue/88} is high efficiency? (For example, was it Energy Star rated?)

- Record reason below (1) ____________________
- Don't know (2)

Answer If What type of additional high efficiency equipment did your company install on its own? Third item, please describe: Is Not Empty

G3.3 How do you know that ${q://QID135/ChoiceTextEntryValue/89} is high efficiency? (For example, was it Energy Star rated?)

- Record reason below (1) ____________________
- Don't know (2)

Answer If What type of additional high efficiency equipment did your company install on its own? Fourth item, please describe: Is Not Empty

G3.4 How do you know that ${q://QID135/ChoiceTextEntryValue/90} is high efficiency? (For example, was it Energy Star rated?)

- Record reason below (1) ____________________
- Don't know (2)

Answer If What type of additional high efficiency equipment did your company install on its own? First item, please describe: Is Not Empty

G4 Did you receive an incentive for installing any of this additional equipment?

If What type of additional high efficiency equipment did your company install on its own? First item, please describe: Is Not Empty

- Yes, for ${q://QID135/ChoiceTextEntryValue/87} (1)

If What type of additional high efficiency equipment did your company install on its own? Second item, please describe: Is Not Empty

- Yes, for ${q://QID135/ChoiceTextEntryValue/88} (2)

If What type of additional high efficiency equipment did your company install on its own? Third item, please describe: Is Not Empty

- Yes, for ${q://QID135/ChoiceTextEntryValue/89} (3)

If What type of additional high efficiency equipment did your company install on its own? Fourth item, please describe: Is Not Empty

- Yes, for ${q://QID135/ChoiceTextEntryValue/90} (4)

- None / no incentives (5)
- Other, specify below: (6) ____________________
- Don't know (7)

CADMUS

Answer If Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/87}? Is Selected Or Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/88}? Is Selected Or Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/89}? Is Selected Or Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/90}? Is Selected
G5 (Fill in box(es) below)

If Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/87}? Is Selected

- Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/87}? (1) ____________________

If Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/88}? Is Selected

- Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/88}? (2) ____________________

If Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/89}? Is Selected

- Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/89}? (3) ____________________

If Who gave this incentive? Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/90}? Is Selected

- Who gave the incentive for ${q://QID135/ChoiceTextEntryValue/90}? (4) ____________________

CADMUS

Answer If What type of additional high efficiency equipment did your company install on its own? First item, please describe: Is Not Empty

G6 On a scale from 1 to 10, with 1 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate your agreement with the following statement: “My experience with the Smart $aver Prescriptive Program in 2014 influenced my decision to install additional high efficiency equipment on my own."

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	7 (7)	8 (8)	9 (9)	10 (10)	Don't know (11)
Agreement with influence (1)	o	o	o	o	o	o	o	o	o	o	o

Answer If On a scale from 1 to 10, with 1 indicating that you strongly disagree, and 10 indicating that you... - 10 Is Not Selected And On a scale from 1 to 10, with 1 indicating that you strongly disagree, and 10 indicating that you... - 9 Is Not Selected And On a scale from 1 to 10, with 1 indicating that you strongly disagree, and 10 indicating that you... - 8 Is Not Selected And On a scale from 1 to 10, with 1 indicating that you strongly disagree, and 10 indicating that you... - Don't know Is Not Selected And What type of additional high efficiency equipment did your company install on its own? First item, please describe: Is Not Empty

G7 What do you consider the most important influence on your choice of this particular equipment?

- o Record response below (1) ____________________
- o Don't know (2)

H1 Have you visited the Savings Store on Duke Energy’s website?

- o Yes (1)
- o No (2)
- o Don't know (3)

Answer If Have you visited the Savings Store on Duke Energy's website? Yes Is Selected

H2 Did you make a purchase on the Savings Store?

- o Yes (1)
- o No (2)
- o Don't know (3)

Answer If Did you make a purchase on the Savings Store? Yes Is Selected

H3 Did you have any problems with using the Savings Store?

- o Yes, please describe in the text box below: (1) ____________________
- o None; no problems (2)
- o Don't know (3)

Answer If What problems did you encounter using the Savings Store, if any? Yes, please describe in the text box below: Is Selected

H4 Was this problem resolved to your satisfaction?

- o Yes (1)
- o No (2)
- o Don't know (3)

I1- We would like to ask you a few questions about your satisfaction with specific areas of the overall Smart $aver Prescriptive Program. For these questions we would like you to rate your satisfaction using a 1 to 10 scale where a 1 means that you are very dissatisfied with the program and a 10 means that you are very satisfied. How would you rate your satisfaction with:

	Extremely dissatisfied 1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	Extremely satisfied 10 (11)	Not Applicable (12)	Don't Know (13)
The amount of the incentives provided by the program (1)	o								o	o	o	o
The time it took for you to receive your incentive (2)	o								o	o	o	o
The variety of technologies covered in the program (3)	o								o	o	o	o
	o								o	o	o	o

	Extremely dissatisfied 1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	Extremely satisfied 10 (11)	Not Applicable (12)	Don't Know (13)
If Do you have an assigned account manager at Duke Energy? Yes Is Selected The information provided by your assigned account manager about the Smart $aver Prescriptive Program (4)	o								o	o	o	o
The information provided on the website about the Smart $aver Prescriptive Program (6)	o								o	o	o	o
Your interactions and communications with Duke Energy staff (7)	o								o	o	o	o

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The amount of the incentives provided by the program Is Less Than or Equal to 7

i8a You noted your satisfaction for the amount of the incentives provided by the program was 7 or less. What could have been done to make this better?

- o Please describe in the text box below: (1) ____________________
- o Don't know (2)

CADMUS

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The time it took for you to receive your incentive Is Less Than or Equal to 7

i8b You noted your satisfaction for the time it took for you to receive your incentive was 7 or less. What could have been done to make this better?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The variety of technologies covered in the program Is Less Than or Equal to 7

i8c You noted your satisfaction for the variety of technologies covered in the program was 7 or less. What would you like to see added?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The information provided by your assigned account manager, if you have one, about the Smart $aver Prescriptive Program Is Less Than or Equal to 7

i8d You noted your satisfaction for the information provided by your assigned account manager was 7 or less. What could have been done to make this better?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The information provided by your vendor or contractor about the Smart $aver Prescriptive Program Is Less Than or Equal to 7

i8e You noted your satisfaction for the information provided by your vendor or contractor about the Smart $aver Prescriptive Program was 7 or less. What could have been done to make this better?

- Please describe in the text box below: (1) ____________________
- Don't know (2)

CADMUS

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... The information provided on the website about the Smart $aver Prescriptive Program Is Less Than or Equal to 7

i8f You noted your satisfaction for the information provided on the website about the Smart $aver Prescriptive Program was 7 or less. What could have been done to make this better?

- o Please describe in the text box below: (1) ____________________
- o Don't know (2)

Answer If We would like to ask you a few questions about your satisfaction with specific areas of the overa... Your interactions and communications with Duke Energy staff Is Less Than or Equal to 7

i8g You noted your satisfaction with your interactions and communications with Duke Energy staff was 7 or less. What could have been done to make this better?

- o Please describe in the text box below: (1) ____________________
- o Don't know (2)

i9 Now, considering all aspects of the program, how would you rate your overall satisfaction with the Smart $aver Prescriptive Program using the same 1 to 10 scale?

	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	10 (11)	Don't know (12)
Satisfaction with Smart $aver Prescriptive Program (1)	o	o	o	o	o	o	o	o	o	o	o

CADMUS

Answer If Now, considering all aspects of the program, how would you rate your overall satisfaction with th... Satisfaction with Smart $aver Prescriptive Program Is Less Than or Equal to 7

i10 How can this be improved, or have we already covered that?

- Please describe in the text box below: (1) ____________________
- Already covered it (2)
- Don't know (3)

i11 What do you like most about this program, if anything?

- Please describe in the text box below: (1) ____________________
- Nothing (2)
- Don't know (3)

i12 What do you like least about this program, if anything?

- Please describe in the text box below: (1) ____________________
- Nothing (2)
- Don't know (3)

i13 What additional services would you like the program to provide that it does not now provide?

- Please describe in the text box below: (1) ____________________
- No suggestion (2)
- Don't know (3)

i14 Are there any other things that you would like to see changed about the program?

- Please describe in the text box below: (1) ____________________
- No suggestion (2)
- Don't know (3)

CADMUS

J1 Using the same 1 to 10 scale, how would you rate your overall satisfaction with Duke Energy?

	1 (2)	2 (3)	3 (4)	4 (5)	5 (6)	6 (7)	7 (8)	8 (9)	9 (10)	10 (11)	Don't know (12)
Overall satisfaction with Duke Energy (1)	o	o	o	o	o	o	o	o	o	o	o

Answer If Using the same 1 to 10 scale, how would you rate your overall satisfaction with Duke Energy? Overall satisfaction with Duke Energy Is Less Than or Equal to 7

J2 How can this be improved?

- o Please describe in the text box below: (1) ____________________
- o Don't know (2)

J3 Please provide any additional comments for Duke Energy:

- o Please describe in the text box below (1) ____________________
- o No comment (2)
- o Don't know (3)

Answer If Please provide any additional comments for Duke Energy: Please describe in the text box below Is Selected

J4 Would you like your comments to be transferred to Duke Energy along with your name for any additional follow-up?

- o Yes (1)
- o No (2)

CADMUS

J5 This concludes our survey. Thank you very much for taking the time to help Duke Energy improve this program. As a token of our appreciation for completing the survey, we would like to enter you into a prize raffle. The winner will receive an Apple iPad Air, which retails for about $400. Or if you prefer, you may designate that the value of this prize be donated to the United Way charity on your behalf. Please let us know the best way to contact you if you win the drawing. [ONCE YOU CLICK "NEXT" THIS SURVEY WILL BE COMPLETE AND YOU CANNOT GO BACK AND MAKE REVISIONS.]

- Contact me this way if I am the winner (PHONE OR EMAIL PREFERRED, VERIFY INFO IS CORRECT): (1) ____________________
- Refused (do not include me in the raffle) (2)

Duke Energy Carolinas Smart $aver® Prescriptive Incentive Program

July 17, 2016

Evaluation, Measurement, & Verification Report

The Cadmus Group, Inc.

An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

CADMUS

Prepared by:

Cadmus

CADMUS

This page left blank.

CADMUS

Table of Contents

CADMUS

Executive Summary

Duke Energy Carolinas (DEC) engaged Cadmus to perform an impact evaluation of the Smart $aver® Prescriptive Incentive Program (Prescriptive Program).

Cadmus performed engineering desk reviews on the work papers describing deemed energy and demand saving calculation methodologies for a sample of measures. We adjusted the per-unit energy and demand saving estimates, as necessary, and applied the updated values to all participants in each reviewed measure for the evaluation period. Finally, we calculated a lighting and non-lighting net-to-gross (NTG) ratio based on the results of process evaluation surveys and calculated net energy and demand saving estimates for the measures reviewed.

This evaluation period was January 2013 through July 2015. We included applications in this evaluation period according to the date on which DEC paid the incentive. Table 1 lists the measures reviewed as part of this evaluation.

Table 1. Summary of DEC Prescriptive Program Measures Reviewed

Measure Category	Evaluated Measure/Measure Group
Food Service	Electronically Commutated Motors (ECM) in Cooler, Freezer, and Display Cases
HVAC	Variable Frequency Drives (VFD) on HVAC Fans
	VFD on HVAC Pumps
Lighting	Linear Fluorescent High Bay Replacing High-intensity Discharge (HID) Fixtures
	High Performance Linear Fluorescents
	LED Lamps
	LED Downlights
Process	VFD on Process Pumps
	VSD on Air Compressors
Pump	High-Efficiency Pumps

Impact Evaluation Results

Table 2 shows the realization rate between the claimed and adjusted gross savings as well as the NTG ratio applied to the adjusted savings. Based on the desk review analysis of the ten measures sampled, Cadmus estimated realization rates ranging from 69% to 139%. We calculated an 86% NTG ratio for lighting measures and a 40% NTG ratio for non-lighting measures, resulting in a 78% NTG ratio for the program overall.

Cadmus' current impact evaluation covered only a selection of measures and the realization rates cannot be extrapolated to the entire Prescriptive Program. However, we selected the process evaluation survey sample from all measures in the program and categorized them based on whether they were lighting or non-lighting measures. Therefore, the calculated lighting and non-lighting NTG ratios are applicable to those respective measure categories.

CADMUS

Table 2. Program Claimed, Adjusted, and Net Energy Impacts

Measure Category	Measure / Measure Group	Claimed Savings (kWh)	Realization Rate	Adjusted Gross Savings (kWh)	NTG	Net Savings (kWh)
Food Service	ECM Motors in Cooler, Freezer, and Display Cases	1,857,315	108%	2,013,547	40%	805,419
HVAC	VFDs on HVAC Fans	14,553,141	139%	20,236,854	40%	8,094,741
	VFDs on HVAC Pumps	5,480,481	69%	3,781,949	40%	1,512,779
Lighting	Linear Fluorescent High Bay	85,708,927	71%	61,212,185	86%	52,642,479
	High Performance Linear Fluorescent	17,420,130	85%	14,767,697	86%	12,700,220
	LED Lamps	16,471,533	124%	20,399,702	86%	17,543,744
	LED Downlights	2,025,100	126%	2,558,387	86%	2,200,213
Process	VFDs on Process Pumps	674,734	106%	713,460	40%	285,384
	VSDs on Air Compressors	1,543,273	93%	1,435,649	40%	574,260
Pump	High-Efficiency Pumps	121,749	129%	157,638	40%	63,055

Table 3 and Table 4 show the claimed and adjusted summer coincident peak (CP), and non-coincident peak (NCP) demand savings for the measures included in this evaluation.

Table 3. Program Claimed, Adjusted, and Net Summer CP Demand Impacts

Measure Category	Measure / Measure Group	Claimed Summer CP Savings (kW)	Realization Rate	Adjusted Gross Summer CP Savings (kW)	NTG	Net Summer CP Savings (kW)
Food Service	ECM Motors in Cooler, Freezer, and Display Cases	246	96%	236	40%	94
HVAC	VFDs on HVAC Fans	2,188	141%	3,086	40%	1,234
	VFDs on HVAC Pumps	799	42%	333	40%	133
Lighting	Linear Fluorescent High Bay	13,758	88%	12,125	86%	10,427
	High Performance Linear Fluorescent	4,404	75%	3,324	86%	2,859
	LED Lamps	4,028	98%	3,943	86%	3,391
	LED Downlights	495	103%	508	86%	437
Process	VFDs on Process Pumps	183	80%	147	40%	59
	VSDs on Air Compressors	371	62%	230	40%	92
Pump	High-Efficiency Pumps	26	123%	32	40%	13

Table 4. Program Claimed, Adjusted, and Net NCP Demand Impacts

Measure Category	Measure / Measure Group	Claimed NCP Savings (kW)	Realization Rate	Adjusted Gross NCP Savings (kW)	NTG	Net Summer NCP Savings (kW)
Food Service	ECM Motors in Cooler, Freezer, and Display Cases	220	107%	236	40%	94
HVAC	VFDs on HVAC Fans	1,695	136%	2,310	40%	924
	VFDs on HVAC Pumps	603	72%	432	40%	173
Lighting	Linear Fluorescent High Bay	14,570	88%	12,763	86%	10,976
	High Performance Linear Fluorescent	3,568	71%	2,526	86%	2,173
	LED Lamps	4,476	114%	5,121	86%	4,404
	LED Downlights	550	120%	660	86%	568
Process	VFDs on Process Pumps	183	80%	147	40%	59
	VSDs on Air Compressors	371	62%	230	40%	92
Pump	High-Efficiency Pumps	33	123%	41	40%	16

Table 5 provides the number of units per measure and the net energy and demand savings for each in the specified evaluation period.

Table 5. Per Unit Net Energy and NCP Demand Savings

Measure Category	Measure / Measure Group	Unit Count	Unit	NTG	Annual Adjusted Net Energy Savings Per Unit (KWh)	Adjusted Net NCP Demand Savings Per Unit (kW)
Food Service	ECM Motors in Cooler, Freezer, and Display Cases*	2,448	Per Motor	40%	329	0.04
HVAC	VFDs on HVAC Fans	10,592	Per Motor hp (horsepower)	40%	764	0.09
	VFDs on HVAC Pumps	1,976	Per Motor hp	40%	766	0.09
Lighting	Linear Fluorescent High Bay*	56,286	Per Fixture	86%	435	0.09
	High Performance Linear Fluorescent*	177,150	Per Fixture	86%	33	0.01
	LED Lamps	130,091	Per Fixture	86%	63	0.02
	LED Downlights	10,383	Per Fixture	86%	99	0.03
Process	VFDs on Process Pumps	705	Per Pump hp	40%	405	0.08
	VSDs on Air Compressors	2,595	Per Compressor hp	40%	221	0.04
Pump	High-Efficiency Pumps*	606	Per Pump hp	40%	104	0.03

* Savings are the average of the per-unit values provided in the work paper review section of the report.

Evaluation Parameters

The start and end dates for the review activities conducted for this impact evaluation were January 2013 to July 2015 for all measure groups.

Conclusions and Recommendations

Cadmus found the DEC Prescriptive Program work papers to be generally clear and well-documented. Cadmus made adjustments to work paper savings based on advancements in energy-efficient technologies, release of third-party field study results, and applicable codes and standards during the evaluation period.

Overall, Cadmus recommends that DEC perform verification on a representative sample of installed measures for an accurate *ex post* saving estimate in the next evaluation. Additionally, future program tracking may be improved significantly by tracking measure saving parameters (such as hp rating of motors) consistently, as well as by removing measure descriptions with generic base cases (when savings should be distinguished by base case). Detailed recommendations for future program tracking by measure is provided below.

Conclusion 1. For the ECM motors measure group, the size of the motors being replaced vary greatly; there is up to five times difference between the hp rating of the smallest and largest motors. The actual savings for a group of motors will vary widely based on the proportion of various sizes in the tracking database population.

Recommendation 1. Calculate refrigeration ECM motor savings on a per hp basis rather than a per motor basis.

Conclusion 2. For the VFDs on HVAC pumps measure, a recently completed metering study for Northeast Energy Efficiency Partnerships (NEEP) showed that there is a large variation in the amount of savings depending on what type of HVAC pump the VFD is installed on. For a VFD installed on a cooling water pump, a hot water pump, or a water source heat pump (WSHP) circulation pump, the typical savings ranged from 19% below to 34% above the average savings for all HVAC pumps.

Recommendation 2. Calculate the savings associated with the VFDs on HVAC pumps based on the pump's duty (cooling water versus hot water versus WSHP) as opposed to a general HVAC assumption.

Conclusion 3. Due to the great variability in pump sizing and configuration, Cadmus did not find an effective or accurate method to determine the average savings resulting from retrofitting an existing pump with a VFD, or to determine if an applicant's pump selection is an efficient choice through the Prescriptive program.

Recommendation 3. To accurately assess the savings potential of each application for the VFDs on process pumps or high-efficiency pump measures, administer incentives for these two measures through the Nonresidential Smart $aver Custom Program (Custom Program).

Conclusion 4. In the case of the VSD and VFD measures reviewed here, the savings depended on the quantity and the hp rating of the motors retrofitted. However, the hp rating of the motors were not always recorded or recorded accurately in the tracking database. Cadmus found this to be an issue in its review of the entire tracking database for measures whose total savings depended on not just the quantity of the measure but also additional parameters, such as hp rating of the motors.

Recommendation 4. Record the quantitative parameters for measure saving determination consistently to facilitate total measure savings and program saving calculations.

Conclusion 5. The tracking database includes three measure codes for VSDs on air compressors: one with a generic base case motor control scheme, one for load/unload controls, and one for variable displacement controls. The database does not include a measure code for the modulation base case control scheme identified in the work paper.

Recommendation 5. Discontinue the generic air compressor control scheme measure code and add a measure code for the modulation base case control scheme.

CADMUS

Introduction

Program Description

The Prescriptive Program is designed to influence business customer decisions to save energy by providing incentives to install qualifying high-efficiency measures such as lighting, HVAC, and motors. Duke Energy's commercial and industrial customers fund all energy-efficiency programs by paying an energy-efficiency rider based upon their kWh usage.

In the Prescriptive Program, customers may install selected energy-efficient measures and then submit an application for rebates. Customers must apply for the incentive within 90 days of installing the equipment and provide invoices with model numbers as proof of purchase. The Prescriptive Program is offered in conjunction with the Custom Program, which is being evaluated in a separate study. Energy-efficiency measures that are not part of the Prescriptive Program may still qualify for an incentive through the Custom Program. The measures offered through the Prescriptive Program have pre-calculated deemed energy savings, while the measures eligible for the Custom Program require customers to submit project-specific energy savings calculations with each application. The combination of both programs provides Duke Energy business customers with a flexible range of options to meet their individual needs for energy-efficient equipment.

DEC completed its last evaluation of the Prescriptive Program in 2013. This evaluation covered the high performance linear fluorescent and occupancy sensor measures and relied on verification of a sample of these measures installed.[1]

The biggest program changes from year to year have been the addition of new technologies to the list of qualifying prescriptive measures and the removal of technologies that have become common practice as a result of market transformation. In 2012, in response to the Energy Independence and Security Act (EISA) of 2007, Duke Energy ended incentives for replacing T12s with T5, Standard T8s, and High-Output T8s. In 2014, Duke Energy removed the chiller tune-up incentives from the program and added new information technology, LED lighting, HVAC, and food service measures to program. In 2016, Duke Energy removed server virtualization from the list of IT measures.

---

[1] TecMarket Works. *Process and Impact Evaluation of the Non-Residential Smart $aver Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors*. Prepared for Duke Energy. April 5, 2013.

Table 6 Evaluated Measure Participation (by Date Paid – 01/2013 to 07/2015)

Measure Category	Measure	Participant Application Count
Food Service	ECM Motors in Cooler, Freezer, and Display Cases	139
HVAC	VFDs on HVAC Fans	93
	VFDs on HVAC Pumps	18
Lighting	Fluorescent High Bay Fixtures	687
	High Performance Linear Fluorescent	1,085
	LED Lamps	893
	LED Downlights	142
Process	VFDs on Process Pumps	5
	VSDs on Air Compressors	27
Pump	High-Efficiency Pumps	10

Evaluation Objectives

The evaluation objective was to review DECs' claimed savings for high-impact Prescriptive Program measures. The evaluation did not perform verification on the installed measures.

Researchable Issues

The researchable issues are summarized here:

- Do the work paper saving calculation methodology, assumptions, and inputs need adjustment based on secondary data sources?
- Do the work paper saving calculation methodology, assumptions, and inputs need to be updated as a result of recent changes in codes and standards?
- What is the level of freeridership and spillover in the program participants?

Methodology

Overview of the Evaluation Approach

Study Methodology

Cadmus performed engineering desk reviews on DEC's work papers describing deemed energy and demand saving calculation methodologies. The work papers were prepared by Franklin Energy Services and are referred to in this document as FES work papers or work papers.

In evaluating DEC's Prescriptive Program, we performed the following activities:

- Selected measures with greatest impact on program savings during the evaluation period from each of the following measure categories: food service, HVAC, lighting, process, and pumps
- Performed a desk review of the work papers describing the measure saving calculation methodology, assumptions, inputs and per-unit savings
- Adjusted estimated energy, NCP demand, or CP demand savings, if necessary, for the selected measures
- Applied the adjusted per-unit saving values across all applicants for the measure reviewed
- Identified potential improvements to work paper for future program years

Duke Energy provided the tracking database containing the participant records for the evaluation period. We used the claimed savings for the population of participants to determine high-impact measures in each measure category. Duke Energy provided the work papers associated with each sampled measure.

Cadmus assessed the baseline and efficient equipment characteristic assumptions used in the work papers to estimate deemed savings for each measure evaluated. We referred to secondary sources that verified these inputs during the evaluation period, where available. If verified values were not available, we tested the assumptions against manufacturer data, national market assessment studies, and available TRMs.

Cadmus did not perform any verification of the quantity or characteristics of the measures installed that would require statistical sampling.

The work papers reviewed here calculate CP demand savings by making assumptions about the percentage of load during DEC peak periods.[2] Cadmus has reviewed these assumptions and provided any adjustments necessary. DEC may choose to use the adjusted work paper CP demand savings estimated in this report or those calculated based on DEC load profiles in their Demand Side Management Option Risk Evaluator (DSMore) software.

---

[2] DEC has identified its summer peak hour as 16:00 – 17:00 in July and winter peak hour as 7:00-8:00 in January.

Net-to-Gross Analysis

Cadmus calculated the applicable NTG ratio based on the results of participant surveys completed for DEC by TecMarket Works and Cadmus as part of the latest process evaluation of the Prescriptive Program.[3] TecMarket Works completed the first wave of surveys in October 2014 and Cadmus completed the second wave in October 2015.[4]

3 Cadmus. *Process Evaluation of the 2013-2014 Smart $aver Nonresidential Prescriptive Incentive Program in the Carolinas System.* Prepared for Duke Energy. April 15 2016.

4 Cadmus acquired TecMarket Works in March 2015.

Impact Evaluation Analysis

This section presents the results of the analysis performed for DEC's Prescriptive Program in preparation for the work paper reviews. We have organized our findings into the following sections:

- Program tracking data review and measure selection
- Net savings analysis

Program Tracking Data Review and Measure Selection

The program tracking database identified the claimed per-unit gross energy and demand saving values for each application to which an incentive was paid. The database did not include the total savings claimed as a result of each application.

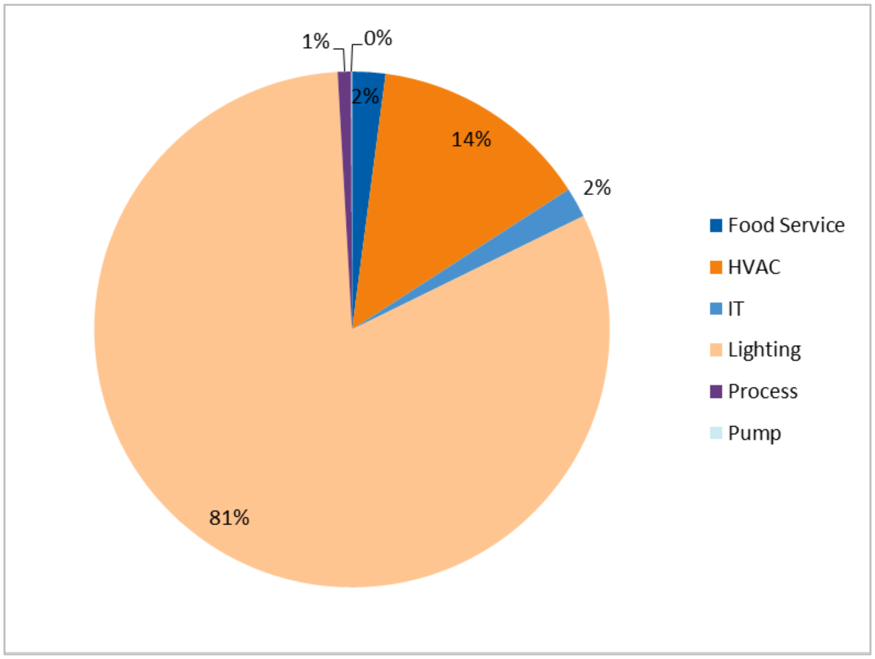
The total savings depend on the quantity of the measures installed. In most cases, the measure savings also depend on the total square foot, hp, or tonnage of the measure installed. These parameters are identified as *custom quantities* in DEC's tracking database. *Custom quantities* are not always recorded or recorded accurately in the database. Cadmus performed quality control on the *custom quantities* recorded and, where missing, we estimated values based on the incentive paid amounts. Cadmus then calculated total gross claimed savings for each application paid in the database, based on quantity, *custom quantity*, and the savings claimed per-unit. Table 7 lists the results.

Table 7. DEC Prescriptive Program Savings by Measure Category

Row Labels	Gross Energy Savings (%)	Gross Energy Savings (kWh)	Gross NCP (kW)	Gross CP (kW)
Food Service	2%	5,485,013	856	592
HVAC	14%	36,269,670	8,560	8,141
IT	2%	4,935,150	736	331
Lighting	81%	213,988,146	38,294	35,953
Process	1%	2,218,007	555	555
Pumps	0%	121,749	33	26
Total	**100%**	**263,017,736**	**49,033**	**45,598**

Cadmus' review of the tracking database revealed that the majority of the claimed savings are attributed to lighting and HVAC measures. The pumps measure category contributed the least to overall program savings. The program energy savings breakdown by measure category is shown in Figure 1.

Figure 1. DEC Prescriptive Program Energy Savings by Measure Category (n=263,017,736 kWh)



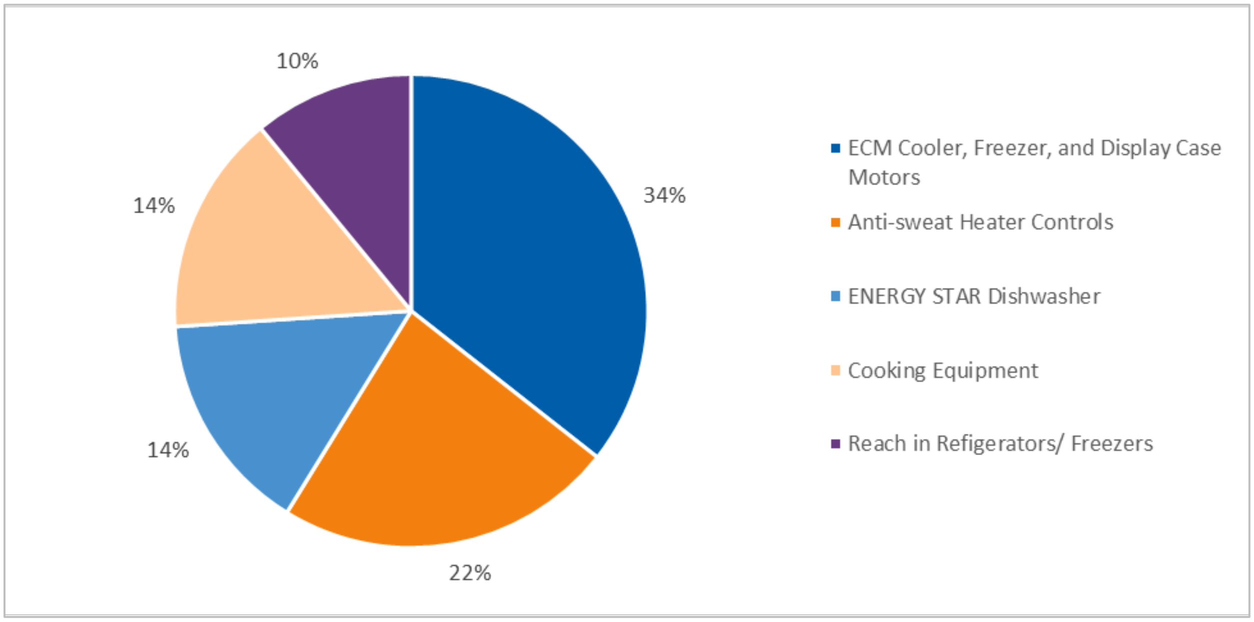
Cadmus reviewed the contribution of measures (or measure groups) to the savings under each measure category, and selected a set of high-impact measures for desk reviews. We selected measures from all categories, except for Information Technology (IT). The breakdown of measures under each measure category and the measures chosen for review are described in the following sections.

CADMUS

Food Service

Cadmus evaluated the ECM motors from the food service category for desk review. ECM motors contributed the majority (34%) of the savings. Figure 2 shows the breakdown of Food Service savings for measures contributing 10% or more total savings.

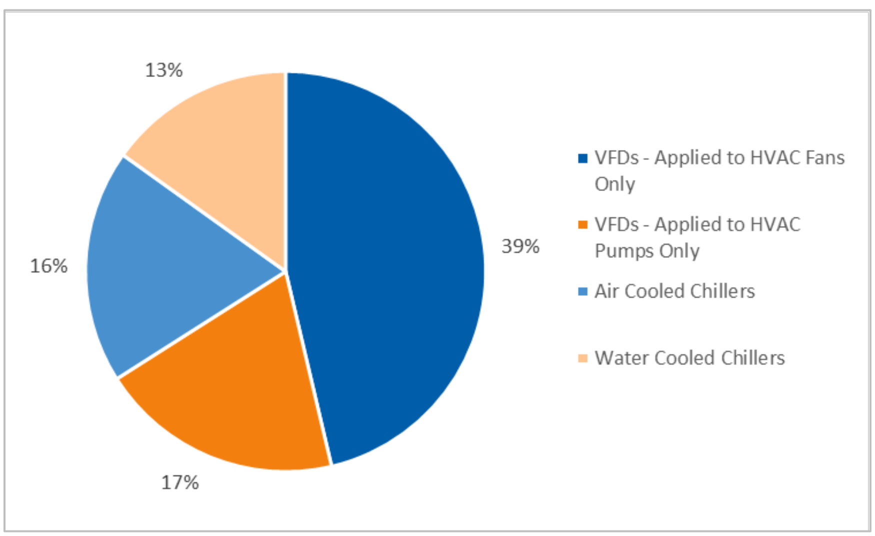
Figure 2. DEC Prescriptive Program Energy Savings: Food Service (n=5,485,013 kWh)



HVAC

For the HVAC category, we evaluated VFD measures applied to HVAC fans and pumps. Together these two measures contributed 56% to the measure category program savings. Figure 3 shows the breakdown of savings from HVAC measures that contributed 10% or more to total savings.

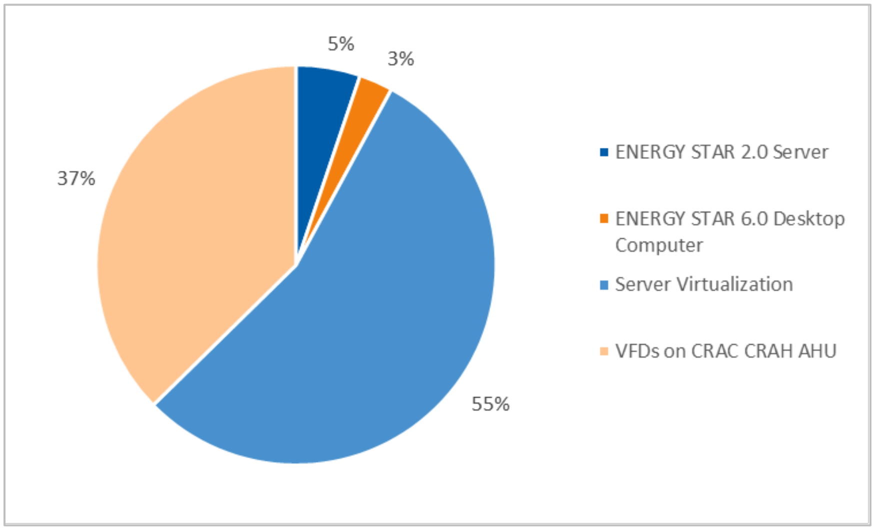
Figure 3. DEC Prescriptive Program Savings: HVAC (n=36,269,670 kWh)



Information Technology

Server virtualization contributed more than half of the savings in the IT measure category. Though initially selected for review, we removed it from sampled measures as DEC no longer provided rebates for this measure in 2016.

Figure 4. DEC Prescriptive Program Energy Savings: IT (n=4,935,150 kWh)

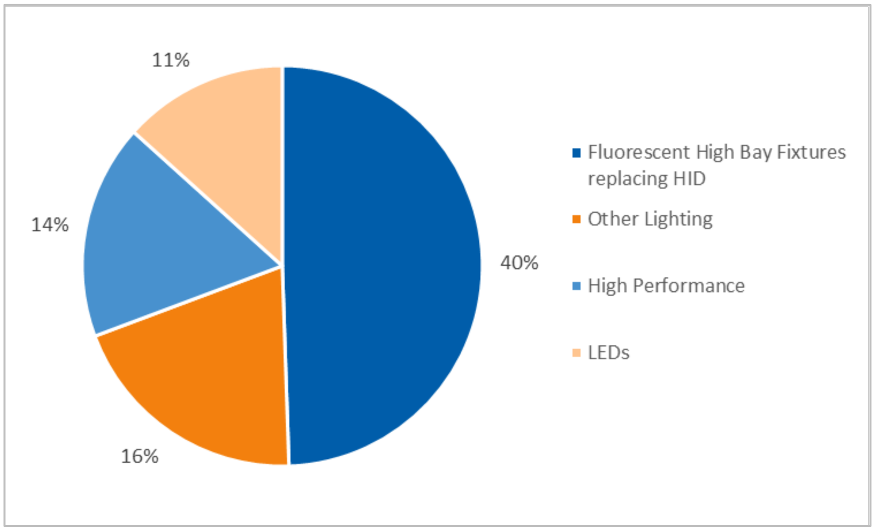


CADMUS

Lighting

Due to their large impact on program savings, the evaluation team chose the fluorescent high bay fixtures replacing HIDs, high performance linear fluorescent, and LEDs measure groups for the work paper review.

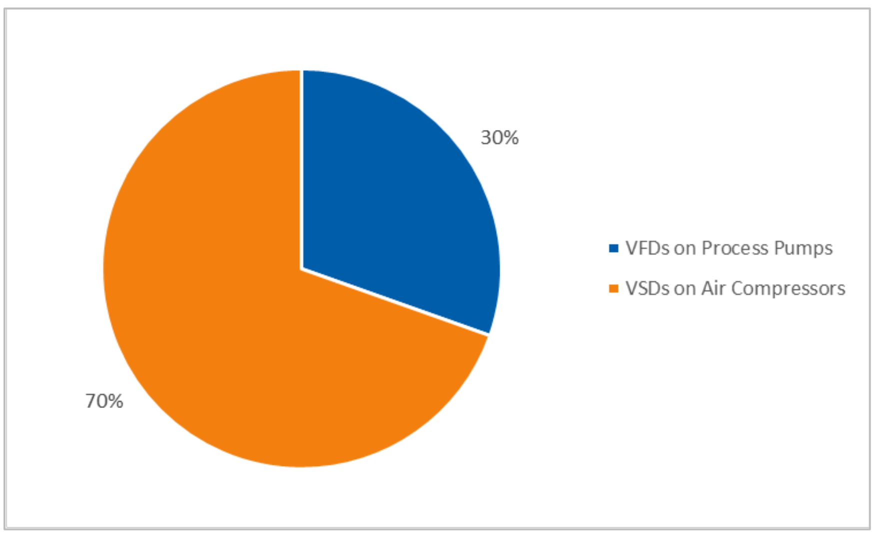
Figure 5. DEC Prescriptive Program Savings: Lighting (n=213,988,146 kWh)



Process Equipment

We reviewed all measures in the process measure category (Figure 6), which consisted of VFDs on process pumps and VSDs on air compressors.

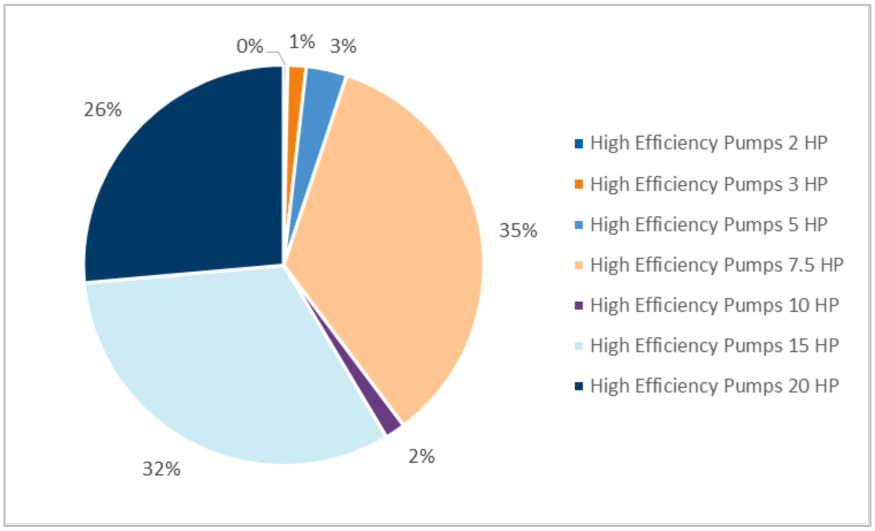
Figure 6. DEC Prescriptive Program Savings: Process Equipment (n=2,218,007 kWh)



Pumps

Figure 7 shows the breakdown of energy savings for the high-efficiency pump measure category. A single work paper describes the saving calculation methodology for all pumps measures; therefore, Cadmus included all pump measures in the review.

Figure 7. DEC Prescriptive Program Savings: Pumps (n=121,749 kWh)



Net Savings Analysis

Cadmus calculated the applicable NTG ratios based on the results of participant surveys completed by TecMarket Works and Cadmus as part of the latest process evaluation of the Prescriptive Program.[5] TecMarket Works completed the first wave of surveys in October 2014, and Cadmus completed the second wave in October 2015.

Freeridership Methodology

The evaluation team used two different sets of questions from the participant surveys. The team asked each participant both sets of questions and combined the results to estimate the level of energy impacts attributable to freeridership.

For the first set of questions, the team began the survey by asking participants if they would have purchased the same equipment without the program and when that purchase would have occurred. The team then asked respondents who said they would have delayed their purchase to estimate how long they would have delayed the purchase. Cadmus used the results from these two questions to establish a “gateway” freeridership score.

[5] Cadmus. *Process Evaluation of the 2013-2014 Smart $aver Nonresidential Prescriptive Incentive Program in the Carolinas System.* Prepared for Duke Energy. April 15, 2016.

Specifically, the first question within the first set of questions asked survey respondents what their behavior would have been if the rebate had not been available. Respondents provided responses within the following categories:

- Bought the same new unit at the same time
- Bought the same new unit at a later time
- Bought a used unit at the same or a later time
- Continued to use the previously installed unit and did not purchase a new or used unit

As shown in Table 8, Cadmus assigned each surveyed participant a gateway freeridership score. For participants who indicated that they would have bought the same unit at the same time, we assigned a gateway freeridership score of 100%. For participants who said that they would have continued using the currently installed unit, we assigned a freeridership score of 0%. To estimate freeridership for participants who indicated that they would have bought their units at a later time, we asked an additional question to determine when they would have purchased the units in the absence of the program. For the purposes of establishing the gateway freeridership score, we treated used units the same as new units and captured differences in efficiency levels between new and used units in the second of a two-step process for calculating freeridership.

Table 8. Step One: Gateway Score Based on Timing of Replacement

Gateway Question Responses	Gateway Freeridership Score
Bought same new unit at the same time	100%
Bought same new unit within 6 months	75%
Bought same new unit 6 to 12 months later	50%
Bought same new unit 12 to 24 months later	25%
Bought same new unit more than 24 months later/delayed purchase indefinitely	0%
Bought same new unit but do not know when	Average % all responses in the five rows above
Bought used unit at the same or later time	Same percentages as new units above
Continued using old unit	0%
Do not know what organization would have done	Mean of all valid responses above

In the second step for calculating freeridership, Cadmus used responses from a second set of questions that asked participants what they would have done without the incentive, and what they would have done without the Prescriptive Program information and technical assistance.

Respondents provided responses in the following four categories:

- Bought a unit with at least the same efficiency level
- Bought a unit with a different efficiency level

- Would not have done the project
- Do not know what organization would have done

For participants who said that they would have bought the same efficiency level without the incentive or program information and assistance, we assigned a freeridership score equal to their gateway freeridership (Table 9). For participants who said they would have purchased less efficient units, we assigned freeridership scores equal to their gateway freeridership score multiplied by a discounting factor based on the relative level of efficiency compared to the unit they did purchase through the program. For participants who did not know what their organization would have done, we assigned a modifier to their gateway freeridership score based on the mean of responses from participants who answered the question.

Table 9. Step Two: Influence of Financial Incentive and Program Information/Technical Assistance

Response for "without financial incentive" and "without program information and technical assistance"	Modified Freeridership Score
Purchased a unit with the same level of efficiency as the new unit purchased through the program	Gateway freeridership X 100%
Different choice "almost as efficient as new model"	Gateway freeridership X 75%
Different choice "significantly more efficient than old model"	Gateway freeridership X 50%
Different choice "somewhat more efficient than old model"	Gateway freeridership X 25%
Different choice "efficiency similar to old model"	Gateway freeridership X 0%
Different choice "not sure what efficiency level"	Gateway freeridership X mean modifier of all other "different choice" responses
Would not have done this project	Gateway freeridership X 0%
Do not know what organization would have done	Mean of all valid responses above

Since the program includes both an incentive payment and technical assistance and program information, each of which can motivate a participant to purchase and install the more efficient choice, we scored the influence of the incentive on one path and the influence of the technical assistance or program information on another path. The final per-respondent freeridership estimate is the lower of their two freeridership scores resulting from these two paths.

For the final step in calculating freeridership, Cadmus weighted the individual freeridership estimates for the surveyed participants by their claimed savings. We chose to use claimed savings for the weighting analysis, since the impact evaluation described in this report covered only select measures in the program and adjusted gross savings were not available for all survey respondents.

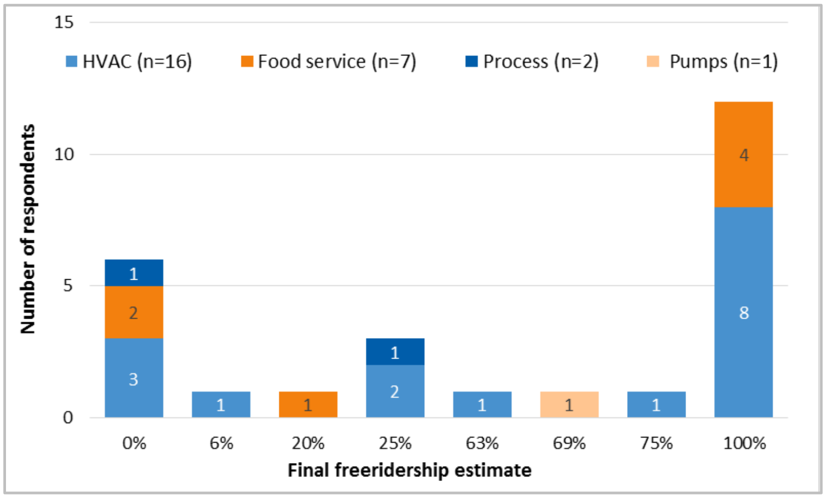
CADMUS

Freeridership Results

Non-lighting Participants

Figure 8 shows the distribution of final freeridership estimates for all 26 surveyed participants who answered the freeridership questions about non-lighting measures. The team assigned freeridership scores of 100% to about half (46%) of the surveyed participants, which indicates they are freeriders who did not contribute any savings to the program.

Figure 8. Distribution of Non-Lighting Freeridership Estimates for 26 Surveyed Participants



After weighting the respondents' freeridership scores by their organizations' gross claimed savings from their non-lighting projects, we calculated a savings weighted freeridership score of 60% for non-lighting measures. Thus, the estimated percentage of gross savings from non-lighting projects which are lost to freeridership is 60%. The following bullet list breaks down the freeridership results by measure category:

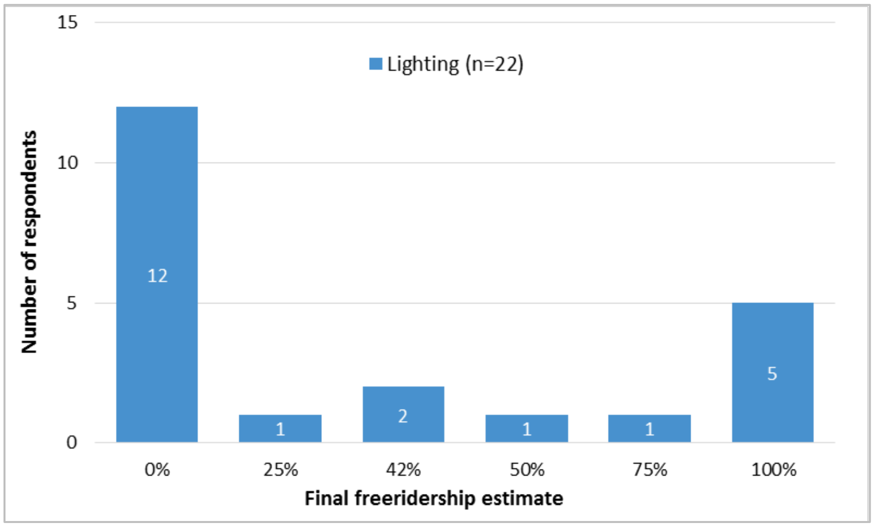
- For the 16 respondents who installed HVAC measures, the savings-weighted average freeridership is 63%.
- For the seven respondents who installed food service measures, we calculated 60% freeridership.
- For the two respondents who installed process measures, we calculated 13% freeridership.
- For the one respondent who installed pump measures, we calculated 69% freeridership.

Note that Cadmus provided the above non-lighting measure freeridership values for informational purposes only. Cadmus did not design the evaluation plan to achieve statistically significant estimates of freeridership at the measure level. The surveyed sample of non-lighting measures by category was further limited by the low levels of participation in those categories. The measure level freeridership values should not be used for program planning.

Lighting Participants

Figure 9 shows the distribution of freeridership estimates for 22 respondents. Cadmus calculated freeridership scores of 0% (no freeridership) to slightly more than half of surveyed lighting participants (55%). We assigned approximately a quarter of the surveyed lighting participants (23%) freeridership scores of 100%.

Figure 9. Distribution of Lighting Freeridership Estimates for 22 Surveyed Participants



After weighting the respondents' freeridership scores by their organizations' gross claimed savings from lighting projects, we calculated a savings weighted freeridership score of 14%.[6]

Spillover

The survey included questions to determine the extent to which the program's information and incentives motivated participants to take additional efficiency actions or install non-incented measures. We found very little evidence of spillover for this program.

Net to Gross Adjustment

The final step in calculating net to gross adjustments for this program is to calculate the NTG ratio for lighting and non-lighting measures.

Non-Lighting NTG

To estimate the net to gross adjustment for non-lighting measures, we compared the weighted average freeridership (60%) with negligible spillover. The average program-wide NTG ratio for this program is 40%, calculated as follows:

$$Non-lighting\ NTG = 100\% - Freeridership + Spillover = 100\% - 60\% + 0\% = 40\%$$

---

[6] Three of the 22 customers surveyed about lighting measures accounted for a combined 65% of the total savings, and all three were assigned freeridership scores of 0%.

CADMUS

Lighting NTG

To estimate the NTG adjustment for lighting measures, we compared the weighted average freeridership (14%) with negligible spillover. The average program-wide NTG ratio for this program is 86%, calculated as follows:

$$Lighting\ NTG = 100\% - Freeridership + Spillover = 100\% - \ 14\% + 0\% = 86\%$$

Combined NTG

The combined NTG ratio for all measures in the program is 78%. It is calculated based on the lighting and non-lighting NTG ratios weighted by program savings:

$$Program\ level\ NTG = (86\%\ \mathrm{x}\ 81\%) + (40\%\ \mathrm{x}\ 19\%) = 78\%$$

The measure category and program-level NTG ratios only include adjustments for freeridership and short-term participant spillover. Cadmus did not estimate short- and long-term non-participant spillover or short- and long-term market effects as a part of this study.

CADMUS

Work Paper Reviews

ECM Cooler, Freezer, and Display Case Motors

For the ECM cooler, freezer, and display case motor (ECM motor) measures, DEC applied a deemed savings per each motor replacing a low efficiency motor in commercial refrigeration applications. DEC incentivized 139 unique applications for this measure group, including 95 replacing permanent split capacitor (PSC) motors in walk-in coolers and freezers, 31 replacing shaded pole (SP) motors in walk-in coolers and freezers, and 44 replacing motors in display cases.

DEC used two different work papers to estimate the per-motor savings for these measures: one for ECM motors replacing PSC and SP motors in walk-in coolers and freezers and one for ECM motors replacing all motors in reach-in display cases.

Table 10 shows the deemed energy, NCP demand, and CP demand savings values in the work paper as well as the savings shown in the tracking database for the evaluation period.

Table 10 DEC Deemed Savings for ECM Motors

Replacement Type	Savings	Savings per Motor		
		Work Paper	Tracking Database	
			2013	2014-2015**
Replacing PSC in Cooler/Freezer*	Average NCP Demand (kW)	0.0660	0.2006	0.2006
	Summer CP Demand (kW)	0.0510	0.3296	0.1809
	Energy (kWh)	581	1,757	1,757
Replacing SP in Cooler/Freezer*	Average NCP Demand (kW)	0.2010	0.0663	0.0663
	Summer CP Demand (kW)	0.1810	0.1090	0.0590
	Energy (kWh)	1,757	581	581
Replacing Display Case Motor	Average NCP Demand (kW)	0.0456	0.0456	0.0456
	Summer CP Demand (kW)	0.0410	0.0668	0.0369
	Energy (kWh)	356	356	356

* Cadmus suspects that the savings figures were inverted between the PSC and SP motor replacement measures in the tracking database as they are exactly opposite of the work paper figures.

** The only difference between 2013 and 2014-2015 savings figures for cooler and freezer measures were summer CP demand savings. Cadmus could not find any documentation explaining this change.

Work Paper Methodology

Both work papers estimate the savings from the motors themselves as well as the savings from a reduced cooling load, as efficient motors produce less waste heat that must be removed by the refrigeration systems.

Walk-in Coolers and Freezers

In this FES work paper, per-motor savings were estimated based on a weighted average of savings calculated for replacing PSC and SP motors ranging from 1/40 hp to 1/2 hp.

The work paper estimated the motor savings by subtracting the ECM efficient case assumed input wattages (W) from the existing assumed values. The assumed input wattages range from 1,060 W/hp to 3,600 W/hp depending on the rated motor size and technology. The savings resulting from the reduced cooling load were then estimated based on assumed refrigeration system efficiencies which in turn were based on assumed coefficient of performance (COP) values of 2.5 and 1.3 for coolers and freezers, respectively.

The work paper does not cite a source for the assumed motor input wattages, the refrigeration system efficiencies, or the basis for weighting the savings associated with PSC and SP motor replacements and those associated with the various motor sizes.

The work paper assumes operating hour for motors in both coolers and freezer to be 8,760 and a peak demand CF of 0.9 based on the 2010 Wisconsin TRM. However, Cadmus could not find the CF value in the TRM.

Display Cases

In this work paper, per-motor savings are based on calculations found in the 2009 Ohio TRM. [7] The TRM assumes that the average SP motor input power, regardless of rated size, is 41.3W and the average ECM motor input power is 11.3 W. The TRM estimates the savings resulting from reduced refrigeration load by applying a bonus factor of 1.3 for coolers and 1.5 for freezers based on assumed and uncited refrigeration efficiencies. The TRM assumes operating hour for motors in both coolers and freezer to be 8,760 and duty cycles of 100% for coolers and 94% for freezers. The work paper assumes a CF = 0.9 and states that this is based on the 2010 Wisconsin TRM. However, Cadmus could not find the 0.9 value in the TRM.

Work Paper Methodology Adjustments Necessary

The motor input wattages used, for both the baseline and efficient cases, did not include sources and thus could not be verified. Cadmus updated the input wattages for the baseline SP motor cases and efficient ECM motor cases using data Cadmus collected as part of the commercial refrigeration load shape project performed on behalf of NEEP in 2012 - 2013.[8] This study included direct power measurement of a large sample of verified installations to determine an average input wattage normalized by motor hp rating. The average normalized input wattages found in this study were 2,088

---

[7] The Public Utilities Commission of Ohio. Technical Reference Manual for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE-UNC. October 15, 2009.

[8] Cadmus. *Commercial Refrigeration Loadshape Project Final Report.* Prepared for Northeast Energy Efficiency Partnerships Regional Evaluation, Measurement, and Verification Forum. October 9, 2015.

W/hp and 758 W/hp for SP and ECM motors, respectively. The study did not have enough data to normalize input wattages of PSC motors so we used data included on vender specification sheets for PSC motors.[9]

Instead of using the refrigeration efficiencies of only a handful of display case models, Cadmus used values from the DOE2.2R refrigeration modeling software as the values are more representative of the wide range of coolers and freezer installations. We used an energy-efficiency ratio (EER) of 9.8 for coolers and 4.0 for freezers for both the walk-in and display case measures.

Given the lack of documentation or explanation for how FES weighted the savings between the various motor sizes, Cadmus weighted the estimated per-motor savings based on the proportions of the different motors sizes in the tracking database during the evaluation period.

Table 11 shows the proportions of the different motor replacements for the walk-in PSC measure. The population weighting used in the work paper for the walk-in PSC measure varied significantly from the distribution shown in the tracking database. The work paper assumes that only 20% of the PSC motor replacements are for 1/20 hp motors or smaller. However, as shown in Table 11, 85% of the PSC motor replacements were for 1/20 hp and 15% for 1/15 hp. This is the main factor contributing to the low realization rate for the walk-in PSC replacement measure as smaller motors receive less savings.

Table 11. Walk-in PSC Motor Replacements Weighting Distribution

Motor Size (hp)	Number of Motors	% of Total (Weighting Factor)
1/20	50	84.7%
1/15	9	15.3%
Total	**59***	**100.0%**

* Cadmus only used the applications that included clear hp ratings to determine the weighting.

Table 12 shows the proportions of the different motor replacements for the walk-in SP measure. The population weighting used in the work paper for the walk-in SP measure varied significantly from the distribution shown in the tracking database. For example, the work paper assumes that only 17% of SP motor replacements are for 1/20 hp motors. However, as shown in Table 12, nearly four times that fraction of SP motor replacements (63%) were for 1/20 hp motors.

[9] Specification sheets are available online: https://www.grainger.com/product/DAYTON-1-20-hp-3RCX2?functionCode=P2IDP2PCP

Table 12 Walk-in SP Motor Replacements Weighting Distribution

Motor Size (hp)	Number of Motors	% of Total (Weighting Factor)
1/50	1	3.3%
1/20	19	63.3%
1/15	10	33.3%
Total	**30***	**100.0%**

* Cadmus only used the applications that included clear hp ratings to determine the weighting.

Table 13 shows the proportions of the different motor replacements for the display case motor replacement measure. For the display case measure, the adjusted savings are much greater than the work paper and tracked savings. This is mainly because the work paper figures assume that most motor replacements were for much smaller motors than what is shown in the tracking database. Because most replaced motors are much greater in size than the work paper assumptions, the adjusted savings are much greater.

Table 13. Display Case Motor Replacements Weighting Distribution

Motor Size (hp)	Number of Motors	% of Total (Weighting Factor)
1/50	5	25.0%
1/30	4	20.0%
1/20	5	25.0%
1/15	4	20.0%
1/10	2	10.0%
Total	**20***	**100.0%**

* Cadmus only used the applications that included clear hp ratings to determine the weighting.

Because the tracking database does not indicate whether the motors are in coolers or freezers, Cadmus estimated the average savings based on assumed equal distribution. We assumed a CF of 1.0 because it is highly likely that the refrigeration systems that these motors are a part of will have high cooling demand during peak grid demand periods.

Work Paper Adjustment Results

Table 14 shows the adjusted deemed savings in comparison with the program tracking values for the three ECM motor measures.

CADMUS

Table 14. Adjusted ECM Motors Measure Savings

Measure	Savings	Work paper [A]	Adjusted [B]	Adjustment Factor [B/A]
ECM Replacing PSC in Cooler/Freezer	Average NCP Demand (kW)	0.0660	0.0891	135%
	Summer CP Demand (kW)	0.0510	0.0891	175%
	Energy (kWh)	581	758	130%
ECM Replacing SP in Cooler/Freezer	Average NCP Demand (kW)	0.2010	0.0999	50%
	Summer CP Demand (kW)	0.1810	0.0999	55%
	Energy (kWh)	1,757	874*	50%
ECM Replacing Display Case Motor	Average NCP Demand (kW)	0.0456	0.0990	217%
	Summer CP Demand (kW)	0.0410	0.0990	241%
	Energy (kWh)	356	844	237%

* Cadmus produced the NEEP Commercial Refrigeration Load Shape Study in 2015 based on field metering. Using the average rated hp from the distribution presented in Table 15, the NEEP Study predicts annual energy and summer peak demand savings of 770 kWh and 0.088 kW for SP to ECM cooler retrofits and 979 kWh and 0.112 kW for SP to ECM freezer retrofits. Therefore, the savings values will depend greatly on the relative mix of coolers and freezers.

The main factor affecting the results of all three measures was the update to the input wattages and the weighting used to estimate the per-motor savings. For the PSC measure, this resulted in a reduction in savings. For the SP cooler, freezer, and display case measures, this resulted in an increase in the savings. Additionally, for the PSC and SP motor measures, a major factor affecting the results was an apparent clerical error in recording the per-motor savings associated with the SP and SP motors in the tracking database (refer to Table 10).

Table 15 lists the total claimed and adjusted savings for the three measures.

Table 15. Total Claimed and Adjusted Savings for ECM Motors

Measure	Claimed Savings			Adjusted Savings			Realization Rates		
	Energy (kWh) [A]	NCP Demand (kW) [B]	CP Demand (kW) [C]	Energy (kWh) [D]	NCP Demand (kW) [E]	CP Demand (kW) [F]	Energy [D/A]	NCP Demand [E/B]	CP Demand [F/C]
Display Case	571,380	73	77	1,355,079	159	159	237%	217%	207%
Walk-in PSC	1,189,489	136	151	513,269	60	60	43%	44%	40%
Walk-in SP	96,446	11	18	145,198	17	17	151%	151%	92%
Total	**1,857,315**	**220**	**246**	**2,013,547**	**236**	**236**	**108%**	**107%**	**96%**

CADMUS

Conclusions and Recommendations

Conclusion 1. For the ECM motors measure group, the size of the motors being replaced vary greatly; there is up to five times difference between the hp rating for the smallest and largest motors in the tracking database. The actual savings for a group of motors will vary widely based on the proportion of various sizes in the tracking database population.

Recommendation 1. Calculate refrigeration ECM motor savings on a per hp basis rather than a per motor basis. Table 16 shows recommended per hp savings based on Cadmus's findings in the NEEP Commercial Refrigeration Load Shape Study which can be applied to both walk-in and display case measures.

Table 16. Recomended ECM Motor per hp Savings

Base Case Motor	Savings Per Horsepower	
	Energy (kWh)	NCP and CP (kW)
SP	11,359	1.3295
PSC	9,090	1.0640

VFD on HVAC Fans and Pumps

DEC provided incentives for a total of 93 unique VFDs on HVAC Fan retrofit applications and 18 unique VFDs on HVAC Pump retrofit applications.

Table 17 and Table 18 show the deemed savings values in the applicable work paper as well as the savings shown in the tracking database for the evaluation period. DEC updated the tracking database values in 2014 based on an update memo provided by TecMarket Works.[10]

Table 17. DEC Deemed Savings for VFD on HVAC Fans

Savings	Savings per hp		
	Work Paper	Tracking Database (2013)	Tracking Database (2014-2015)
Average NCP Demand (kW)	0.1920	0.1600	0.1600
Summer CP Demand (kW)[11]	0.1720	0.2580	0.1570
Energy (kWh)	1,281	1,374	1,374

Table 18. DEC Deemed Savings for VFD on HVAC Pumps

Savings	Savings per hp		
	Work paper	Tracking Database (2013)	Tracking Database (2014-2015)
Average NCP Demand (kW)	0.5130	0.3050	0.3050
Summer CP Demand (kW)[12]	0.3210	0.5200	0.2990
Energy (kWh)	3,698	2,774	2,774

Work Paper Methodology

BuildingMetrics developed a set of commercial prototypical building models by using the DOE-2.2 building energy simulation program for each of the market segments defined such as hospitals, hotels, and large office buildings. The prototypes are based on the models used in the California Database for Energy Efficiency Resources studies, with appropriate modifications to adapt these models to local design practices and climate.[13]

[10] TecMarket Works. *Carolinas - Non-Residential Smart $aver - VFD Update Memo*. Technical Memorandum. February 2, 2012.

[11] Cadmus could not find the source of the VFD on HVAC fans summer CP demand savings in the tracking database and, thus, assumes that they are based on DEC DSMore analysis.

[12] Cadmus could not find the source of the VFD on HVAC pumps summer CP demand savings in the tracking database and, thus, assumes that they are based on DEC DSMore analysis.

[13] These prototypes are described in more detail in Building Metrics, Inc., Duke Energy Measure Savings Database – Weather Sensitive Retrofit Measures for Residential and Commercial Buildings. Technical memorandum. July 2010.

The work paper estimates annual energy, summer peak, and winter peak demand savings based on differences between the simulated energy consumption and peak demand at the baseline and the measure efficiency levels. The work paper assumed that summer peak demand occurs during the month of July, while winter peak impacts were calculated during the month of January. The savings were based on a calculated average of savings from 75 models with different HVAC systems, building types, and locations (described in the Table 19).

Table 19 Variation in Work paper Model Inputs

Types	Location*	System Type
• Hospital • Hotel • Large Office	• Asheville, NC • Charlotte, NC • Greenville, NC • Indianapolis, IN • Cincinnati, OH	• VAV reheat with economizer with air cooled chiller (fan measure only) • VAV reheat with economizer with water cooled chiller (fan measure only) • CV reheat with economizer (pump measure only) • CV reheat with no economizer (pump measure only) • VAV reheat with economizer (pump measure only)

* Though the last two cities are not in the Carolinas, they were included in the work paper analysis.

The TecMarket Works memo used by DEC to update the savings in 2014 mapped all of the previous year's applications to the savings based on the specific building type and location to find more application specific savings for this measure. TecMarket Works calculated the average, per fan hp and per pump hp savings to inform to future projects.

Work Paper Methodology Adjustments Necessary

Cadmus used the results from a recent HVAC VFD load shape project performed by Cadmus on behalf of NEEP. The VFD Load Shape Study report, and accompanying MS Excel tool,[14] describe a measurement based study to determine the annual peak and hourly demand impacts from installations on HVAC fans and pumps. The study metered 392 individual HVAC motors with VFDs for over a year (June 2012 – September 2013). The study compared metered energy consumption of each motor to a baseline of either metered consumption (pre-installation, when available) or of the DOE2.2 modeled consumption of the system without a VFD. The results of the study, similar to those in the work paper, are summarized in terms of energy and demand savings per hp.

Though the study focuses on cities in the Northeast, one of the major observations of the study was that a variation in climate and outdoor air conditions had negligible impact on the load shape. This, and other key findings include the following:

- Variable speed drives frequently operate at constant speed.
- Operators may select constant speed operation over variable speed operation.

[14] The Cadmus Group. *Variable Speed Drive Load shape Project*. Northeast Energy Efficiency Partnership, n.d. Available online: http://www.neep.org/variable-speed-drive-load shape-study-final-report.

- Variable speed drive performance often does not track outside temperature.
- The savings estimates for each weather region are similar and similarly diverse.

Because of this, Cadmus concluded that the NEEP savings figures are applicable to DEC projects. Moreover, the aggregate results of the NEEP report included instances where the VFD installed motors were not operating at optimal efficiency (e.g., controls bypassed and running at full speed or single speed set by operator). This means that the average deemed savings figures, applied program-wide, will account for cases where the controls are not implemented as planned. Cadmus has encountered these cases in our verifications for Duke Energy Ohio.[15]

The NEEP study also shows that there is a large variation in the amount of savings depending on what type of HVAC pump the VFD is installed on. As shown in Table 20, for a VFD installed on a cooling water pump, a hot water pump, or a water source heat pump (WSHP) circulation pump, the typical savings ranged from 19% below to 34% above the average savings for all HVAC pumps. The variation between the two types of HVAC fans analyzed (supply and return) was not as large (±6%).

Because the tracking database did not contain enough information to determine the type of pump associated with each application, we could not make any adjustments based on these findings. In order to estimate more accurate program savings in the future, we recommend that the VFD on HVAC pumps measure be administered by pump duty (cooling water vs. hot water vs. WSHP).

Table 20. Comparison of Savings for VFDs on HVAC Pumps Depending on Pump Duty Based on NEEP Variable Speed Drive Load shape Project

Equipment Type	Savings per Pump (hp)			
	Energy (kWh)	Energy Difference from Average	Average NCP Demand (kW)	Average NCP Demand Difference from Average
Cooling Water Pump	1,633	-14.7%	0.1860	-14.8%
Hot Water Pump	1,548	-19.1%	0.1770	-18.9%
WSHP Circulation Pump	2,562	33.8%	0.2920	33.7%
Average All Pump	1,914	0.0%	0.2183	0.0%

Work Paper Adjustment Results

Table 21 and Table 22 show per hp adjusted savings figures for HVAC fans and pumps, respectively.

The main reason for the difference is because Cadmus based the adjusted savings on real-world metering as opposed to modeled savings. Table 23 and Table 24 show the claimed savings, the adjusted savings, and the realization rates for HVAC fans and pumps, respectively.

[15] Cadmus. *Evaluation of the Smart $aver Nonresidential Custom Incentive Program in Ohio.* Evaluation, Measurement, & Verification for Duke Energy Ohio. November 15, 2015.

Table 21 Adjusted VFDs on HVAC Fans Measure Savings

Savings Parameter (per hp)	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Energy (kWh)	1,281	1,910	149%
Average NCP Demand (kW)	0.1920	0.2181	114%
Summer CP Demand (kW)	0.1720	0.2914	169%
Winter CP Demand (kW)	n/a	0.2990	n/a

Table 22 Adjusted VFDs on HVAC Pumps Measure Savings

Savings Parameter (per hp)	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Energy (kWh)	3,698	1,914	52%
Average NCP Demand (kW)	0.5130	0.2185	43%
Summer CP Demand (kW)	0.3210	0.1687	53%
Winter CP Demand (kW)	n/a	0.2408	n/a

Table 23. Total Claimed and Adjusted Savings for HVAC Fans

Savings	Total Savings (kWh)	Total NCP Savings (kW)	Total CP Savings (kW)
Claimed [A]	14,553,141	1,695	2,188
Adjusted [B]	20,236,854	2,310	3,086
Realization Rate [B/A]	139%	136%	141%

Table 24. Total Claimed and Adjusted Savings for HVAC Pumps

Savings	Total Savings (kWh)	Total NCP Savings (kW)	Total CP Savings (kW)
Claimed [A]	5,480,481	603	799
Adjusted [B]	3,781,949	432	333
Realization Rate [B/A]	69%	72%	42%

Conclusions and Recommendations

Conclusion 1. A recently completed metering study by Cadmus on behalf of NEEP showed that there is a large variation in the amount of savings depending on what type of HVAC pump the VFD is installed on. For a VFD installed on a cooling water pump, a hot water pump, or a WSHP circulation pump, the typical savings ranged from 19% below to 34% above the average savings for all HVAC pumps.

Recommendation 1. Calculate savings based on the pump's duty (cooling water vs. hot water vs. WSHP) as opposed to a general HVAC pump assumption. The recommended savings by pump duty cycle were shown in Table 20.

Conclusion 2. The savings for VFDs on HVAC Fans and Pumps depended on the quantity and the hp rating of the motors retrofitted. However, the hp rating of the motors were not always recorded or recorded accurately in the tracking database. Cadmus found this to be an issue in its review of the entire tracking database for measures where total savings depended on not just the quantity of the measure, but also additional parameters such as hp rating of the motors.

Recommendation 2. Record the quantitative parameters for measure saving determination consistently to facilitate total measure savings and program saving calculations.

Linear Fluorescent High Bay Fixtures Replacing HID

The linear fluorescent high bay measure group work paper identifies DEC savings resulting from retrofitting HID fixtures with high-output T5 and T8 linear fluorescent fixtures in two, three, four, and eight lamp configurations. DEC provides incentives for 11 measures identified in the work paper. DEC also provides incentives for one additional retrofit scenario, high-bay 2 lamp T8, even though the savings for this configuration were not addressed in the work paper. Table 25 and Table 26 summarize these 12 retrofit scenarios and the associated work paper energy and demand savings.

The high bay measure was part of an evaluation performed by TecMarket Works in 2011.[16] DEC applied evaluated savings prospectively in the tracking database after that evaluation. Therefore, as shown in Table 25 and Table 26, the values in the tracking database are different from those in the work paper. This current evaluation includes a review of the work paper methodology; however, the total adjusted savings are presented in comparison to the DEC claimed saving values in the tracking database at the end of this section.

Table 25. DEC Deemed Energy Savings for Linear Fluorescents High Bay

Efficient Fixture	Existing HID Fixture (W)	Savings per Fixture	
		Work Paper (kWh)	Tracking Database (kWh)
High Bay 2-L T5	150-249	300	561
High Bay 3-L T5	250-399	449	843
High Bay 4-L T5	400-999	882	1,748
High Bay 6-L T5	400-999	374	835
High Bay 8-L T5	750-999	1,514	2,842
2 High Bay 6-L T5	1,000	1,456	1,456
High Bay 2-L T8	150-249	n/a	513
High Bay 3-L T8	150-249	341	641
High Bay 4-L T8	250-399	616	1,124
High Bay 6-L T8	400-999	961	1,811
High Bay 8-L T8	400-999	649	1,218
2 High Bay 8-L T8 (single fixture 16 lamps)	1,000	2,005	2,005

16 TecMarket Works. *Evaluation of the Non-Residential Smart $aver Prescriptive Program in North and South Carolina: Results of a Results of a Process and Impact Evaluation*. Prepared for Duke Energy. Final: February 6, 2011 (Revised: June 16, 2011).

CADMUS

Table 26. DEC Deemed Average NCP and CP Demand Savings for Linear Fluorescents High Bay

Efficient Fixture	NCP Demand (kW)		CP Demand (kW)	
	Work Paper	Tracking Database	Work Paper	Tracking Database
High Bay 2-L T5 High Output	0.0720	0.0950	0.0684	0.0900
High Bay 3-L T5 High Output	0.1080	0.1430	0.1026	0.1354
High Bay 4-L T5 High Output	0.2120	0.2960	0.2014	0.2803
High Bay 6-L T5 High Output	0.0900	0.1410	0.0855	0.1335
High Bay 8-L T5 High Output	0.3640	0.4810	0.3458	0.4555
2 High Bay 6-L T5 High Output	0.3500	0.3500	0.3325	0.3325
High Bay 2-L T8	n/a	0.1261	n/a	0.1030
High Bay 3-L T8	0.0820	0.1090	0.0779	0.1032
High Bay 4-L T8	0.1480	0.1900	0.1406	0.1799
High Bay 6-L T8	0.2310	0.3060	0.2195	0.2878
High Bay 8-L T8	0.1560	0.2060	0.1482	0.1951
2 High Bay 8-L T8 (single fixture 16 lamps)	0.4820	0.4820	0.4579	0.4579

Work Paper Methodology

The work paper assesses the equivalency of various efficient high bay linear fluorescent fixtures with existing metal halide fixtures in terms of light output. The light output for each fixture is assumed to be equal to the mean lumens of the lamps in each fixture. By developing the equivalency based on mean lumens, the light output of a lamp at 40% of its rated life, the work paper has accounted for the depreciation in light output during the lifetime of a lamp. The work paper considers a differential light output of less than 25% as acceptable.

FES then compares the input wattages of equivalent existing and efficient fixtures to calculate energy and NCP demand savings. The work paper uses 4,160 annual hours based on the Focus on Energy deemed savings manual, using a 50/50 weighting of industrial and commercial hours of use values.[17] However, the value is not supported in the Focus on Energy deemed savings manual (the evaluation team calculates 4,238 using the same weighting method). The work paper assumed a CF of 0.95 which is an internal FES standard value. The work paper does not account for the interactive effects of lighting and HVAC.

Work Paper Adjustments Necessary

Cadmus found the work paper methodology reasonable in developing equivalent retrofit scenarios and assigning wattages to the baseline and efficient fixtures in each scenario. Note that the savings depend

---

17 Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

significant on the baseline fixture installed. Cadmus verified that the Prescriptive Program application specifies the baseline fixture for each measure.[18]

However, we found the following adjustments necessary:

We used the following saving algorithm from the Ohio TRM, which incorporates the interactive effects of lighting and HVAC in the adjusted saving calculation:

Energy Savings

$$\Delta kWh = (WATTS_{BASE} - WATTS_{EE}) * HOURS * (1 + WHF_E) / 1{,}000$$

Where:

$WATTS_{BASE}$	=	connected wattage of the baseline fixtures
$WATTS_{EE}$	=	connected wattage of high-efficiency fixtures
HOURS	=	annual lighting operating hours
WHF_E	=	lighting-HVAC interaction factor

Summer CP Demand Reduction

$$\Delta kW = ((WATTS_{BASE} - WATTS_{EE}) * CF * (1 + WHF_{D})) / 1{,}000$$

Where:

WHF_D	=	lighting-HVAC waste heat factor for demand and
CF	=	summer peak coincidence factor.

Cadmus used the HVAC interactive effects multipliers from the Ohio TRM,[19] which are 0.20 for demand and 0.097 for energy. TecMarket works used these values in the 2011 evaluation by TecMarket.

The work paper used 4,160 as the annual hours of operation for the metal halide lamps as a place-holder. The 2011 TecMarket Works evaluation of the high bay measure found that on average, the metered hours of use predicted about 2% fewer annual operating hours in North Carolina and 15% more annual hours of use in South Carolina compared with the participants self-reported hours of use. [20]

[18] Duke Energy. *North Carolina and South Carolina Lighting Smart $aver Prescriptive Incentive Application.* 1/2016 v3. Available online: http://www.duke-energy.com/pdfs/NC_Lighting.pdf

[19] The Public Utilities Commission of Ohio. Ohio Technical Reference Manual for Ohio Senate Bill 221 Energy Efficiency and Conservation Program and 09-512-GE-UNC. October 15, 2009.

[20] TecMarket Works. *Evaluation of the Non-Residential Smart $aver Prescriptive Program in North and South Carolina: Results of a Results of a Process and Impact Evaluation.* Prepared for Duke Energy. Final: February 6, 2011 (Revised: June 16, 2011. P. 60).

CADMUS

Cadmus calculated the average self-reported and logged hours of use weighted by the evaluated savings in the 2011 TecMarket Works evaluation. The ratio of weighted average logged over self-reported hours of use in the evaluation for both states together was 117%.

Cadmus calculated the average self-reported hours of use for the participants in the current tracking database weighted by claimed savings. We used the self-reported hours of use from 687 applications in the tracking database in our calculation. Cadmus increased the self-reported average hours of use by the ratio of logged over self-reported hours of use calculated based on the TecMarket Works evaluation. We used this value as the average annual hours of use in the current evaluation. Table 27 lists the results.

Table 27. Adjusted Hours of Use Calculation Based on Self-reported Annual Hours of Operation

	Annual Hours of Operation
Tracking Database Self-Reported Weighted Average [A]	4,488
Ratio of Logged / Self-Reported from Previous Evaluation [B]	1.17
Adjusted Hours of Use [A x B]	5,246

We also calculated the CF verified by TecMarket Works in 2011, weighted by the evaluated savings (0.97) and deemed the work paper CF value of 0.95 as reasonable.

Work Paper Adjustment Results

Table 28, Table 29, and Table 30 show the adjusted savings values and how they compare to the work paper values. The main factors causing the higher kWh savings are the addition of HVAC interactive effects and the adjusted annual hours of operation. The main factor causing the higher kW savings is the addition of HVAC interactive effects.

Table 28. Adjusted Linear Fluorescent High Bay Measure Energy Savings

Efficient Fixture	Work Paper (kWh) [A]	Adjusted Savings (kWh) [B]	Adjustment Factor [B/A]
High Bay 2-L T5	300	414	138%
High Bay 3-L T5	449	622	138%
High Bay 4-L T5	882	1220	138%
High Bay 6-L T5	374	518	138%
High Bay 8-L T5	1,514	2,095	138%
2 High Bay 6-L T5	1,456	2,014	138%
High Bay 2-L T8	n/a	653	n/a
High Bay 3-L T8	341	472	138%
High Bay 4-L T8	616	852	138%
High Bay 6-L T8	961	1329	138%
High Bay 8-L T8	649	898	138%
2 High Bay 8-L T8 (or single fixture 16 lamps)	2,005	2,774	138%

CADMUS

Table 29. Adjusted Linear Fluorescent High Bay Measure CP Demand Savings

Efficient Fixture	Work Paper (kW) [A]	Adjusted Savings (kW) [B]	Adjustment Factor [B/A]
High Bay 2-L T5	0.0684	0.0821	120%
High Bay 3-L T5	0.1026	0.1231	120%
High Bay 4-L T5	0.2014	0.2417	120%
High Bay 6-L T5	0.0855	0.1026	120%
High Bay 8-L T5	0.3458	0.4150	120%
2 High Bay 6-L T5	0.3325	0.3990	120%
High Bay 2-L T8	n/a	0.1294	n/a
High Bay 3-L T8	0.0779	0.0935	120%
High Bay 4-L T8	0.1406	0.1687	120%
High Bay 6-L T8	0.2195	0.2633	120%
High Bay 8-L T8	0.1482	0.1778	120%
2 High Bay 8-L T8 (or single	0.4579	0.5495	120%

Table 30. Adjusted Linear Fluorescent High Bay Measure NCP Demand Savings

Efficient Fixture	Work Paper (kW) [A]	Adjusted (kW) [B]	Adjustment Factor [B/A]
High Bay 2-L T5	0.0720	0.0864	120%
High Bay 3-L T5	0.1080	0.1296	120%
High Bay 4-L T5	0.2120	0.2544	120%
High Bay 6-L T5	0.0900	0.1080	120%
High Bay 8-L T5	0.3640	0.4368	120%
2 High Bay 6-L T5	0.3500	0.4200	120%
High Bay 2-L T8	n/a	0.1362	n/a
High Bay 3-L T8	0.0820	0.0984	120%
High Bay 4-L T8	0.1480	0.1776	120%
High Bay 6-L T8	0.2310	0.2772	120%
High Bay 8-L T8	0.1560	0.1872	120%
2 High Bay 8-L T8 (single	0.4820	0.5784	120%

A summary of the savings associated with all linear fluorescent high bay applications in the evaluation period, including the claimed savings, the adjusted savings, and the realizations rates are shown in Table 31. Cadmus used the tracking database per-unit savings for each efficient fixture to calculate claimed savings. As mentioned previously and noted in Table 25 and Table 26, the DEC tracking database per-unit savings and hence the total claimed savings calculated by Cadmus, include the realization rates from the previous evaluation (1.77 and 1.14 for energy and CP demand respectively in NC and 1.62 and 1.02 for energy and CP demand respectively in SC). Therefore, the realization rates noted in Table 31 are lower than the adjustment rates shown for the work paper savings in the previous tables.

CADMUS

Table 31. Total Claimed and Adjusted Savings for the Linear Fluorescent High Bay Measure

Savings	Energy (kWh)	NCP Demand (kW)	CP Demand (kW)
Claimed [A]	85,708,927	14,570	13,758
Adjusted [B]	61,212,185	12,763	12,125
Realization Rate [B/A]	71%	88%	88%

Conclusions and Recommendations

None.

High Performance Linear Fluorescent

The high performance linear fluorescent measure group includes 38 unique measures:

- Nine measures provide incentives for retrofitting standard T8 fixtures with *high-performance* or *reduced-wattage* T8s as designated by the Consortium for Energy Efficiency (CEE).[21]
- Ten measures provide incentives for retrofitting standard or high output T12 fixtures with *high-performance* or *reduced-wattage* T8 fixtures as designated by CEE.
- Nineteen measures provide incentives for retrofitting four-foot T12 fixtures with regular or high output T8 or T5 lamps and retrofitting eight-foot T12 fixtures with *high-performance* T8s. DEC discontinued these measures as of January 2013 in response to the federal standards that went into effect in July of 2012. The federal standards include efficacy requirements that cannot be met by standard T12 lamps (with a few exception) and instead can be met with T8 lamps. Although there are instances of incentives paid to these measures in the DEC tracking database, the evaluation team assumed that these incentives were applied for before the measures were discontinued in 2013 (and paid for after 2013). Therefore, these measures are not included in the work paper review.

The high-performance linear fluorescent measure was part of an evaluation performed by TecMarket Works in 2013.[22] DEC applied evaluated savings prospectively in the tracking database after this evaluation. Therefore, as shown in Table 32, the values in the tracking database are different from those in the FES work paper. This current evaluation includes a review of the work paper methodology; however, the total adjusted savings are presented in comparison to the DEC claimed saving values in the tracking database at the end of this section.

[21] The qualifying lists can be found at: https://www.cee1.org.

[22] TecMarket Works. *Process and Impact Evaluation of the Non-Residential Smart $aver Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors.* Prepared for Duke Energy. April 5, 2013.

CADMUS

Table 32. DEC Deemed Savings for High Performance Linear Fluorescents

Measure	Energy		NCP Demand		CP Demand	
	Work Paper (kWh)	Tracking Database (kWh)	Work Paper (kW)	Tracking Database (kW)	Work Paper (kW)	Tracking Database (kW)
High-Performance (HP) T8 Replacing T12s						
HP T8 32W - 4' 1 Lamp	43	75	0.0118	0.0190	0.0106	0.0160
HP T8 32W - 4' 2 Lamp	58	101	0.0158	0.0255	0.0142	0.0215
HP T8 32W - 4' 3 Lamp	97	169	0.0265	0.0427	0.0238	0.0360
HP T8- 32W - 4' 4 Lamp	111	192	0.0301	0.0486	0.0271	0.0410
HP T8 Replacing Standard T8s						
HP T8 32W - 4' 1 Lamp	19	33	0.0053	0.0083	0.0047	0.0068
HP T8 32W - 4' 2 Lamp	31	54	0.0083	0.0136	0.0075	0.0109
HP T8 32W - 4' 3 Lamp	35	61	0.0095	0.0154	0.0085	0.0123
HP T8- 32W - 4' 4 Lamp	52	90	0.0141	0.0228	0.0127	0.0191
Low-Wattage (LW) T8 Replacing T8s						
LW 25/28W - 4' 1 Lamp	29	50	0.0079	0.0127	0.0071	0.0097
LW 25/28W - 4' 2 Lamp	48	83	0.0131	0.0211	0.0118	0.0160
LW 25/28W - 4' 3 Lamp	62	108	0.0170	0.0272	0.0153	0.0208
LW 25/28W - 4' 4 Lamp	92	160	0.0250	0.0404	0.0225	0.0307
LW T8 Replacing T12s						
LW 25/28W - 4' 1 Lamp	53	92	0.0144	0.0232	0.0130	0.0196
LW 25/28W - 4' 2 Lamp	76	132	0.0206	0.0333	0.0185	0.0280
LW 25/28W - 4' 3 Lamp	125	217	0.0340	0.0548	0.0306	0.0463
LW 25/28W - 4' 4 Lamp	151	262	0.0410	0.0662	0.0369	0.0559
HP T8 Replacing 8' HO T12s						
HP T8 32W - 4' 2 Lamp	123	213	0.0333	0.0537	0.0300	0.0454
HP T8- 32W - 4' 4 Lamp	225	389	0.0610	0.0985	0.0549	0.0831
LW T8 Replacing T8 – Lamp Only						
LW T8 – 4’ 1 lamp	15	26	0.0040	0.0066	0.0036	0.0054

CADMUS

Work Paper Methodology

The work paper uses common T12 and T8 wattages for the baseline fixtures and qualifying *high-performance* and *reduced-wattage* system wattages listed by the CEE for the replacements fixtures. Wattages for *reduced-wattage* replacement fixtures are determined based on a weighted average of 25W and 28W CEE qualified *reduced-wattage* T8 systems. Wattages for *high-performance* replacement fixtures are determined based on a weighted average of qualified *high-performance* fixtures using a low ballast factor (LBF), normal ballast factor (NBF), and high ballast factor (HBF). The work paper makes the following assumptions for calculating the weighted average wattage for the high-performance replacement fixtures:

- Four-foot T12 and T8 systems are replaced with *high-performance* or *reduced-wattage* T8 systems with 75% LBF ballasts and 25% NBF ballasts.
- Eight-foot T12 systems are replaced with *high-performance* systems with 100% NBF ballasts.
- Eight-foot T12 high output systems are assumed to be replaced with *high-performance* systems with 50% NBF ballasts and 50% HBF ballasts.

The work paper uses 3,680 annual hours of use based on the Focus on Energy deemed savings manual.[23] Cadmus could not verify this value based on the same reference (3,730 is the commercial building hours of use according to the manual). The work paper assumed a CF of 0.90 which is an internal FES standard value. The work paper does not account for the interactive effects of lighting and HVAC.

Work Paper Adjustments Necessary

Cadmus found the work paper methodology in assigning input wattages to the baseline and efficiency lighting fixtures reasonable. We made the following adjustments:

- We used the common lighting saving algorithm presented in the Linear Fluorescent High Bay Fixtures Replacing HID section, which incorporates the interactive effects of lighting and HVAC in the adjusted saving calculation. We used the following weighted average energy and demand waste heat factors determined in the 2013 evaluation of this measure by TMW:[24]
  - WHFD = 0.220
  - WHFE = 0.042

[23] Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

[24] TecMarket Works. *Process and Impact Evaluation of the Non-Residential Smart $aver Prescriptive Program in the Carolina System: Lighting and Occupancy Sensors*. Prepared for Duke Energy. April 5, 2013. p.25.

CADMUS

- The work paper used 3,680 as the annual hours of operation for linear fluorescent lamps. The 2013 TecMarket Works evaluation of the high performance linear fluorescent measure found that on average, the metered hours of use predicted 14% more than the participant self-reported hours of use, and 170% times more operating hours than the 3,680 assumption in the work paper.[25] The TecMarket Works logged and self-reported hours of use were weighted by the evaluated savings in the evaluation. Of the 1,085 applications recorded for this measure group in the tracking database, 494 had self-reported hours of use. Cadmus calculated the average self-reported hours of use by application, weighted by the claimed savings for each application. Cadmus increased the self-reported average hours of use by the ratio of logged over self-reported hours of use calculated in the 2013 TecMarket Works evaluation. Cadmus used this value as the average annual hours of use in the adjusted savings. The results are summarized in Table 33.

Table 33. Adjusted Hours of Use Calculation Based on Self-reported Annual Hours of Operation

	Annual Hours of Operation
Tracking Database Self-reported Weighted Average [A]	4,563
Ratio of Logged / Self-reported from TecMarket Works 2013 Evaluation [B]	1.14
Adjusted Hours of Use [C] (=AxB)	5,202

- In lieu of the 0.9 CF used in the work paper, an internal FES value, the evaluation team used the weighted average verified CF determined in the 2013 TecMarket Works evaluation (0.76).[26]

Work Paper Adjustment Results

Table 34 , Table 35, and Table 36 show the adjusted savings figures and how they compare to the work paper values. The factors causing the higher kWh savings are the addition of HVAC interactive effects and the adjusted annual hours of operation. The factors affecting the demand savings are the addition of HVAC interactive effects and the adjusted CF.

A summary of the savings associated with all high performance linear fluorescent applications in the evaluation period, including the claimed savings, the adjusted savings, and the realizations rates are shown in Table 36. Cadmus used the per-unit savings and the quantities recorded in the tracking database for each measure to calculate claimed savings. As mentioned previously and noted in Table 32, the program tracking savings recorded by DEC and hence the total claimed savings calculated by Cadmus, include the realization rate from the previous evaluation (1.73, 1.61, 1.47 for energy, NCP demand, and CP demand savings on average respectively).Therefore, the realization rates noted in Table 36 are lower than the adjustment rates shown for the work paper savings in the tables above.

[25] Ibid. Pp 23-24.

[26] Ibid. P 23.

CADMUS

Table 34. Adjusted High Performance Linear Fluorescent Measure Energy Savings

Measure	Work Paper (kWh) [A]	Adjusted Savings (kWh) [B]	Adjustment Factor [B/A]
HP T8 Replacing T12s			
HP T8 32W - 4' 1 Lamp	43	64	147%
HP T8 32W - 4' 2 Lamp	58	86	147%
HP T8 32W - 4' 3 Lamp	97	143	147%
HP T8- 32W - 4' 4 Lamp	111	163	147%
HP T8 Replacing Standard T8s			
HP T8 32W - 4' 1 Lamp	19	28	147%
HP T8 32W - 4' 2 Lamp	31	45	147%
HP T8 32W - 4' 3 Lamp	35	51	147%
HP T8- 32W - 4' 4 Lamp	52	76	147%
LW T8 Replacing T8s			
LW 25/28W - 4' 1 Lamp	29	43	147%
LW 25/28W - 4' 2 Lamp	48	71	147%
LW 25/28W - 4' 3 Lamp	62	92	147%
LW 25/28W - 4' 4 Lamp	92	136	147%
LW T8 Replacing T12s			
LW 25/28W - 4' 1 Lamp	53	78	147%
LW 25/28W - 4' 2 Lamp	76	112	147%
LW 25/28W - 4' 3 Lamp	125	184	147%
LW 25/28W - 4' 4 Lamp	151	222	147%
HP T8 Replacing 8'HO T12s			
HP T8 32W - 4' 2 Lamp	123	180	147%
HP T8- 32W - 4' 4 Lamp	225	331	147%
LW T8 Replacing T8 – Lamp Only			
LW T8 – 4’ 1 lamp	15	22	147%

CADMUS

Table 35. Adjusted High Performance Linear Fluorescent Measure Demand Savings

Measure	NCP (kW)			CP (kW)		
	Work Paper [A]	Adjusted Savings [B]	Adjustment Factor [B/A]	Work Paper [C]	Adjusted Savings [D]	Adjustment Factor [D/C]
HP T8 Replacing T12s						
HP T8 32W - 4' 1 Lamp	0.0118	0.0143	122%	0.0106	0.0109	103%
HP T8 32W - 4' 2 Lamp	0.0158	0.0193	122%	0.0142	0.0146	103%
HP T8 32W - 4' 3 Lamp	0.0265	0.0323	122%	0.0238	0.0245	103%
HP T8- 32W - 4' 4 Lamp	0.0301	0.0367	122%	0.0271	0.0279	103%
HP T8 Replacing Standard T8s						
HP T8 32W - 4' 1 Lamp	0.0053	0.0064	122%	0.0047	0.0049	103%
HP T8 32W - 4' 2 Lamp	0.0083	0.0101	122%	0.0075	0.0077	103%
HP T8 32W - 4' 3 Lamp	0.0095	0.0115	122%	0.0085	0.0088	103%
HP T8- 32W - 4' 4 Lamp	0.0141	0.0172	122%	0.0127	0.0131	103%
LW T8 Replacing T8s						
LW 25/28W - 4' 1 Lamp	0.0079	0.0097	122%	0.0071	0.0073	103%
LW 25/28W - 4' 2 Lamp	0.0131	0.0160	122%	0.0118	0.0121	103%
LW 25/28W - 4' 3 Lamp	0.0170	0.0207	122%	0.0153	0.0157	103%
LW 25/28W - 4' 4 Lamp	0.0250	0.0305	122%	0.0225	0.0232	103%
LW T8 Replacing T12s						
LW 25/28W - 4' 1 Lamp	0.0144	0.0176	122%	0.0130	0.0134	103%
LW 25/28W - 4' 2 Lamp	0.0206	0.0251	122%	0.0185	0.0191	103%
LW 25/28W - 4' 3 Lamp	0.0340	0.0414	122%	0.0306	0.0315	103%
LW 25/28W - 4' 4 Lamp	0.0410	0.0500	122%	0.0369	0.0380	103%
HP T8 Replacing 8'HO T12s						
HP T8 32W - 4' 2 Lamp	0.0333	0.0406	122%	0.0300	0.0309	103%
HP T8- 32W - 4' 4 Lamp	0.0610	0.0744	122%	0.0549	0.0566	103%
LW T8 Replacing T8 – Lamp Only						
LW T8 – 4’ 1 lamp	0.0040	0.0049	122%	0.0036	0.0037	103%

Table 36. Total Claimed and Adjusted Energy Savings for High Performance Linear Fluorescents

Savings	Energy (kWh)	NCP Demand (kW)	CP Demand (kW)
Claimed [A]	17,420,130	4,404	3,568
Adjusted [B]	14,767,697	3,324	2,526
Realization Rate [B/A]	85%	75%	71%

Conclusions and Recommendations

None.

CADMUS

LED Lamps and Downlights

The LED lamps measure provides incentives for replacing incandescent bulbs with ENERGY STAR® LEDs. The work paper assumes a 60W incandescent bulb as the baseline in 2012. The 60W incandescent bulb was subject to EISA 2007 requiring that a former 60W lamp manufactured and sold on or after January 1, 2014, use 43W or less, while providing the same amount of light.[27] Therefore, the work paper (and DEC) changed the baseline for the LED lamps measure in 2014 to reflect the 43W minimum standard. The deemed energy and demand savings for this measure changed from 2013 to 2014 as a result in the tracking database.

The LED downlights measure provides incentives for replacing 60W to 100W incandescent bulbs with ENERGY STAR qualified LED downlights of 18W or less.

Table 37 shows deemed savings per lamp for LED lamps and downlights in 2013 and beyond.

Table 37. DEC Deemed Savings for LED Lamps and Downlights

Savings	Energy (kWh)		NCP Demand (kW)		CP Demand (kW)	
Evaluation Year	2013	2014-2015	2013	2014-2015	2013	2014-2015
LED Lamps	177	114	0.0481	0.0310	0.0432	0.0310
LED Downlights	195	195	0.0530	0.0530	0.0477	0.0477

Work Paper Methodology

The LED lamps and downlights work paper includes the following assumptions:

LED Lamp Assumptions

- Existing watts/fixture = 60W (2013); 43W (2014 and beyond)
- Efficient watts/fixture = 12W
- CF = 0.77
- Annual Operating Hours = 3,680

LED Downlight Assumptions

- Existing watts/fixture = 65W
- Baseline watts/fixture = 12W
- CF = 0.77
- Annual operating hours = 3,680

---

27 The EISA 2007 minimum efficacy standards applied to 100W lamps in 2012, 75W lamps in 2013, and 60W/45W lamps in 2014.

The work paper uses 3,680 as the annual hour of use based on the Focus on Energy deemed savings manual.[28] Cadmus could not verify this value based on the same reference (3,730 is the commercial building hours of use according to the manual). The work paper assumed a CF of 0.90, which is an internal FES standard value. The work paper does not account for the interactive effects of lighting and HVAC.

Work Paper Adjustments Necessary

Cadmus used the HVAC interactive effects multipliers from the Ohio TRM (0.20 for demand and 0.097 for energy interactive effects).[29] We also determined the Focus on Energy deemed savings manual CF of 0.77 is appropriate for the adjusted peak demand saving calculations. The remaining adjustments are described separately for LED lamps and downlights.

LED Lamp Assumptions

Cadmus found the efficient wattage assumption (12W) for the LED lamps measure is appropriate. We calculated 12.45W as the average wattage of the 60W equivalent LED lamps in the ENERGY STAR data base available during the evaluation period. [30]

However, Cadmus found that the 2013 baseline wattage assumption (60W) for the LED does not agree with the average wattage of incandescent lamps in use in commercial and industrial buildings according to the 2010 characterization of the lighting market as issued by the Department of Energy (52W).[31] We revised the baseline wattage assumption from 60W to 52W in the adjusted saving calculations for 2013. We determined that in 2014 and 2015 the EISA baseline of 43W is appropriate.

The weighted average of self-reported hours of use for LED lamps in the tracking database is 4,358. In order to calculate this weighted average hours of use, Cadmus used 1,030 of the 1,553 applications for LED lamps in the DEC tracking database, which had self-reported hours of use recorded. Cadmus calculated the average self-reported hours of use, by application, weighted by the claimed savings for each application. Cadmus used 4,358 as the adjusted hours of use.

---

[28] Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

[29] The Public Utilities Commission of Ohio. *Technical Reference Manual for Ohio Senate Bill 221 Energy Efficiency and Conservation Program* and 09-512-GE-UNC. October 15, 2009.

[30] ENERGY STAR-certified lamps available after 2012, but before July 2015, filtered to 700-1100 lumens in brightness, excluding the decorative lamp category. The full database is available for download at: https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Light-Bulbs

[31] U.S. Department of Energy. *U.S. Lighting Market Characterization 2010*. 2013.

CADMUS

LED Downlight Assumptions

Cadmus found the work paper's 60W average wattage is appropriate given the federal standards that took effect in July 2012. We calculated 72W as the average wattage of incandescent reflector lamps in downlights in commercial and industrial buildings according to the 2010 U.S. Lighting Market Characterization Report.[32] However, the DOE standards increased average efficacy of reflector lamps manufactured for sale and reduced the average wattage of available reflector lamps by as much as 10W.[33]

Cadmus calculated 15W as the average wattage of directional lamps rated for enclosed fixtures in the ENERGY STAR data base available during the evaluation period.[34] Given the relatively small change between this and the wattage calculated in the work paper (12W), we decided to not adjust the baseline or efficient wattages for this measure.

There were 143 applications in the DEC tracking database for this measure, and only 127 had self-reported hours of use recorded. Therefore, we used the average annual hours of use between commercial and industrial uses in the Focus on Energy manual, which is 4,238.

Work Paper Adjustment Results

Table 38 and Table 39 show the adjusted savings figures and how they compare to the work paper values. The main factors causing the higher kWh savings are the adjusted annual hours of operation. The main factor causing the higher CP demand savings is the addition of HVAC interactive effects. Due to a reduction in the adjusted CF, CP demand increased only slightly.

Table 38. Adjusted LED lamps Measure Savings

Savings Parameter	Work Paper		Adjusted		Adjustment Factor (2013) [C/A]	Adjustment Factor (2014-2015) [D/B]
	2013 [A]	2014-2015 [B]	2013 [C]	2014-2015 [D]		
Energy (kWh/year)	177	114	191	148	108%	130%
NCP (kW)	0.0480	0.0310	0.0480	0.0372	100%	120%
CP (kW)	0.0432	0.0279	0.0370	0.0286	86%	103%

32 US Department of Energy. *U.S. Lighting Market Characterization 2010*. 2013.

33 In a Cadmus internal assessment, the average of available incandescent reflector lamps wattage reduced by 9W within a year after EISA regulations took effect in California.

34 Directional lamps available after 2012 but before July 2015, filtered to 600 to 1,500 lumens in brightness, rated for enclosed fixtures. The full database is available for download at: https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Light-Bulbs

Table 39. Adjusted LED Downlights Measure Savings

Savings Parameter	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Energy (kWh/year)	195	246	126%
NCP (kW)	0.0530	0.0636	120%
CP (kW)	0.0477	0.0490	103%

A summary of the savings associated with all LED lamps and downlights applications in the evaluation period, including the claimed savings, the adjusted savings, and the realizations rates, are shown in Table 40 and Table 41.

Table 40. Total Claimed and Adjusted Energy Savings for LED Lamps (2013 – 2015)

Savings	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Energy (kWh/year)	16,471,533	20,399,702	124%
NCP (kW)	4,476	5,121	114%
CP (kW)	4,028	3,943	98%

Table 41. Total Claimed and Adjusted Energy Savings for LED Downlights

Savings	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Energy (kWh/year)	2,025,100	2,558,387	126%
NCP (kW)	550	660	120%
CP (kW)	495	508	103%

Conclusions and Recommendations

None.

VFDs on Process Pumps

DEC applied a deemed savings per hp for each VFD installed on an industrial process pump that received incentives to calculate the energy and demand savings for eight applications. Table 42 shows the savings values in the work paper as well as the savings shown in the tracking database during the evaluation period. The values in the tracking database are different from those in the work paper because they were updated in 2013 based on an update memo prepared by TecMarket Works in 2012.[35]

Table 42. DEC Deemed Savings for VFDs on Process Pumps

Savings	Savings per hp	
	Work paper	Tracking Database
Average NCP Demand (kW)	0.2480	0.2600
Summer CP Demand (kW)	0.2480	0.2600
Energy (kWh)	912	957

Work Paper Methodology

The work paper calculated the savings figures by comparing the modeled energy consumption of a pumped system utilizing throttling control against one utilizing VFD control with a flow profile that averages 70% flow. Using throttling as the base case control scheme is appropriate because it is a more common control method in industrial applications. Additionally, the measure savings are more conservatively estimated using a throttling control as the base case control scheme than a bypass loop.

The work paper utilizes a curve fit for a 20 hp pump.

The work paper uses 3,680 hours based on the Focus on Energy deemed savings manual.[36] Cadmus could not verify this value based on the same reference (3,730 is the commercial building hours of use according to the manual).

The work paper assumes a CF of 0.78 that was taken from a NYSERDA program. However the TecMarket update memo and the tracked savings database, assumes a CF of 1.0.

The paper did not provide a source for the assumed motor efficiency (92%). However, the assumed efficiency is reasonable when compared to the average minimum efficiency from the EISA efficiency standards for motor sizes 5 to 50 hp. The work paper assumed a full load motor load factor of 85% for industrial processes.

---

35 TecMarket Works. *Carolinas - Non-Residential Smart $aver - VFD Update Memo.* Technical Memorandum. February 2, 2012.

36 Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

CADMUS

Work Paper Methodology Adjustments Necessary

While the work paper allows DEC to assign a single energy or demand saving figure per VFD on industrial pump, Cadmus found large uncertainty in the inputs and assumptions used to calculate this saving figure. There is significant variability in sizing, configuration, and operation of pumps (including the operational hours, the pressure difference through the pump, the pump flow profile, and even the fluid being pumped). We recommend including this measure in the Custom Program in the future. However, for the applications submitted during the evaluation period, Cadmus made the following adjustments:

- Used three typical flow profiles as opposed to a single flow profile more accurately represents all possible VFD retrofit scenarios. We used the average savings resulting from 60%, 70%, and 80% flows, as opposed to a single 70%.
- Assumed a full load motor load factor of 75%, based on the review team's experience. This is a more conservative estimate than the work paper.
- Used a generic performance curve for both base and measure cases instead of a single pump curve for a 20 hp pump. [37] The generic curve is an approximation based on a variety of pump configurations, whereas the work paper model assumes a single, specific, pump configuration.
- Assumed annual hours of 3,733 based on a national market assessment study of industrial electric motors.[38] This number is slightly higher than the hours used in the work paper. This estimate is specific to process pumping systems. This is the weighted average, based on the distribution of pump motor sizes, of the national average hours of operation for pump applications for motor sizes 1 to 50 hp. The self-reported operating hours in the tracking database ranged from 21% less to 131% greater than the assumed hours of operation in the DEC work paper. The updated hours are within less than 1% of the average of the self-reported hours.
- Assumes that the summer coincident and non-coincident kW savings are the same as process pumps are typically not affected seasonally or by weather. This assumption follows the methodology of the FES work paper.

Work Paper Adjustment Results

Table 43 shows the adjusted savings figures and how they compare to the program tracking values. The main factors affecting the higher kWh savings is an increase in the assumed hours of operation. The main factors affecting the lower kW savings is a lower assumed full load motor load factor of the pumps.

---

[37] Bonneville Power Administration. ASD Calculator for Fan & Pump Applications – Summary of information provided in Flow Control. Westinghouse publication, Bulletin B-851, F/86/Rev–CMS 8121.

[38] United States Industrial Electric Motor Systems Market Opportunities Assessment. December 2002. p. B-2 <http://www1.eere.energy.gov/industry/bestpractices/pdfs/mtrmkt.pdf

Table 43. Adjusted VFDs on Process Pumps Measure Savings

Savings Parameter	Work Paper	Adjusted Savings	Adjustment Factor
Average NCP Demand (kW)	0.2480	0.2090	84%
Summer CP Demand (kW)	0.2480	0.2090	84%
Energy (kWh)	912.00	1,012.00	111%

A summary of each application for this measure in the evaluation period, including the originally claimed savings, the adjusted savings, and the realizations rates are shown in Table 44.

Conclusions and Recommendations

Conclusion 1. Due to the great variability in pump sizing and configuration, Cadmus did not find an effective or accurate method to determine the average savings resulting from retrofitting an existing pump with a VFD.

Recommendation 1. To accurately assess the savings potential of each VFDs on process pumps application, administer incentives for this measure though the Custom Program.

Table 44. Total Claimed and Adjusted VFDs on Process Pump Savings

Savings	Total Savings (kWh)	Total NCP Savings (kW)	Total CP Savings (kW)
Claimed [A]	674,734	183	183
Adjusted [B]	732,495	147	147
Realization Rate [B/A]	109%	80%	80%

CADMUS

VSDs on Air Compressors

DEC applied a deemed savings per hp for each compressor to calculate energy and demand savings for 27 applications. The savings are significantly affected by the base case control scheme; therefore, the work paper provides three sets of savings for variable displacement, load/unload, and modulation. Table 41 shows the deemed savings according to the work paper.

Table 45. DEC Deemed Savings for VSDs on Air Compressors

Base Case	Number of Applications	Savings	Savings per hp
Variable Displacement	1	Average NCP Demand (kW)	0.0450
		Summer CP Demand (kW)	0.0450
		Energy (kWh)	188
Load/Unload	4	Average NCP Demand (kW)	0.1210
		Summer CP Demand (kW)	0.1210
		Energy (kWh)	501
Modulation	22	Average NCP Demand (kW)	0.1510
		Summer CP Demand (kW)	0.1510
		Energy (kWh)	629

The values in the tracking database match the work paper values. However, there are three measure descriptions for the VSDs on air compressors measure group in the tracking database:

- VSDs on Air Compressors
- VSDs on Air Compressors replacing load/unload
- VSDs on Air Compressors replacing variable displacement

The load/unload and variable displacement base cases are distinguished in the database. However, there are no measure descriptions for the modulation base case. Cadmus could not verify the base cases associated with the applications recorded under the *VSDs on Air Compressors* measure description (and most of the applications are recorded under this measure code). Since the savings assigned by DEC to these applications match those in the work paper for the modulation base case, Cadmus assumed that the base case for the retrofit in these applications is modulation. In order to improve program tracking in the future, each application should be specifically assigned to one of the three base cases in the tracking database.

CADMUS

Work Paper Methodology

The work paper algorithms used to determine savings are based on the percentage of kW input versus the percentage of capacity for various air compressor control types published by the Compressed Air Challenge (note below).[39]

Modulating Control

$kW_{Mod} = \text{Max } kW_{Mod} * (\% \text{ Max Flow}_{Mod} * 0.3 + 0.7)$

Load/No Load Control

$kW_{L/NL} = \text{Max } kW_{L/NL} * (0.25 + 1.166 * \% \text{ Max Flow}_{L/NL} - 0.416 * \% \text{ Max Flow}_{L/NL}{}^2)$

Variable Displacement

$kW_{VD} = \text{Max } kW_{VD} * (0.77 * \% \text{ Max Flow}_{VD} + 0.23)$

Variable Speed Control

$kW_{VFD} = \text{Max } kW_{VFD} * \% \text{ Max Flow}_{VFD}$

Where:

Max kW = Compressor input power as design cfm
% Max Flow = Compressed air max design cfm

The work paper also includes these assumptions:

- The full load performance of each base case and the measure case was taken from Compressed Air and Gas Institute (CAGI) datasheets of Ingersoll Rand 100 hp, air-cooled, oil-injected units at 100 pounds per square inch utilizing the four different output control methods (modulating, load/no load, variable displacement, and variable speed control).
- The annual operating hours were assumed to be 4,160, based on 80 hours per week, 52 weeks a year. This value was rounded from the average operating hours for all manufacturing motors under 200 hp from the Department of Energy's (DOE's) market assessment of industrial electrical motors.[40]
- Average flows were assumed at 75% full load for energy and demand savings, this provides somewhat conservative savings, since the lower the load factor the greater the savings for VSD control. This is what was used in the "%Max Flow" variables in the above equations.

---

[39] U.S. Department of Energy, Energy Efficiency and Renewable Energy, Compressed Air Challenge, *Improving Compressed Air System Performance*, DOE/GO-102003-182. November 2003. Accessed online: https://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/compressed_air_sourcebook.pdf

[40] U.S. Department of Energy. United States Industrial Electric Motor Systems Market Opportunities Assessment. December 2002.

CADMUS

- The compressors were assumed to have a design factor of 33%. This means that the VFD compressors will typically only operate at ~75% [1/(1+33%)] of its output capacity during peak air demand periods.
- The work paper assumes that the compressors will be running at design air demand during peak electrical demand periods. Also, an Industrial compressed air systems operation is rarely dependent on seasons or weather. Thus, the measure NCP and summer CP demand savings are assumed to be the same (CF = 1.0).

Work Paper Methodology Adjustments Necessary

Cadmus found the work paper methodology and calculator to be appropriate. However, the following adjustments were necessary:

- The models of compressors used for the full load performance were updated from Ingersoll Rand (IR) to Gardener Denver as IR does not manufacture variable displacement units. Furthermore, the IR units used in the work paper analysis are particularly inefficient and no longer manufactured, thus the adjusted savings are more conservative.
- Instead of using the part-load curves from Compressed Air Challenge (CAC) for VFD case, Cadmus used the actual CAGI performance curve of the VFD because VFD technology has improved since the time that the CAC was published in 2003. The base case technologies have not changed significantly since its publishing, thus those curves are still valid.
- Cadmus updated the assumed design factor from 33% to 20% based on the engineering teams experience that manufactures rarely oversize their compressors more than 20%.

Cadmus updated hours of operation to be 4,066 per year based on the DOE's market assessment study. Whereas the work paper assumes the average hours for all industrial motors, we used the information provided in the market assessment study to determine the average operating hours of motors only associated with compressed air systems. We weighted the average by the number of applications in each motor size category as shown in Table 46.

Table 46. Weighted Average Annual Hours of Operation Calculated for Various Motor Sizes

Size Category	DOE Market Assessment Annual Hours	DEC Tracking Database Number of Applications (2013-2015)	Percentage of Total Application Population
6 - 20 hp	2,131	0	0%
21 - 50 hp	3,528	15	56%
51 - 100 hp	4,520	5	19%
101 - 200 hp	4,685	6	22%
201 - 500 hp	6,148	1	4%
501 - 1000 hp	6,156	0	0%
1000+ hp	7,485	0	0%
Weighted Average	**4,066**	**27**	**100%**

Though each of the 27 applications in the tracking database contained self-reported operating hours, Cadmus did not use these to determine the adjusted savings for this measure. The self-reported hours varied from 74% less than to 115% greater than the adjusted hours.

Work Paper Adjustment Results

Aside from the quantity of VSDs installed as part of each application, the savings depend on the hp rating of the pump. The hp ratings are identified as *custom quantities* in DEC's tracking database. *Custom quantities* are not always recorded or recorded accurately in the DEC database. For the VSDs measure, the hp ratings were entered into the *quantity*, the *custom quantity*, or the *hp* column. This made it difficult to determine the savings for each application. Cadmus found this to be a persistent issue in the entire tracking database where the total measure savings depended on not just the quantity of the measure but also additional parameters, such as hp rating of motors or pumps. Where necessary, Cadmus calculated the actual hp values based on the incentive amounts paid to each application.

The adjusted per hp savings for each of the different base cases are shown in Table 47. The adjusted savings for VSD air compressor projects for the program years 2013 through 2015 are shown in Table 48.

The largest factor effecting the savings in the evaluated figure was better performance of the updated base case compressors and the reduction in the hours of use.

Table 47. Adjusted VSDs on Air Compressors Measure Savings

Base Case	Savings Parameter	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Variable Displacement	NCP kW	0.0450	0.0081	18%
	Summer CP kW	0.0450	0.0081	18%
	Annual kWh	188	112	60%
Load/Unload	NCP kW	0.1210	0.0624	52%
	Summer CP kW	0.1210	0.0624	52%
	Annual kWh	501	388	77%
Modulation	NCP kW	0.1510	0.0973	64%
	Summer CP kW	0.1510	0.0973	64%
	Annual kWh	629	607	96%

Table 48. Total Claimed and Adjusted Savings for VSDs on Air Compressors

Savings	Total Savings (kWh)	Total NCP Savings (kW)	Total CP Savings (kW)
Claimed [A]	1,543,273	371	371
Adjusted [B]	1,435,649	230	230
Realization Rate [B/A]	93%	62%	62%

Conclusions and Recommendations

Conclusion 1. In the case of the VSDs on air compressors measure, the savings depended on the quantity and the hp rating of air compressor motors. However, the hp rating of the motor was not always recorded or recorded accurately in the tracking database. Cadmus found this to be an issue in its review of the entire tracking database for measures whose total savings depended on not just the quantity of the measure but also additional parameters, such as hp rating of the motors.[41]

Recommendation 1. Record the quantitative parameters for measure saving determination consistently to facilitate total measure savings and program saving calculations.

Conclusion 2. The tracking database includes three measure codes for VSDs on air compressors: one with a generic base case motor control scheme, one for load/unload controls, and one for variable displacement controls. The database does not include a measure code for the modulation base case control scheme identified in the work paper.

Recommendation 2. Discontinue the generic air compressor control scheme measure code and add a measure code for the modulation base case control scheme.

[41] Further discussion of this issue was provided in this report under Program Tracking Data Review and Measure Selection.

High-Efficiency Pumps

DEC applied a deemed savings per hp for each pump in the 10 applications for high-efficiency pumps. Table 49 shows the deemed savings per pumping hp for program years 2013 through 2014. The table shows deemed annual energy, NCP demand, and summer CP demand, savings included in the work paper.

Table 49. DEC Deemed Saving for High-Efficiency Pumps

Savings	Savings per hp
Average NCP Demand (kW)	0.0550
Summer CP Demand (kW)	0.0430
Energy (kWh)	201.00

Work Paper Methodology

According to the work paper, the deemed energy and demand savings per hp were calculated by averaging the energy and demand savings for 17 high-efficiency pump configurations. The configurations compared standard efficiency Bell Gossett pumps to comparable more efficient Bell Gossett pumps ranging from 2 to 20 hp. The 17 configurations had pressure heads that ranged from 20 to 100 feet and flows that ranged from 100 to 500 gallons per minute. The average loading of the pumps was assumed to be 65% based on findings in the *United States Industrial Electric Motor Systems Market Opportunities Assessment, December 2002 (MSMA).*[42] DEC used the following algorithm to calculate the energy and demand savings for each configuration.

$$\Delta kW_{NCP} = (Bhp_{Base} - Bhp_{Eff}) / \eta_{motor} \times 0.746 \text{ kW/hp}$$

$$\Delta kWh = \Delta kW_{NCP} \times H$$

$$\Delta kW_{CP} = \Delta kW_{NCP} \times CF$$

Where,

Bhp = Break hp

η_{motor} = motor efficiency, assumed, 90%

H = annual operating hours, assumed, 3,680[43] hours per year

42 U.S. Department of Energy. United States Industrial Electric Motor Systems Market Opportunities Assessment. December 2002.

43 Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

CF = coincidence factor[44], 0.78

The work paper cites the Focus on Energy Deemed Savings Manual for annual hours of use.[45] The CF is stated to be the NYSERDA program value. The paper did not provide a source for motor efficiency.

Work Paper Methodology Adjustments Necessary

While the work paper allows DEC to assign a single energy or demand saving figure per pump hp, Cadmus found large uncertainty in the inputs and assumptions used to calculate this saving figure. There is significant variability in sizing, configuration, and operation of pumps (including the operational hours, the pressure difference through the pump, the pump flow profile, and even the fluid being pumped). One pump model may be efficient in one configuration while being very inefficient in another. Cadmus recommends this measure be included as a Custom Program measure in the future. However, for the applications submitted during the evaluation period, the following adjustments are necessary:

- The work paper methodology to normalize the savings based on a pump load factor of 65% is not correct. The source used to identify this 65% load factor was referring to the motor load factor, not the pump load factor. A pump's load factor is dependent on the specific pump output configuration and selection and Cadmus determined that the different configurations used in the 17 models were a good representation of typical pump systems. Thus, normalizing the savings to an average pump load factor is not necessary.
- The assumed motor efficiency of 90% was updated to 88.5% based on the EISA 2007 Mandatory Minimum Full-Load Efficiency Standards for motor sizes from 1-20 hp. [46]
- All of the applications included self-reported annual operating hours, which ranged from 2,130 to 8,736 hours. The hours used in the work paper are based on commercial equipment operation only. However, this measure is applicable for both commercial and industrial pumps. Thus, Cadmus determined that using the self-reported hours on each individual measure line item as appropriate for the adjustment calculations.

---

44 Coincident factor is the likelihood that a piece of equipment will be running at the designed load during peak grid demand hours.

45 Kema, Inc. *Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0.* Prepared for State of Wisconsin Public Service Commission of Wisconsin. March 22, 2010.

46 http://energy.gov/sites/prod/files/2014/04/f15/amo_motors_handbook_web.pdf (pg. 2-4)

Work Paper Adjustment Results

Table 50 shows the adjusted per hp savings rates and the realization rates for the previous rates. Table 51 shows the adjusted savings figures and how they compare to the program values used in the previous years for the three ECM motor measures.

Table 50 Adjusted High-Efficiency Pumps Measure Savings

Savings	Savings per hp		
	Work Paper [A]	Adjusted [B]	Adjustment Factor [B/A]
Average NCP Demand (kW)	0.0550	0.0674	123%
Summer CP Demand (kW)	0.0430	0.0526	122%
Energy (kWh)	201.00	248.19	123%

Conclusions and Recommendations

Conclusion 1. Due to the great variability in pump sizing and configuration, Cadmus did not find an effective or accurate method to determine if an applicant's pump selection is actually an efficient choice through a Prescriptive Program.

Recommendation 1. Administer incentives for high-efficiency pumps through the Custom Program instead of the Prescriptive Program in order to accurately assess the savings potential of each application.

Table 51. Total Claimed and Adjusted Savings for High-Efficiency Pumps

Savings	Total Savings (kWh)	Total NCP Savings (kW)	Total CP Savings (kW)
Claimed [A]	121,749	33	26
Adjusted [B]	157,638	41	32
Realization Rate [B/A]	129%	123%	123%

CADMUS

Appendix A. Charts with Measure-Level Inputs for Duke Energy Analytics

Table 52 and Table 53 include adjusted gross and net measure savings as recommended in this evaluation:

- The tables include no savings for measure descriptions with generic base cases (when savings should be distinguished by base case). Cadmus has added new measure descriptions with the associated savings distinguished by base case.
- The tables include no savings for measures where we recommend that the unit of measure be changed. Cadmus has recommended new measure descriptions with the associated savings.
- The tables include no savings for measures where we recommend that the measure be moved to the Custom Program.

Table 52. Gross Savings Chart with Measure-Level Inputs

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
ECM Case Motors	Discontinue	NC					Per motor	60.00%
ECM Case Motors	Discontinue	SC					Per motor	60.00%
ECM Walk-In Cooler and Freezer Motors - ECM replacing PSC (retrofit only)	Discontinue	NC					Per motor	60.00%
ECM Walk-In Cooler and Freezer Motors - ECM replacing SP (retrofit only)	Discontinue	NC					Per motor	60.00%
ECM Case Motors replacing PSC (per hp)	New	NC/SC	9090.45	1.0640	1.0640	1.0640	Per HP	60.00%

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
ECM Case Motors replacing SP (per hp)	New	NC/SC	11359.25	1.3295	1.3295	1.3295	Per HP	60.00%
ECM Walk-In Cooler and Freezer Motors - ECM replacing PSC (per hp)	New	NC/SC	9090.45	1.0640	1.0640	1.0640	Per HP	60.00%
ECM Walk-In Cooler and Freezer Motors - ECM replacing SP (per hp)	New	NC/SC	11359.25	1.3295	1.3295	1.3295	Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC Fans Only	Continue	NC	1910.61	0.2181	0.2914	0.2990	Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC Fans Only	Continue	SC	1910.61	0.2181	0.2914	0.2990	Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC Pumps Only	Discontinue	NC					Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC Pumps Only	Discontinue	SC					Per HP	60.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
Variable Frequency Drives (VFDs) - Applied to HVAC Cooling Water Pumps	New	NC/SC	1633.12	0.1860	0.1846	0.1957	Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC Hot Water Pumps	New	NC/SC	1547.74	0.1770	0.0935	0.2319	Per HP	60.00%
Variable Frequency Drives (VFDs) - Applied to HVAC WSHP Circulation Pumps	New	NC/SC	2561.95	0.2920	0.2280	0.2949	Per HP	60.00%
Variable Frequency Drives (VFDs) - For Process Fluid Pumping Only	Discontinue	NC					Per HP	60.00%
15 Horse Power High Efficiency Pumps	Discontinue	SC					Per HP	60.00%
20 Horse Power High Efficiency Pumps	Discontinue	SC					Per HP	60.00%
3 Horse Power High Efficiency Pumps	Discontinue	SC					Per HP	60.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
7.5 Horse Power High Efficiency Pumps	Discontinue	SC					Per HP	60.00%
High Efficiency Pumps 10 HP	Discontinue	NC					Per HP	60.00%
High Efficiency Pumps 15 HP	Discontinue	NC					Per HP	60.00%
High Efficiency Pumps 2 HP	Discontinue	NC					Per HP	60.00%
20 Horse Power High Efficiency Pumps	Discontinue	NC					Per HP	60.00%
3 Horse Power High Efficiency Pumps	Discontinue	NC					Per HP	60.00%
High Efficiency Pumps 5 HP	Discontinue	NC					Per HP	60.00%
7.5 Horse Power High Efficiency Pumps	Discontinue	NC					Per HP	60.00%
VSD Air Compressors	Discontinue	NC					Per HP	60.00%
VSD Air Compressors	Discontinue	SC					Per HP	60.00%
VSD Air COMP replacing modulation	New	NC/SC	607.10	0.0973	0.0973	0.0973	Per HP	60.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
VSD Air COMP replacing load no load COMP	Continue	NC	388.20	0.0624	0.0624	0.0624	Per HP	60.00%
VSD Air COMP replacing variable displacement COMP	Continue	SC	111.90	0.0081	0.0081	0.0081	Per HP	60.00%
High Bay 2L T-5 High Output	Continue	NC	414.38	0.0864	0.0821	9,999	Per Fixture	14.00%
High Bay 4L T-5 High Output	Continue	NC	1220.11	0.2544	0.2417	9,999	Per Fixture	14.00%
High Bay 6L T-5 High Output	Continue	NC	517.97	0.1080	0.1026	9,999	Per Fixture	14.00%
High Bay 8L T-5 High Output	Continue	NC	2094.90	0.4368	0.4150	9,999	Per Fixture	14.00%
High Bay T8 4ft Fluorescent 4 Lamp (F32 Watt T8)	Continue	NC	851.77	0.1776	0.1687	9,999	Per Fixture	14.00%
High Bay T8 4ft Fluorescent 6 Lamp (F32 Watt T8)	Continue	NC	1329.46	0.2772	0.2633	9,999	Per Fixture	14.00%
T8 HB 4ft 8L replacing a 400-999W HID(retrofit only)	Continue	NC	897.82	0.1872	0.1778	9,999	Per Fixture	14.00%
2 High Bay 6L T-5 High Output	Continue	SC	2014.33	0.4200	0.3990	9,999	Per Fixture	14.00%

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
replacing 1000W HID								
High Bay 4L T-5 High Output	Continue	SC	1220.11	0.2544	0.2417	9,999	Per Fixture	14.00%
High Bay 6L T-5 High Output	Continue	SC	517.97	0.1080	0.1026	9,999	Per Fixture	14.00%
High Bay T8 4ft Fluorescent 4 Lamp (F32 Watt T8)	Continue	SC	851.77	0.1776	0.1687	9,999	Per Fixture	14.00%
T8 HB 4ft 3L replacing 150-249W HID(retrofit only)	Continue	SC	471.93	0.0984	0.0935	9,999	Per Fixture	14.00%
High Bay T8 4ft Fluorescent 8 Lamp (F32 Watt T8)	Continue	SC	897.82	0.1872	0.1778	9,999	Per Fixture	14.00%
2 High Bay 6L T-5 High Output replacing 1000W HID	Continue	NC	2014.33	0.4200	0.3990	9,999	Per Fixture	14.00%
2 fixtures - T8 HB 4ft 8 Lamp (32W) (or single fixture 16 lamps) replacing 1,000 W HID (2 for 1 replacement retrofit only)	Continue	NC	2774.02	0.5784	0.5495	9,999	Per Fixture	14.00%
High Bay 3L T-5 High Output	Continue	NC	621.57	0.1296	0.1231	9,999	Per Fixture	14.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
High Bay T8 4ft Fluorescent 3 Lamp (F32 Watt T8)	Continue	NC	471.93	0.0984	0.0935	9,999	Per Fixture	14.00%
High Bay T8 4ft Fluorescent 6 Lamp (F32 Watt T8)	Continue	SC	1329.46	0.2772	0.2633	9,999	Per Fixture	14.00%
T8 HB 4ft 2L rplcng 150-249W HID (retrofit only)	Continue	NC	653.22	0.1362	0.1294	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 1 lamp, replacing standard T8	Continue	SC	42.91	0.0097	0.0073	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 2 lamp, replacing standard T8	Continue	SC	70.87	0.0160	0.0121	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 3 lamp, replacing standard T8	Continue	SC	91.93	0.0207	0.0157	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 4 lamp, replacing standard T8	Continue	SC	135.52	0.0305	0.0232	9,999	Per Fixture	14.00%
High Performance T8 4ft 2 lamp	Continue	SC	85.58	0.0193	0.0146	9,999	Per Fixture	14.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
fixture replacing T12 4ft 2 lamp								
High Performance T8 4ft 2 lamp, replacing T12 High Output 8ft 1 lamp	Continue	SC	180.48	0.0406	0.0309	9,999	Per Fixture	14.00%
High Performance T8 4ft 4 lamp, replacing T12 High Output 8ft 2 lamp	Continue	SC	330.72	0.0744	0.0566	9,999	Per Fixture	14.00%
High Performance T8 4ft 1 lamp, replacing standard T8	Continue	SC	28.46	0.0064	0.0049	9,999	Per Fixture	14.00%
High Performance T8 4ft 1 lamp, replacing T12-HPT8	Continue	SC	63.69	0.0143	0.0109	9,999	Per Fixture	14.00%
High Performance T8 4ft 2 lamp, replacing standard T8	Continue	SC	44.93	0.0101	0.0077	9,999	Per Fixture	14.00%
High Performance T8 4ft 3 lamp, replacing standard T8	Continue	SC	51.23	0.0115	0.0088	9,999	Per Fixture	14.00%
High Performance T8 4ft 3 lamp, replacing T12-HPT8	Continue	SC	143.38	0.0323	0.0245	9,999	Per Fixture	14.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
High Performance T8 4ft 4 lamp, replacing standard T8	Continue	SC	76.43	0.0172	0.0131	9,999	Per Fixture	14.00%
Low Watt T8 lamps 2-4ft, replacing standard 32 Watt T8	Continue	SC	21.68	0.0049	0.0037	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 1 lamp, replacing standard T8	Continue	NC	42.91	0.0097	0.0073	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 2 lamp, replacing standard T8	Continue	NC	70.87	0.0160	0.0121	9,999	Per Fixture	14.00%
High Performance Low Watt T8 4ft 3 lamp, replacing standard T8	Continue	NC	91.93	0.0207	0.0157	9,999	Per Fixture	14.00%
High Performance T8 4ft 2 lamp fixture replacing T12 4ft 2 lamp	Continue	NC	85.58	0.0193	0.0146	9,999	Per Fixture	14.00%
Relamp T8 4ft 32W fixtures with Reduced Wattage	Continue	NC	21.68	0.0049	0.0037	9,999	Per Fixture	14.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
T8 lamps 28 watts or less								
High Performance T8 4ft 4 lamp, replacing T12-HPT8	Continue	NC	163.16	0.0367	0.0279	9,999	Per Fixture	14.00%
High Performance T8 4ft 1 lamp, replacing standard T8	Continue	NC	28.46	0.0064	0.0049	9,999	Per Fixture	14.00%
High Performance T8 4ft 1 lamp fixture replacing T12 4ft 1 lamp	Continue	NC	63.69	0.0143	0.0109	9,999	Per Fixture	14.00%
High Performance T8 4ft 2 lamp, replacing standard T8	Continue	NC	44.93	0.0101	0.0077	9,999	Per Fixture	14.00%
High Performance T8 4ft 3 lamp, replacing standard T8	Continue	NC	51.23	0.0115	0.0088	9,999	Per Fixture	14.00%
High Performance T8 4ft 3 lamp, replacing T12-HPT8	Continue	NC	143.38	0.0323	0.0245	9,999	Per Fixture	14.00%
High Performance T8 4ft 4 lamp,	Continue	NC	76.43	0.0172	0.0131	9,999	Per Fixture	14.00%

CADMUS

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
replacing standard T8								
High Performance Low Watt T8 4ft 4 lamp, replacing standard T8	Continue	NC	135.52	0.0305	0.0232	9,999	Per Fixture	14.00%
High Performance T8 4ft 2 lamp, replacing T12 High Output 8ft 1 lamp	Continue	NC	180.48	0.0406	0.0309	9,999	Per Fixture	14.00%
High Performance T8 4ft 4 lamp, replacing T12 High Output 8ft 2 lamp	Continue	NC	330.72	0.0744	0.0566	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 1 lamp of 28W or less & ballast replacing standard T12 4ft 1 lamp	Continue	NC	78.14	0.0176	0.0134	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 1 lamp of 28W or less & ballast replacing standard T12 4ft 1 lamp	Continue	SC	78.14	0.0176	0.0134	9,999	Per Fixture	14.00%

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
Reduced Wattage T8 4ft 2 lamp of 28 W or less & ballast replacing standard T12 4 ft 2 lamp	Continue	NC	111.52	0.0251	0.0191	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 2 lamp of 28 W or less & ballast replacing standard T12 4 ft 2 lamp	Continue	SC	111.52	0.0251	0.0191	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 3 lamp of 28 W or less & ballast replacing standard T12 4 ft 3 lamp	Continue	NC	184.08	0.0414	0.0315	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 3 lamp of 28 W or less & ballast replacing standard T12 4 ft 3 lamp	Continue	SC	184.08	0.0414	0.0315	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 4 lamp of 28 W or less & ballast replacing standard T12 4 ft 4 lamp	Continue	NC	222.25	0.0500	0.0380	9,999	Per Fixture	14.00%
Reduced Wattage T8 4ft 4 lamp of 28 W or less & ballast	Continue	SC	222.25	0.0500	0.0380	9,999	Per Fixture	14.00%

Measure Name	Evaluation Recommendation	State	EM&V Gross Target Annual kWh Savings/Unit	EM&V Gross Target Annual Non-Coincident kW/Unit	EM&V Gross Target Annual Summer Coincident kW/Unit	EM&V Gross Target Annual Winter Coincident kW/Unit	Unit of Measure	Combined Free Rider % - Spillover%
replacing standard T12 4 ft 4 lamp								
Replace 60-100W incandescent with ENERGY STAR qualified LED downlight 18 Watts or less. (retrofit only)	Continue	NC	246.40	0.0636	0.0490	9,999	Per Fixture	14.00%
Replace 60-100W incandescent with ENERGY STAR qualified LED downlight 18 Watts or less. (retrofit only)	Continue	SC	246.40	0.0636	0.0490	9,999	Per Fixture	14.00%
Replace incandescent bulbs with Energy Star LED (retrofit only)	Continue	NC	148.19	0.0372	0.0286	9,999	Per Lamp	14.00%
Replace incandescent bulbs with Energy Star LED (retrofit only)	Continue	SC	148.19	0.0372	0.0286	9,999	Per Lamp	14.00%

CADMUS

Table 53. Net Savings Chart with Measure-Level Inputs and Recommendations

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
ECM Case Motors	Discontinue					3743	Cadmus recommends the savings be calculated by hp, not by motor, and distinguished between SP and PSC motors.
ECM Case Motors	Discontinue					3744	Cadmus recommends the savings be calculated by hp, not by motor, and distinguished between SP and PSC motors.
ECM Walk-In Cooler and Freezer Motors - ECM replacing PSC (retrofit only)	Discontinue					3748	Cadmus recommends the savings be calculated by hp, not by motor, and distinguished between SP and PSC motors.

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
ECM Walk-In Cooler and Freezer Motors - ECM replacing SP (retrofit only)	Discontinue					3753	Cadmus recommends the savings be calculated by hp, not by motor, and distinguished between SP and PSC motors.
ECM Case Motors replacing PSC (per hp)	New	3636.18	0.4256	0.4256	9,999		New code for case motors SP
ECM Case Motors replacing SP (per hp)	New	4543.70	0.5318	0.5318	9,999		New code for case motors PSC
ECM Walk-In Cooler and Freezer Motors - ECM replacing PSC (per hp)	New	3636.18	0.4256	0.4256	9,999		New code for walk-ins SP
ECM Walk-In Cooler and Freezer Motors - ECM replacing SP (per hp)	New	4543.70	0.5318	0.5318	9,999		New code for walk-ins PSC
Variable Frequency	Continue	764.25	0.0872	0.1165	0.1196	3637	

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
Drives (VFDs) - Applied to HVAC Fans Only							
Variable Frequency Drives (VFDs) - Applied to HVAC Fans Only	Continue	764.25	0.0872	0.1165	0.1196	3639	
Variable Frequency Drives (VFDs) - Applied to HVAC Pumps Only	Discontinue					3642	Cadmus recommends distinguishing savings by pump duty.
Variable Frequency Drives (VFDs) - Applied to HVAC Pumps Only	Discontinue					3644	Cadmus recommends distinguishing savings by pump duty.
Variable Frequency Drives (VFDs) - Applied to HVAC Cooling Water Pumps	New	653.25	0.0744	0.0739	0.0783		New code for savings by pump duty
Variable Frequency Drives (VFDs) - Applied to HVAC	New	619.09	0.0708	0.0374	0.0928		New code for savings by pump duty

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
Hot Water Pumps							
Variable Frequency Drives (VFDs) - Applied to HVAC WSHP Circulation Pumps	New	1024.78	0.1168	0.0912	0.1179		New code for savings by pump duty
Variable Frequency Drives (VFDs) - For Process Fluid Pumping Only	Discontinue					3647	Cadmus recommends moving to Custom program.
15 Horse Power High Efficiency Pumps	Discontinue					1324	Cadmus recommends moving to Custom program.
20 Horse Power High Efficiency Pumps	Discontinue					1328	Cadmus recommends moving to Custom program.
3 Horse Power High Efficiency Pumps	Discontinue					1330	Cadmus recommends moving to Custom program.

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
7.5 Horse Power High Efficiency Pumps	Discontinue					1333	Cadmus recommends moving to Custom program.
High Efficiency Pumps 10 HP	Discontinue					1422	Cadmus recommends moving to Custom program.
High Efficiency Pumps 15 HP	Discontinue					1427	Cadmus recommends moving to Custom program.
High Efficiency Pumps 2 HP	Discontinue					1438	Cadmus recommends moving to Custom program.
20 Horse Power High Efficiency Pumps	Discontinue					1440	Cadmus recommends moving to Custom program.
3 Horse Power High Efficiency Pumps	Discontinue					1446	Cadmus recommends moving to Custom program.

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
High Efficiency Pumps 5 HP	Discontinue					1452	Cadmus recommends moving to Custom program.
7.5 Horse Power High Efficiency Pumps	Discontinue					1455	Cadmus recommends moving to Custom program.
VSD Air Compressors	Discontinue					3853	Cadmus recommends distinguishing savings by base case control scheme.
VSD Air Compressors	Discontinue					3854	Cadmus recommends distinguishing savings by base case control scheme.
VSD Air COMP replacing modulation	New	242.84	0.0389	0.0389	9,999		New code for modulation base case control
VSD Air COMP replacing load no load COMP	Continue	155.28	0.0250	0.0250	9,999	6062	

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
VSD Air COMP replacing variable displacement COMP	Continue	44.76	0.0032	0.0032	9,999	6182	
High Bay 2L T-5 High Output	Continue	356.36	0.0743	0.0706	9,999	1181	
High Bay 4L T-5 High Output	Continue	1049.29	0.2188	0.2078	9,999	1182	
High Bay 6L T-5 High Output	Continue	445.46	0.0929	0.0882	9,999	1183	
High Bay 8L T-5 High Output	Continue	1801.62	0.3756	0.3569	9,999	1184	
High Bay T8 4ft Fluorescent 4 Lamp (F32 Watt T8)	Continue	732.53	0.1527	0.1451	9,999	1185	
High Bay T8 4ft Fluorescent 6 Lamp (F32 Watt T8)	Continue	1143.33	0.2384	0.2265	9,999	1186	
T8 HB 4ft 8L replacing a 400-999W HID(retrofit only)	Continue	772.12	0.1610	0.1529	9,999	1187	
2 High Bay 6L T-5 High Output	Continue	1732.33	0.3612	0.3431	9,999	1325	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
replacing 1000W HID							
High Bay 4L T-5 High Output	Continue	1049.29	0.2188	0.2078	9,999	1370	
High Bay 6L T-5 High Output	Continue	445.46	0.0929	0.0882	9,999	1371	
High Bay T8 4ft Fluorescent 4 Lamp (F32 Watt T8)	Continue	732.53	0.1527	0.1451	9,999	1373	
T8 HB 4ft 3L replacing 150-249W HID(retrofit only)	Continue	405.86	0.0846	0.0804	9,999	1376	
High Bay T8 4ft Fluorescent 8 Lamp (F32 Watt T8)	Continue	772.12	0.1610	0.1529	9,999	1377	
2 High Bay 6L T-5 High Output replacing 1000W HID	Continue	1732.33	0.3612	0.3431	9,999	1431	
2 fixtures - T8 HB 4ft 8 Lamp (32W) (or single fixture 16 lamps) replacing 1,000	Continue	2385.66	0.4974	0.4726	9,999	1434	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
W HID (2 for 1 replacement retrofit only)							
High Bay 3L T-5 High Output	Continue	534.55	0.1115	0.1059	9,999	1547	
High Bay T8 4ft Fluorescent 3 Lamp (F32 Watt T8)	Continue	405.86	0.0846	0.0804	9,999	1550	
High Bay T8 4ft Fluorescent 6 Lamp (F32 Watt T8)	Continue	1143.33	0.2384	0.2265	9,999	1806	
T8 HB 4ft 2L rplcng 150-249W HID (retrofit only)	Continue	561.77	0.1171	0.1113	9,999	6036	
High Performance Low Watt T8 4ft 1 lamp, replacing standard T8	Continue	36.90	0.0083	0.0063	9,999	1393	
High Performance Low Watt T8 4ft 2 lamp,	Continue	60.94	0.0137	0.0104	9,999	1394	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
replacing standard T8							
High Performance Low Watt T8 4ft 3 lamp, replacing standard T8	Continue	79.06	0.0178	0.0135	9,999	1395	
High Performance Low Watt T8 4ft 4 lamp, replacing standard T8	Continue	116.55	0.0262	0.0199	9,999	1396	
High Performance T8 4ft 2 lamp fixture replacing T12 4ft 2 lamp	Continue	73.60	0.0166	0.0126	9,999	1397	
High Performance T8 4ft 2 lamp, replacing T12 High Output 8ft 1 lamp	Continue	155.22	0.0349	0.0266	9,999	1398	
High Performance T8 4ft 4 lamp,	Continue	284.42	0.0640	0.0487	9,999	1400	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
replacing T12 High Output 8ft 2 lamp							
High Performance T8 4ft 1 lamp, replacing standard T8	Continue	24.47	0.0055	0.0042	9,999	1401	
High Performance T8 4ft 1 lamp, replacing T12-HPT8	Continue	54.77	0.0123	0.0094	9,999	1402	
High Performance T8 4ft 2 lamp, replacing standard T8	Continue	38.64	0.0087	0.0066	9,999	1403	
High Performance T8 4ft 3 lamp, replacing standard T8	Continue	44.06	0.0099	0.0075	9,999	1405	
High Performance T8 4ft 3 lamp, replacing T12-HPT8	Continue	123.30	0.0278	0.0211	9,999	1406	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
High Performance T8 4ft 4 lamp, replacing standard T8	Continue	65.73	0.0148	0.0112	9,999	1407	
Low Watt T8 lamps 2-4ft, replacing standard 32 Watt T8	Continue	18.65	0.0042	0.0032	9,999	1426	
High Performance Low Watt T8 4ft 1 lamp, replacing standard T8	Continue	36.90	0.0083	0.0063	9,999	1553	
High Performance Low Watt T8 4ft 2 lamp, replacing standard T8	Continue	60.94	0.0137	0.0104	9,999	1554	
High Performance Low Watt T8 4ft 3 lamp, replacing standard T8	Continue	79.06	0.0178	0.0135	9,999	1555	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
High Performance T8 4ft 2 lamp fixture replacing T12 4ft 2 lamp	Continue	73.60	0.0166	0.0126	9,999	1557	
Relamp T8 4ft 32W fixtures with Reduced Wattage T8 lamps 28 watts or less	Continue	18.65	0.0042	0.0032	9,999	1568	
High Performance T8 4ft 4 lamp, replacing T12-HPT8	Continue	140.32	0.0316	0.0240	9,999	1793	
High Performance T8 4ft 1 lamp, replacing standard T8	Continue	24.47	0.0055	0.0042	9,999	1794	
High Performance T8 4ft 1 lamp fixture replacing T12 4ft 1 lamp	Continue	54.77	0.0123	0.0094	9,999	1795	
High Performance T8	Continue	38.64	0.0087	0.0066	9,999	1796	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
4ft 2 lamp, replacing standard T8							
High Performance T8 4ft 3 lamp, replacing standard T8	Continue	44.06	0.0099	0.0075	9,999	1797	
High Performance T8 4ft 3 lamp, replacing T12-HPT8	Continue	123.30	0.0278	0.0211	9,999	1798	
High Performance T8 4ft 4 lamp, replacing standard T8	Continue	65.73	0.0148	0.0112	9,999	1799	
High Performance Low Watt T8 4ft 4 lamp, replacing standard T8	Continue	116.55	0.0262	0.0199	9,999	1807	
High Performance T8 4ft 2 lamp, replacing T12	Continue	155.22	0.0349	0.0266	9,999	1826	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
High Output 8ft 1 lamp							
High Performance T8 4ft 4 lamp, replacing T12 High Output 8ft 2 lamp	Continue	284.42	0.0640	0.0487	9,999	1827	
Reduced Wattage T8 4ft 1 lamp of 28W or less & ballast replacing standard T12 4ft 1 lamp	Continue	67.20	0.0151	0.0115	9,999	3823	
Reduced Wattage T8 4ft 1 lamp of 28W or less & ballast replacing standard T12 4ft 1 lamp	Continue	67.20	0.0151	0.0115	9,999	3824	
Reduced Wattage T8 4ft 2 lamp of 28 W or less & ballast replacing	Continue	95.91	0.0216	0.0164	9,999	3828	

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
standard T12 4 ft 2 lamp							
Reduced Wattage T8 4ft 2 lamp of 28 W or less & ballast replacing standard T12 4 ft 2 lamp	Continue	95.91	0.0216	0.0164	9,999	3829	
Reduced Wattage T8 4ft 3 lamp of 28 W or less & ballast replacing standard T12 4 ft 3 lamp	Continue	158.30	0.0356	0.0271	9,999	3833	
Reduced Wattage T8 4ft 3 lamp of 28 W or less & ballast replacing standard T12 4 ft 3 lamp	Continue	158.30	0.0356	0.0271	9,999	3834	
Reduced Wattage T8 4ft 4 lamp of 28 W or less & ballast	Continue	191.13	0.0430	0.0327	9,999	3838	

CADMUS

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
replacing standard T12 4 ft 4 lamp							
Reduced Wattage T8 4ft 4 lamp of 28 W or less & ballast replacing standard T12 4 ft 4 lamp	Continue	191.13	0.0430	0.0327	9,999	3839	
Replace 60-100W incandescent with ENERGY STAR qualified LED downlight 18 Watts or less. (retrofit only)	Continue	211.91	0.0547	0.0421	9,999	3813	
Replace 60-100W incandescent with ENERGY STAR qualified LED downlight 18 Watts or less. (retrofit only)	Continue	211.91	0.0547	0.0421	9,999	3814	
Replace incandescent	Continue	127.44	0.0320	0.0246	9,999	3818	

Measure Name	Evaluation Recommendation	EM&V Net Target Annual kWh Savings/Unit	EM&V Net Target Annual Non-Coincident kW/Unit	EM&V Net Target Annual Summer Coincident kW/Unit	EM&V Net Target Annual Winter Coincident kW/unit	SRC_PGM_MEAS_ID	Notes
bulbs with Energy Star LED (retrofit only)							
Replace incandescent bulbs with Energy Star LED (retrofit only)	Continue	127.44	0.0320	0.0246	9,999	3819	

CADMUS

Appendix B. Summary Form

DUKE ENERGY

Smart $aver Nonresidential Prescriptive Incentive Program

Duke Energy Carolinas
Completed EM&V Fact Sheet
2016 Evaluation – Cadmus

Program Description

The Duke Energy Smart $aver Nonresidential Prescriptive Incentive Program encourages energy efficiency by providing incentives for qualifying high-efficiency measures such as lighting, HVAC, and motors. Duke Energy business customers may install the energy-efficient measures and then apply for the incentive within 90 days of installing the equipment and provide proof of purchase.

Date	May 13, 2016
Region(s)	Carolinas
Evaluation Period	Applications Paid from January 2013 through July 2015
Gross Energy Savings (kWh)	Adjusted savings calculated for select measures
Net Coincident kW Impact (Summer)	Adjusted savings calculated for select measures
Measure life	Various
Net Energy Savings (kWh)	Adjusted savings calculated for select measures
Process Evaluation	Yes, reported separately.
Previous Evaluation(s)	Yes.

Evaluation Methodology

The evaluation team performed engineering desk reviews on the work papers describing deemed energy and demand saving calculation methodologies for the following measures: ECM motors, high efficiency pumps, high efficiency linear fluorescents, high-bay linear fluorescents, LEDs, VFDs on motors, and VSDs on air compressors.

The evaluation team adjusted the claimed per-unit energy and demand saving estimates, as necessary, and applied the updated values to all measure participants. The evaluation team calculated a lighting and non-lighting Net-to-Gross (NTG) ratio and calculated net energy and demand saving estimates for the measures reviewed.

Impact Evaluation Details:

- The majority of the claimed program savings are attributed to lighting and HVAC measures. The pumps measure category contributed the least to the overall claimed program savings.
- The desk review analysis for the ten measures sampled produced realization rates ranging from 69% to 139%.
- The evaluation team calculated 40% NTG ratio for lighting and 86% NTG ratio for non-lighting projects.

Impact Evaluation and Review of the 2014 PowerShare Program® Duke Energy Carolinas

January 8, 2016

Duke Energy
400 S. Tryon St
Charlotte, NC 28202

This page intentionally left blank.

Prepared by:

Duke Energy Carolinas and Cadmus

Contact: John Mills, Lead Analyst
Duke Energy
Demand Response Analytics

Table of Contents

Executive Summary

PowerShare® is a demand response program designed to reduce nonresidential customers' energy use (kW demand) during periods of high energy prices or when high energy usage would cause energy supplies across the transmission and distribution system be at, or near, critical levels. In both these situations, the PowerShare Program allows Duke Energy Carolinas (DEC or the Company) to purchase capacity from their commercial and industrial (C&I) customers who reduce their energy demand.

Duke Energy Carolinas notifies customers that a demand response event is needed via a multi-approach communications system. Customers then reduce their electric usage to a level consistent with their program participation agreements. The actual reduction period is a specific period of time set to match the period of time in which the critical supply condition is expected to occur, but not beyond the timing period specified in the participation agreements.

PowerShare is the brand name covering several of Duke Energy Carolina's C&I demand response program tariffs. Rider PS, PowerShare non-residential load curtailment is known as NC Rider PS in North Carolina and SC Rider PS in South Carolina. These programs were implemented on or after June 1, 2009. Customers and the Company will enter into a service agreement under the parameters established in the Rider PS.

Duke Energy Carolinas conducted the program year 2014 (PY2014) impact evaluation using a variety of commonly accepted, standard utility industry statistical practices and applications. These included calculating baseline pro-forma load calculations for each customer and monthly and hourly peak hour analysis. These approaches were then reviewed by an independent, third-party evaluator (Cadmus) and commensurate with standard evaluation, measurement, and verification (EM&V) industry practice. Based on a critical review of the processes used for PowerShare, the findings for PY2014 are credible.

Program Year 2014 Highlights

An overview of the PY2014 PowerShare parameters and results include:

- The impact evaluation covers January 1, 2014 through December 31, 2014.
- There were three PowerShare events; two emergency and one voluntary
- The summer peak program capability [1] for the PowerShare program was calculated to be 377 MWs
- The summer peak program capability for the PowerShare Generator program was calculated to be 26 MWs

[1] Summer Peak Program Capability is defined as the Program Year, average load shed capability for active program participants, at the generator, from June – September, for HE17.

Introduction

PowerShare® is a demand response program designed to reduce nonresidential customers' energy use (kW demand) during periods of high energy prices or when high energy usage would cause energy supplies across the transmission and distribution system be at, or near, critical levels. In both these situations, the PowerShare Program allows Duke Energy Carolinas (DEC or the Company) to purchase capacity from their commercial and industrial (C&I) customers who reduce their energy demand.

Duke Energy Carolinas notifies customers that a demand response event is needed via a multi-approach communications system. Customers then reduce their electric usage to a level consistent with their program participation agreements. The actual reduction period is a specific period of time set to match the period of time in which the critical supply condition is expected to occur, but not beyond the timing period specified in the participation agreements.

PowerShare is the brand name covering several of Duke Energy Carolina's C&I demand response program tariffs. Rider PS, PowerShare non-residential load curtailment is known as NC Rider PS in North Carolina and SC Rider PS in South Carolina. These programs were implemented on or after June 1, 2009. Customers and the Company will enter into a service agreement under the parameters established in the Rider PS.

Duke Energy Carolinas conducted the program year 2014 (PY2014) impact evaluation using a variety of commonly accepted, standard utility industry statistical practices and applications. These included calculating baseline pro-forma load calculations for each customer and monthly and hourly peak hour analysis. These approaches were then reviewed by an independent, third-party evaluator (Cadmus) and commensurate with standard evaluation, measurement, and verification (EM&V) industry practice. Based on a critical review of the processes used for PowerShare, the findings for PY2014 are credible.

Program Year 2014 Options

In PY2014, DEC offered four product options within PowerShare; PowerShare Mandatory, PowerShare Generator, PowerShare Voluntary, and PowerShare CallOption®. Only customers able to provide a minimum of 100 kW load reduction qualify for the PowerShare program options.

In North Carolina, other large C&I demand response programs exist through Riders IS and SG; these programs are not part of PowerShare and are not included in this report.

PowerShare Mandatory

- Under the PowerShare Mandatory program option, a participating customer agrees, upon notification by the Company, to reduce its demand to a pre-specified firm service level
- Each time the Company exercises its option under the PowerShare agreement, the Company will provide the customer a credit for the measured energy reduced
- PowerShare Mandatory is an 'emergency only' program. Emergency events are implemented due to reliability concerns as determined by the DEC System Operations Center (SOC).

- Program participants are required to reduce load during emergency events
- In addition to the event energy credit, customers on PowerShare Mandatory receive a monthly capacity credit
- PowerShare Mandatory is a year around program that permits 100 hours of event time as needed
- There are not a defined maximum number of events for this program

PowerShare Generator

- A PowerShare Generator program participant agrees, upon notification by the Company, to reduce its demand from the Company by starting an on-site generator to supply all or a portion of the customer's electric needs
- Each time the Company exercises its option under the agreement, the Company will provide the customer an event credit for the energy self-supplied
- PowerShare Generator is an emergency only program. Emergency events are implemented due to reliability concerns as determined by the DEC SOC
- In addition to the event energy credit, customers on Generator receive a monthly capacity credit
- PowerShare Generator is a year around program that permits 100 hours of event time as needed. There are not a defined maximum number of events for this program
- The PowerShare Generator program requires participants to start their generators for a 1-hour test period each month

PowerShare Voluntary

- Under the PowerShare Voluntary product, the Company may notify the program participant of a Voluntary event and provide a price quote to the customer for each event hour.
- The program participant will decide whether to reduce demand during the event period. If they decide to do so, the customer will notify the Company and provide a firm service level for the event hours.
- Each time the Company exercises the option, the Company will provide the participating customer who reduces load an energy credit.
- There is no monthly capacity credit for the Voluntary product since customer load reductions are voluntary.
- Customers may participate in PowerShare Mandatory and Voluntary concurrently

Program Year 2014 Participation

The PowerShare program has an annual enrollment for participation. This evaluation report covers the calendar year of 2014. The set of customers participating in PowerShare from January through May, 2014, could vary from the set of customers enrolled from June through December, 2014. Under normal circumstances, Duke Energy Carolinas is a summer peaking utility and therefore, the capacity and participation period are calculated in the summer months of June through September.

Table 1 below compares account participation levels for summer 2013 and summer 2014, as well as megawatts (MWs) enrolled in the program. The MW values are Duke Energy Carolinas's estimate of the load reduction capability averaged across the summer.

Table 1. Program Participation and Capability

PowerShare Mandatory	2013	2014
Account Participation*	110	185
MW Capability**	186	377
PowerShare Generator	**2013**	**2014**
Account Participation*	4	25
MW Capability**	7	26
PowerShare Voluntary	**2013**	**2014**
Due to the voluntary nature of this program option, customers are not counted as part of the Summer Capability and are not tracked on an annual basis. However, kW impacts from customers who choose to participate in events are reported in the Impacts section of this report.		

* Average participation customer count during the summer months of June – September.

** Values are reported at the point of generation during the summer months of June – September during HE17 using 1.08 conversion factor.

2014 PowerShare Program Events and Impacts

PowerShare Events

During the winter of 2013/2014, there were three PowerShare events. During the summer of 2014, there were no PowerShare events. PowerShare events taking place after December 31, 2014 will be reported in the PY2015 evaluation.

Table 2 outlines the MW savings for each event, per hour, by day. All impacts are reported at the point of generation.

Table 2. Event Impacts for January

Date	Hour Ending	State	Event Type	PowerShare Mandatory (MW)	PowerShare Generator (MW)	PowerShare Voluntary (MW)	Total Event Impact (MW)
1/7/14	7	NC/SC	Voluntary and Emergency	267	6	0	273
	8			271	13	0	284
	9			286	13	0	299
	10			296	14	0	310
	11			303	13	0	316
1/8/14	7	NC/SC	Voluntary and Emergency	345	13	0	358
	8			356	13	0	369
	9			364	13	0	377
	10			369	13	0	382
1/23/14	7	NC/SC	Voluntary	0	0	3	3
	8			0	0	3	3
	9			0	0	3	3
	10			0	0	4	4
	11			0	0	4	4

2014 PowerShare Program Evaluation Methodology

Duke Energy Carolinas calculates and reports a variety of internal and external values related to the PowerShare Program, which are used for a variety of purposes. Three categories represent a large portion of the analytics effort and are relevant to this evaluation. This section outlines these categories and calculation areas, listed below then described in more detail.

Pro-Forma Load Estimates

Pro-forma load (PFL) are estimates of participants' hourly electric power consumption for the next day. These projections are used in the measurement and verification (M&V) analysis to determine the potential load reduction for a next day event. The baseline is the customers' load absent the event.

Measurement and Verification Load Reduction Estimates

In the M&V verification load reduction approach, the actual load reduction provided by individual program participants on a specific event day is calculated using the pro-forma, or baseline, as a proxy.

Peak Available Load Reduction Estimates

Also known as load reduction capability (LRC), these estimates of participant load reduction are calculated under peak normal weather conditions, if applicable, over a specified period of time (such as a month or the entire summer).

As the three calculation methodologies imply, analysis of the PowerShare Program must meet a diverse set of goals. The specific methodology of how values are calculated for each approach are detailed below.

Pro-Forma Load Estimates

As the name implies, the process for PFL estimates is to create the day-ahead pro-forma (i.e., estimated assuming no control events) load shapes specific to each program participant in the PowerShare Mandatory option or CallOption.

Estimating the PFL involves using 12 weeks (84 days) of historical load and weather data (eliminating or accounting for North American Electric Reliability Corporation (NERC) holidays, event days, and any days identified as quiet periods from the analysis) to produce hourly predicted load shapes for the next 30 days based on the forecasted regional weather, if available. From that data, there are five ways to estimate the PFL, outlined below.

Hourly Regression Method

This method involves regression hourly energy on a set of Fourier, weather, and monthly dummy variables (if appropriate), and fitting an autoregressive process to the error terms. Then the same model is re-fit with weather variables excluded, and an F-test is performed to determine if weather is a significant explanatory factor. The appropriate model results are used for further calculations.

PJM Method

This method is based on the default method PJM uses to calculate a Customer Baseline CBLfor settlement, using an average load shape based on the highest four of five days selected by the method from a 45-day window. Only NERC holiday weekdays are excluded as event days.

The initial set of days is the most recent five days in the 45-day window. If the average usage over the exposure hours on any of those days was less than 25% of the overall average usage over the exposure hours for all five days, that day is dropped and a replacement selected. This loop is repeated until there are five viable days, and the four days with the highest usage are selected from this group for calculating an average load shape.

MISO Method

The MISO method is similar to the PJM method, except it uses 10 days, there are no exclusions for low usage, and all 10 days are used to calculate the load shape.

Last Two Days Method

For this method, the load shape is calculated based on the most recent two non-NERC holiday and non-event day weekdays.

Hybrid Method

This method involves first performing a regression of the daily energy usage for a customer. The explanatory variables are binary variables for day of the week, a daily weather variable, monthly dummy variables (if appropriate), and interactions between the weather variables and binary variables.

As with the hourly regression, the model is re-fit without the weather variables and an F-test performed to determine the appropriate model. The predicted daily energy is spread over the hours of the day using the load shape from the PJM method, after normalizing that load shape by the total energy under the shape.

Measurement and Verification Load Reduction Estimates

The M&V process for PowerShare Mandatory, CallOption, and PowerShare Voluntary requires collecting hourly load data from all enrolled customers for a particular month.Data is treated similarly among the processes, with a few exceptions such as the modeling of quiet periods. In all the processes, event days are excluded. However, quiet periods, such as days when participants reduced load due to a maintenance period, are included and accounted for in the M&V process model. If an event occurs when the customer is on a maintenance shutdown, the information used in the analysis requires special handling to focus only during their shutdown period.

In this rare event, the typical procedure is to combine the data with actual weather data for that month. Then, the process is to develop regression models (with and without weather terms) using the combined data, similar to the hourly regression model used in the day-ahead PFL calculations discussed above. Specifically, the regression equation relates the customers' hourly electricity load to:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- The temperature humidity index
- Binary variables for holidays and quiet periods, if appropriate
- Interactions between the Fourier transforms and other variables

An F-test is calculated for each customer to determine if weather is a significant explanatory variable (unless weather is explicitly excluded for customers known to not be weather sensitive). If weather is significant, the estimated parameters are used to create predicted loads using actual weather conditions on the event days. Thus, the baselines from the M&V process represent the actual load absent an event. These event-day baselines are then combined with actual load data from the event hours to calculate the load reduction.

All regression results are reviewed by DSM Analytics. If the results are clearly not representative of a specific participant load absent the event, an adjustment to the baseline may be applied. In addition, small variances around the baseline expected from typical model variance, above and below, are set to zero and therefore not considered load reduction.

M&V results are shown above in the Introduction section. Note that the PFL event load reduction estimates are used for settlement with customers due to their quicker availability, and because the baselines are available for customers to review for load reduction decisions. However, M&V load reduction leads to DEC's best estimate of the load reduction impacts, which are used for regulatory reporting purposes.

Customer Settlement

After each event, the level of load reduction must be calculated for each participant. If the participant is on a firm service level reduction agreement, a determination is made about whether they reduced load during the event period from a baseline. Another determination is made about whether the customer's actual load was at or below the firm service level during the event hours, regardless of the amount of load reduction.

Note that there is a completely different approach for this under the PowerShare Generator option than all the other options, since generators must be metered and impacts derived from the generator output is metered during events. Credits or penalties for event participants are calculated using PFL baselines, within the Energy Profiler Online system for PowerShare, and are recorded on the customers' utility bills.

Peak Available Load Reduction Estimates

Similar to the M&V regression process described above, LRC is calculated on a monthly basis for the PowerShare Mandatory option. For the PowerShare Generator option, capability is defined by the metered performance during test hours and events.

The LRC process requires collecting hourly load data from all enrolled customers for a particular month, eliminating event day and quiet period information (i.e.-known shutdown periods such as plant maintenance) from the analysis. The regression methodology is the same as for the M&V regression described above, with a few differences:

- While event day information is eliminated in both types of analysis, quiet periods, which are eliminated in the M&V process, are included and modeled in the LRC analysis.
- Once the regression equation is specified as described above in the M&V section, the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month, if weather is applicable. Thus, the baselines from the LRC process represent the peak normalized load the customer would have consumed throughout the month.
- The weekday, non-holiday baselines are then used with the customer's specified fixed reduction amount or firm load level to calculate the load reduction available each hour. By hour, these values are averaged across the month.

The monthly LRC by participant is typically not of interest for most reporting purposes, but the summer LRC is of primary interest since Duke Energy Carolinas is a summer peaking utility. Therefore, a weighted average of the summer monthly LRC values is calculated, by hour and by participant. Then, the hour ending Eastern Daylight Time (EDT) 17 is captured to determine the summer LRC of each participant. The sum across all participants provides the summer LRC for the program.

Specifically, the regression equation relates the customers' hourly electricity load to:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- The temperature humidity index
- Binary variables for holidays
- Interactions between the Fourier transforms and the other variables

An F-test is calculated for each customer to determine if weather is a significant explanatory variable (unless weather is explicitly excluded for customers known to not be weather sensitive). If weather is significant, the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month. Thus, the baselines from the P&L process represent the peak normalized load that would have consumed throughout the month for all customers, even those who were not actually participating in one or more of the summer months.

For this next step, the processes for LRC and P&L differ. In LRC, the monthly June value for a participant who joined the program in July would be 0.

Continuing, the weekday, non-holiday baselines are then used with the customer's specified fixed reduction amount or firm load level to calculate the load reduction available each hour, and these values are averaged across the month. Then a weighted average of the four monthly values is calculated, by hour and by participant.

Next, the hourly value for the hour ending EDT 17 is captured to determine the summer P&L of each participant. The LRC process terminates after summing across all participants. However, in the P&L process, monthly values are now calculated by summing the summer values described above for each month, only for participants in that particular month. These monthly values are then delivered to DSM Analytics for final calculations of the P&L results. Accounting adjustments are made as needed, including the application of a line loss factor.

Best-of-Breed

For each customer, the best calculation method is chosen to produce the final day-ahead baseline estimates. This is accomplished by comparing the predicted load from each method to the actual load for the five days outlined by the PJM method at an hourly, daily, and total level:

- For the hourly value, the absolute value of each hourly difference between the predicted and actual load is summed across all five days
- For the daily value, the difference for each hour is summed for each day, then the absolute value is summed across the five days
- For the total value, the difference in each hour for all five days is calculated, then summed to determine the absolute value

The best method is chosen based on each methods' relative performance of these differences. If a method is best for at least two values, then the PFL results from that method are used. Otherwise, the PFL results from the method that produces the lowest hourly variance is used.

Cadmus Review of Analytical Approach

Cadmus, as the third-party evaluator, reviewed the files for participation and impacts for the PowerShare program year 2014 provided by Duke Energy Carolinas. A conservative approach was taken by the Duke Energy Carolinas measurement and verification team to ensure accurate calculation of load reduction. The data reported here are align with the information provided in the spreadsheets received. The methods reviewed are comparable with Cadmus' experience in other jurisdictions and confirmed as reliable estimates.

Impact Evaluation and Review of the 2015 PowerShare Program Duke Energy Carolinas

Final, April 6, 2016

Duke Energy
400 S. Tryon St
Charlotte, NC 28202

This page intentionally left blank.

CADMUS

Prepared by:

Cadmus

Yinsight, Inc.

Contact: John Mills, Lead Analyst

Duke Energy

Demand Response Analytics

CADMUS

Table of Contents

Executive Summary

PowerShare® is a demand response program designed to reduce nonresidential customers' energy use (kW demand) during periods of high energy prices or when high energy usage would cause energy supplies across the transmission and distribution system be at or near critical levels. In both of these situations, the PowerShare program allows Duke Energy Carolinas (DEC) to provide incentives for commercial and industrial (C&I) customers that can provide capacity by reducing their energy demand when called upon.

DEC notifies customers that a demand response event is needed via a multi-approach communications system. Customers then reduce their electricity usage to a level consistent with their program participation agreements. The reduction period matches the timeframe in which the critical supply condition is expected to occur, but does not extend beyond the timeframe specified in the participation agreements.

PowerShare is the brand name for DEC's two C&I demand response program tariffs. Rider PS, PowerShare's nonresidential load curtailment, is known as NC Rider PS in North Carolina and SC Rider PS in South Carolina. These programs were implemented on or after June 1, 2009. Customers enter into a service agreement with DEC under the parameters established in the Rider PS.

DEC conducted the program year 2015 (PY2015) impact evaluation using commonly accepted, standard utility industry statistical practices and applications such as calculating baseline *pro forma* load calculations for each customer and performing monthly and hourly peak hour analysis. These approaches were then reviewed by an independent, third-party evaluator (Cadmus) commensurate with standard evaluation, measurement, and verification (EM&V) industry practice. Based on a critical review of the processes used for PowerShare, the findings for PY2015 are credible.

Program Year 2015 Highlights

An overview of the PY2015 PowerShare parameters and results includes the following:

- The evaluation program year covers January 1, 2015 through December 31, 2015.
- During this time period, there were four PowerShare Mandatory events and one PowerShare Generator event, all occurring in January and February 2015. There were no PowerShare Voluntary events for which customers offered load reductions.
- The rounded summer peak program capability[1] for the PowerShare Mandatory program was calculated to be 373 MWs. The summer peak program capability for the PowerShare Generator program was calculated to be 49 MWs.

---

[1] Summer peak program capability is defined as the program year's average load shed capability for active program participants (at the generator) from June to September, for HE17.

- PowerShare has undergone significant modifications in recent years in response to changes in regulations and the marketplace, and the program will continue to evolve as market conditions and policies change. Throughout this time of change, PowerShare has placed the customer's interests at the forefront, and has modified program operations to decrease the impact of programmatic adjustments.
- PowerShare has launched extensive efforts in the last two years to enroll medium-sized businesses in PowerShare.
- Most surveyed PowerShare participants reported that the amount of capacity that they are providing through PowerShare is "about right," suggesting that DEC is successful in maximizing PowerShare reserves through customers that can provide this capacity.
- Participants gave high satisfaction ratings to all aspects of the PowerShare program.
- Participant satisfaction with PowerShare has consistently increased over the years, which is a testament to the efforts of DEC's program manager and PowerShare staff members.

Introduction

PowerShare® is a demand response program designed to reduce nonresidential customers' energy use (kW demand) during periods of high energy prices or when high energy usage would cause energy supplies across the transmission and distribution system to be at or near critical levels. In both of these situations, the PowerShare program allows Duke Energy Carolinas (DEC) to provide incentives for commercial and industrial (C&I) customers that can provide capacity by reducing their energy demand when called upon.

DEC notifies customers that a demand response event is needed via a multi-approach communications system. Customers then reduce their electricity usage to a level consistent with their program participation agreements. The reduction period matches the timeframe in which the critical supply condition is expected to occur, but does not extend beyond the timeframe specified in the participation agreements.

PowerShare is the brand name for DEC's two C&I demand response program tariffs, Rider PS (PowerShare) and Rider PSC (PowerShare Call Option). These programs were implemented on or after June 1, 2009. Customers enter into a service agreement under the parameters established in the Rider PS.

DEC conducted the PY2015 impact evaluation using commonly accepted, standard utility industry statistical practices and applications such as calculating baseline *pro forma* load calculations for each customer and performing monthly and hourly peak hour analysis. These approaches were then reviewed by an independent, third-party evaluator (Cadmus), commensurate with standard evaluation, measurement, and verification (EM&V) industry practices. The critical review of the processes used for PowerShare determined that the findings for PY2015 are credible.

Program Year 2015 Options

In PY2015, DEC offered four product options within PowerShare: PowerShare Mandatory, PowerShare Generator, PowerShare Voluntary, and PowerShare CallOption®. Only customers that can reduce their loads by at least 100 kW qualify for the PowerShare program options.[2]

PowerShare Mandatory

The following are the main characteristics of this program option:

- A participating customer agrees, upon notification by DEC, to reduce its demand to a pre-specified, firm service level.

[2] In North Carolina, other large C&I demand response programs exist through Riders IS and SG; these programs are not part of PowerShare and are not included in this report.

- Each time DEC exercises its option under the PowerShare agreement, it provides the participant with a credit for the energy reduced.
- PowerShare Mandatory is an emergency-only program. Emergency events are implemented when the DEC System Operations Center (SOC) determines that there are reliability concerns.
- Program participants are required to reduce their loads during emergency events.
- In addition to the event energy credit, customers in the PowerShare Mandatory program receive a monthly capacity credit.
- PowerShare Mandatory is a year-round program that permits 100 hours of event time as needed.
- There is not a defined maximum number of events for this program.

PowerShare Generator

The following are the main characteristics of this program option:

- Upon notification by DEC, a program participant agrees to reduce its demand by starting an on-site generator to supply all or a portion of its electricity needs.
- Each time DEC exercises its option under the agreement, it will provide the participant with an event credit for the self-supplied energy.
- PowerShare Generator is an emergency-only program. Emergency events are implemented when the DEC SOC determines that there are reliability concerns.
- In addition to the event energy credit, participants receive a monthly capacity credit.
- PowerShare Generator is a year-round program that permits 100 hours of event time as needed. There is not a defined maximum number of events for this program.
- The PowerShare Generator program requires participants to start their generators for a one-hour test period each month unless an emergency event occurs prior to the regularly scheduled test.

PowerShare Voluntary

The following are the main characteristics of this program option:

- DEC notifies the program participant of a voluntary event and provides a price quote to the customer for each event hour.
- If the program participant decides to reduce demand during the event period, the participant notifies DEC and provides a firm service-level for the event hours.
- Each time DEC exercises the option, it gives an energy credit to participants that reduce their loads.
- There is no monthly capacity credit for the voluntary program because customers' load reductions are voluntary.
- Customers can participate in PowerShare Mandatory and Voluntary concurrently.

PowerShare CallOption®

The following are the main characteristics of this program option:

- A customer served under a CallOption® product agrees, upon notification by the Company, to reduce its demand.
- Each time the Company exercises its option under the agreement, the Company will provide the customer a credit for the energy reduced.
- There are two types of events.
    - Economic events are primarily implemented to capture savings for customers and not necessarily for reliability concerns. Participants are not required to curtail during economic events. However, if participants do not curtail, they must pay a marginal energy cost-based price for the energy not curtailed. This is called "buy through energy."
    - Emergency events are implemented due to reliability concerns. Participants are required to curtail during emergency events.
- If available, the customer may elect to buy through the reduction at a marginal energy cost-based price. The buy through option is not always available as specified in the PowerShare® Agreements. During system emergency events, customers are not provided the option to buy through.
- In addition to the energy credit, customers on the CallOption® will receive a capacity credit.

Program Year 2015 Participation

The PowerShare program has an initial three-year contract period that can start at any time during the calendar year and that renews annually thereafter. Under normal circumstances, DEC is a summer peaking utility, and therefore the capacity and participation period are calculated in the summer months of June through September.

Table 1 compares account participation levels for summer 2014 and summer 2015 and the number of megawatts (MWs) for customers enrolled in the program. The MW values are DEC's estimate of the load reduction capability averaged across the summer.

Table 1. Program Participation and Capability

PowerShare Mandatory	PY2015
Account Participation*	170
MW Capability**	373
PowerShare Generator	**2015**
Account Participation*	41
MW Capability**	49
PowerShare Voluntary	**2015**

* Average participation is the customer count during the summer months of June to September.

** Values are reported at the point of generation during the summer months of June to September during HE17, using 1.062187 conversion factor.

CADMUS

2015 PowerShare Program Impact Evaluation Methodology

DEC calculates and reports internal and external values for the PowerShare program, which are used for a variety of purposes. Three categories represent a large portion of the analytics effort and are relevant to this evaluation. This section outlines these categories and calculation areas, listed below and then described in more detail.

Pro Forma Load Estimates

Pro forma loads (PFL) are estimates of participants' hourly electric power consumption for the next day. These projections are used in the measurement and verification (M&V) analysis to determine the potential load reduction for a next-day event. The baseline is the customers' load absent the event.

Measurement and Verification Load Reduction Estimates

In the M&V verification load reduction approach, the actual load reductions of each program participant on an event day are calculated using the *pro forma*, or baseline, as a proxy.

Peak Available Load Reduction Estimates

Also known as load reduction capability (LRC), these estimates of participants' load reductions are calculated under peak normal weather conditions, if applicable, during a specified period of time (such as a month or the entire summer).

As the three calculation methodologies imply, an analysis of the PowerShare program must meet a diverse set of goals. The specific methodology of how values are calculated for each approach are detailed below.

Pro Forma Load Estimates

As the name implies, the process for PFL estimates is to create the day-ahead *pro forma* load shapes (i.e., estimated assuming no control events) for each participant in the PowerShare Mandatory, Voluntary or CallOption programs. Estimating the PFL involves using 12 weeks (84 days) of historical load and weather data, which means that the analysis must eliminate or account for North American Electric Reliability Corporation (NERC) holidays, event days, and any days identified as quiet periods to produce hourly predicted load shapes for the next 30 days based on the forecasted regional weather, if available. From that data, there are five ways to estimate the PFL, outlined below.

Hourly Regression Method

This method involves performing a regression analysis of hourly energy usage on a set of Fourier, weather, and monthly dummy variables (if appropriate), and fitting an autoregressive process to the error terms. Then, the same model is refit with weather variables excluded, and an F-test is performed to determine whether the weather is a significant explanatory factor. The appropriate model results are used for further calculations.

Last Two Days Method

For this method, the load shape is calculated based on the most recent two non-NERC holiday and non-event-day weekdays.

Hybrid Method

This method involves first performing a regression of the daily energy usage for a customer. The explanatory variables are binary variables for day of the week, a daily weather variable, monthly dummy variables (if appropriate), and interactions between the weather variables and binary variables. As with the hourly regression, the model is refit without the weather variables and an F-test is performed to determine the appropriate model. The predicted daily energy usage is distributed over the hours of the day using the load shape from the PJM method after the load shape has been normalized by the total energy under the shape.

Measurement and Verification Load Reduction Estimates

The M&V process for the PowerShare Mandatory, CallOption, and PowerShare Voluntary programs requires collecting hourly load data from all enrolled customers for a particular month. Data is treated similarly for the programs, with a few exceptions such as the modeling of quiet periods. In all the programs, event days are excluded. Quiet periods, such as days when participants reduced their loads for maintenance reasons, are included and accounted for in the M&V process model. If an event occurs when the customer is on a maintenance shutdown, the information used in the analysis requires special handling to focus on the shutdown period only. In this rare event, the typical procedure is to combine the data with weather data for that month. Then, the process is to develop regression models (with and without weather terms) using the combined data, similar to the hourly regression model used in the day-ahead PFL calculations. Specifically, the regression equation relates the customers' hourly electricity load to the following variables:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- The temperature humidity index
- Binary variables for holidays and quiet periods, if appropriate
- Interactions between the Fourier transforms and other variables

An F-test is calculated for each customer to determine whether the weather is a significant explanatory variable (unless weather is explicitly excluded for customers known to not be weather sensitive). If weather is significant, the estimated parameters are used to create predicted loads using weather conditions on the event days. Thus, the baselines from the M&V process represent the load absent an event. These event-day baselines are then combined with load data from the event hours to calculate the load reduction.

All regression results are reviewed by DSM Analytics. If the results are clearly not representative of a specific participant load absent the event, an adjustment to the baseline might be applied. In addition, small variances around the baseline expected from typical model variance, above and below, are set to zero, and therefore are not considered load reduction.

The PFL event load reduction estimates are used for settlement with customers because they are available more quickly and the customers can review the baselines to make load reduction decisions. M&V load reduction leads to DEC's best estimate of the load reduction impacts, which are used for regulatory reporting purposes.

Customer Settlement

After each event, the level of load reduction must be calculated for each participant. If the participant is on a firm service-level reduction agreement, a determination is made about whether the company reduced its load from a baseline during the event period. Another determination is made about whether the customer's load was at or below the firm service-level during the event hours, regardless of the amount of load reduction.

Credits or penalties for non-generator event participants are calculated using PFL baselines in the Energy Profiler Online system for PowerShare and recorded on the customers' utility bills.

There is a completely different approach for the PowerShare Generator option than all the other options because generators must be metered, and impacts derived from the generator output are metered during events.

Peak Available Load Reduction Estimates

Similar to the M&V regression process described above, LRC is calculated monthly for the PowerShare Mandatory option. For the PowerShare Generator option, capability is defined by the metered performance during test hours and events during the current month. The LRC process requires collecting hourly load data from all enrolled customers for a particular month and eliminating from the analysis event-day and quiet-period information (i.e., known shutdown periods such as plant maintenance).

The regression methodology is the same as for the M&V regression described above, with a few differences:

- Event-day information is eliminated in both types of analysis. Quiet periods are eliminated in the M&V process, but are included and modeled in the LRC analysis.
- After the regression equation is specified as described above in the M&V section, the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month, if weather is applicable. Thus, the baselines from the LRC process represent the peak normalized load the customer would have consumed throughout the month.
- The weekday, non-holiday baselines are then used with the customer's fixed reduction amount or firm load-level to calculate the load reduction available for each hour. By hour, these values are averaged across the month.

The monthly LRC by participant is typically not of interest for most reporting purposes, but the summer LRC is of primary interest because DEC is a summer peaking utility. Therefore, a weighted average of the summer monthly LRC values is calculated, by hour and by participant. Then, the hour ending Eastern Daylight Time (EDT) 17 is captured to determine the summer LRC of each participant. The sum across all participants provides the summer LRC for the program.

Specifically, the regression equation relates the customers' hourly electricity load to the following variables:

- A Fourier transform of hour of the day
- A Fourier transform of hour of the week
- A Fourier transform of hour of the month
- The temperature humidity index
- Binary variables for holidays
- Interactions between the Fourier transforms and the other variables

An F-test is calculated for each customer to determine whether the weather is a significant explanatory variable (unless weather is explicitly excluded for customers known to not be weather sensitive). If weather is significant, the estimated parameters are used to create predicted loads using peak normal weather conditions for all days of the month. Thus, the baselines from the P&L process represent the peak normalized load that all customers would have consumed throughout the month, even those who did not participate during one or more of the summer months.

For this next step, the processes for LRC and P&L differ. In LRC, the monthly June value for a participant that joined the program in July would be zero. The weekday, non-holiday baselines are then used with the customer's fixed reduction amount or firm load-level to calculate the load reduction available each hour, and these values are averaged across the month. Then, a weighted average of the four monthly values is calculated, by hour and by participant. Next, the hourly value for the hour ending EDT 17 is captured to determine the summer P&L of each participant. The LRC process terminates after summing across all participants. In the P&L process, monthly values are calculated by summing the summer values for each month for only the participants in that particular month. These monthly values are then delivered to DSM Analytics for final calculations of the P&L results. Accounting adjustments are made as needed, including the application of a line loss factor.

Best of Breed

For each customer, the best calculation method is chosen to produce the final day-ahead baseline estimates. This is accomplished by comparing the predicted load from each method to the actual load for the five days at an hourly, daily, and total level:

- For the hourly value, the absolute value of each hourly difference between the predicted and actual load is summed across all five days.
- For the daily value, the difference for each hour is summed for each day, and then the absolute value is summed across the five days.
- For the total value, the difference in each hour for all five days is calculated, and then summed to determine the absolute value.

The best method is chosen based on each method's relative performance on these differences. If a method is best for at least two values, then the PFL results from that method are used. Otherwise, the PFL results from the method that produces the lowest hourly variance is used.

2015 PowerShare Program Events and Impacts

PowerShare Events

During the winter of 2014–2015, there were four PowerShare events. There were no summer events in PY2015. PowerShare events that occurred after December 31, 2015 will be reported in the PY2016 evaluation.

Table 2 outlines the rounded MW savings for each event, per hour and by day. All impacts are reported at the point of generation.

Table 2. Event Impacts for January and February

Date	Hour Ending	State	Event Type	PowerShare Mandatory (MW)*	PowerShare Generator (MW)	PowerShare Voluntary (MW)	Total Event Impact (MW)
1/8/15	6	NC/SC	Emergency	305	0**	0	305
	7			313	0**	0	313
	8			321	0**	0	321
	9			326	0**	0	326
	10			326	0**	0	326
1/9/15	6	NC/SC	Emergency	301	0**	0	301
	7			304	0**	0	304
	8			305	0**	0	305
2/19/15	7	NC/SC	Emergency	329	0**	0	329
	8			335	0**	0	335
2/20/15	7	NC/SC	Emergency	301***	33	0	334
	8			307***	33	0	340

* Savings include a line loss factor of 1.062187.

** No PowerShare Generator curtailment was in effect during this hour.

*** An aggregate level adjustment was applied to offset artificially low impacts resulting from customer shutdowns for entire February curtailment period (Feb 19th 6 a.m. through Feb 20th 9 a.m.)

CADMUS

2015 PowerShare Program Process Evaluation

Process Evaluation Objectives

The process evaluation of the PY2015 PowerShare program has two main purposes. First, this process evaluation is intended to help identify areas where the program could be improved, drawing upon the insights of DEC staff members in multiple divisions and a sample of participating customers. Second, this evaluation will document program operations for future reference, including ways in which the program has addressed and overcome past program challenges.

Methodology

Overview of the Evaluation Approach

Cadmus and Yinsight, Inc. (the evaluation team) conducted the process evaluation for the PowerShare program. The results presented in this report draw upon management interviews and participant surveys.

Management Interviews

The evaluation team developed the interview protocol for PowerShare program managers that was implemented in January 2016. The full interview guide is in Appendix A: Management Interview Protocol. Evaluation team members conducted hour-long interviews with a Duke Energy program manager for PowerShare in the Southeast and an account executive serving DEC customers.

Participant Survey

The evaluation team developed a customer survey for PowerShare Program participants, and administered questionnaires via short telephone interviews with the person identified as the primary PowerShare contact at the company. The evaluation team conducted the surveys between December 16, 2015 and January 19, 2016 (see Appendix B: Participant Survey Protocol).

Data collection methods, sample sizes, and sampling methodology

The evaluation team attempted to contact 66 out of 86 companies that participated in PowerShare in PY2015. [3] The team completed 31 surveys by telephone between December 16, 2015 and January 19, 2016. These 31 companies comprise 19 manufacturers and seven water treatment plants; the remaining five customers were a correctional institution, a retailer, and three local government facilities. Of the 31, 10 reported that they managed more than one site. Only one company reported being new to PowerShare. The participants' years of experience with Duke Energy's curtailment programs spanned one to 30 years, with an average of just over seven years. Seven respondents reported that their

[3] There were 86 businesses with unique contact information (after removing records with duplicate or missing information). However, in some cases the provided company contact information was incomplete and not usable in the survey effort.

company participated in both the PowerShare Mandatory and Voluntary programs; 13 participated in Mandatory only, four in Voluntary only, two in Generator, and five did not know.

Survey Response Rates and Precision

Table 3 summarizes the response rates and achieved precision levels for the participant survey.

Table 3. Process Evaluation Data Collection and Analysis

Evaluation Component	Population	Attempted Contacts	Achieved Completes	Response Rate	Precision at 90% Confidence
Program Management Staff	N/A	2	2	2	N/A
Participant Surveys	211	66	31	47%	±13.6%

Conclusions and Recommendations

In the absence of an emergency event, and in light of participants' high satisfaction with the PowerShare program, the evaluation team sees no need to change program operations, and thus has no major process recommendations for the PowerShare program. The evaluation team has three minor recommendations.

Conclusion #1: Respondents exhibited some confusion about PY2015 PowerShare program features, and might not understand the requirements for the emergency-only offering. For example, when asked to share their biggest concern about PowerShare participation and asked how they thought Duke Energy might decrease that concern, two respondents suggested fewer or no event calls, one wanted DEC to "fix" grid reliability, and one wanted DEC to provide his company with generators (see "Event Experiences" section).

Recommendation #1: DEC program and account executives should consider developing additional ways to reinforce customers' knowledge of current and upcoming PowerShare program features. If DEC is not already doing so, staff members could develop additional marketing materials that can be distributed to customers, which clearly identify the program year, the current program options, and the programs' requirements. Alternatively, DEC could schedule "talking points" for account executives to remind participants of upcoming program changes and test events. The evaluation team understands that account executives engage in regular communication about program changes, but believes that participants will have greater satisfaction with PowerShare if they do not have to rely on their memories when further changes are made to PowerShare in the future.

Conclusion #2: DEC's PowerShare program manager and account executive have a thorough understanding of program challenges, and they have proactively initiated efforts to address upcoming challenges. Participants' overall satisfaction with the PowerShare program has consistently increased over the years.

Recommendation #2: The evaluation team suggests that DEC continue tracking participant satisfaction against the baseline data that have been gathered through PowerShare process evaluations since PY2011.

Conclusion #3: The evaluation team did not find any data that warrant substantive changes to the PowerShare program. The new outreach effort from the business energy advisors is promising, and the evaluation team recommends that DEC conduct an early process evaluation to capture their activities and successes and identify any need for improvement.

Recommendation #3: After the 2016 summer event season, if there are emergency event calls, DEC should consider conducting a process evaluation dedicated to medium-sized businesses enrolled in PowerShare. This evaluation will allow DEC to gauge these customers' satisfaction with the PowerShare program and their understanding of the program's requirements. This will help DEC identify any unmet needs and potentially find examples of successes to share with prospective PowerShare participants in the medium-sized business sector.

Process Evaluation

PowerShare Program Objectives

DEC's PowerShare program was implemented primarily as an emergency program in the Carolinas in PY2015. The PowerShare program manager reported that the program's objective is to provide a cost-effective and reliable resource for DEC's system operators during grid constraints, targeting customers that are capable of and willing to curtail their loads.

PowerShare Program Options

In PY2015, PowerShare was offered with four options: Mandatory Curtailment, Voluntary Curtailment, Generator Curtailment, and CallOption (see Table 4).

Table 4. PY2015 PowerShare Programs

	Mandatory Curtailment	Voluntary Curtailment	Generator Curtailment	CallOption	
				Emergency Events	Economic Events
Program Description	Customer **agrees to** curtail load to a contracted firm demand level during all curtailment periods.	Customer **can elect to** participate in a curtailment period. A firm demand level at which the customer can curtail and receive credits is negotiated.	Customer **agrees to** transfer load from the utility source to a generator during all curtailment periods and readiness tests.	Customer **agrees to** curtail load to a contracted firm demand level, or to the *proforma* less fixed demand reduction level, during all curtailment periods.	Customer **can elect to** curtail load to a contracted firm demand level, or to the *proforma* less fixed demand reduction level, during all curtailment periods.
Contract Term	3-year initial term with automatic 1-year renewals	1-year initial term with automatic 1-year renewals	3-year initial term with automatic 1-year renewals	N.C.: 3-year term beginning on Jan. 1 of each year. S.C.: 1-year term beginning on June 1 of each year.	
Curtailment Minimums	Curtail a minimum of 100 kW	Curtail a minimum of 100 kW	Transfer a minimum of 100 kW	Curtail a minimum of 100 kW	
Monthly Capacity/ Premium Credit Rate	$3.50/kW/month	$0	$3.50/kW/month during monthly tests or curtailment periods	PS – 0/5: $0.83/kW/month PS – 5/5: $1.25/kW/month PS – 10/5: $2.08/kW/month PS – 15/5: $2.50/kW/month PS – 200/5: $4.17/kW/month	

Note: Table adapted from Duke Energy's PowerShare Carolinas brochure, version 131197 1/14, available during 2015 on duke-energy.com.

DEC began offering PowerShare Mandatory and Generator to customers in 2009 as emergency demand response programs. PowerShare Mandatory participants could also participate in PowerShare Voluntary, an economic demand response program in which DEC offers a certain incentive for a particular level of load reduction. Very few companies participate in the voluntary program alone. The voluntary program does not entail a commitment to any particular amount of load reduction and has no penalties if customers choose not to participate.

The PowerShare CallOption programs also provide incentives to curtail during emergency events but differ from previous PowerShare programs in that they offer participants an opportunity to share in energy savings during economic events. When energy prices are high, curtailment allows DEC to save on generation costs and pass those savings on to CallOption participants. CallOption differs from PowerShare Voluntary in that participants must commit to responding to each economic event called by DEC or pay "buy-through" charges.

The program manager reported that CallOption was successful in Duke Energy's Midwest states, and Duke Energy hoped to replicate that success in the Carolinas. DEC began full marketing of the PowerShare CallOption in the Carolinas in PY2012. At that time, CallOption differed from the PowerShare Mandatory and Generator programs in three key aspects:

- CallOption participants received a smaller premium credit;
- CallOption offered more advance notice of events (6 hours for emergency events, and day ahead for economic events); and
- Participants only needed to have a minimum of 100 kW of curtailable load to participate, instead of the minimum of 200 kW required for the Mandatory and Generator programs, thereby widening the pool of potential participants for DEC's demand response programs.

As past evaluation reports described, customers were reluctant to switch from the higher incentive PowerShare Mandatory and Generator programs to CallOption. The program manager reported that only two customers have enrolled in CallOption in the history of the program, and they have since decided not to participate in DEC's demand response programs because Carolinas customer prefer to participate concurrently in Mandatory and Voluntary for a combination of emergency and economic event opportunities. The program manager reported that although the PowerShare CallOption is still available, DEC intends to end the program after two more years due to lack of customer interest.

The program manager reported that current PowerShare offerings can meet customers' needs. DEC made a change to PowerShare Mandatory and Generator two years ago, partly because an increasing number of large customers opted out of DEC's demand side management programs. DEC changed the minimum load requirements for Mandatory and Generator to 100 kW, a decrease from the previous requirement of 200 kW. The other PowerShare programs now include smaller customers that had only been eligible for CallOption.

PowerShare Mandatory

The program manager reported that the bulk of PowerShare participation is in the Mandatory curtailment program. At the end of PY2015, 167 participants in PowerShare Mandatory were providing 349 MW of capacity. Most PowerShare Mandatory participants are concurrently enrolled in PowerShare Voluntary: of the mandatory program participants, 111 are also enrolled in the voluntary program.

PowerShare Generator

This program has undergone changes in PY2015. The Environmental Protection Agency's (EPA) regulation on generator emissions, which went into effect in May 2014, affected PowerShare Generator participants with smaller, older generators. The EPA made an exemption to allow these generators to be used for up to 100 hours a year when conditions reach Energy Emergency Level 2 standards as defined by NERC. This exemption has allowed many PowerShare participants to continue offering capacity to DEC by switching from PowerShare Mandatory, for which companies used generators as part of their load curtailment strategy, to Generator. The program manager noted that traditionally, DEC dispatched their Generator program during EEA Level 1 to avoid reaching EEA Level 2, which is one step before service interruptions may occur.

To assist customers with the transition, the program manager reported that DEC restructured the PowerShare Generator program to meet EPA rules for emergency demand response use of generators. Thus, the Generator program was only called during one of the four emergency demand response events in PY2015. Participants with generators that meet the EPA's more stringent emissions standards can continue to participate in the Mandatory program. In addition to restructuring the Generator program, the program manager reported that DEC temporarily changed the dispatch criteria for the Mandatory program to give PowerShare Mandatory participants with older generators more time to make the transition, so they could continue participating and still comply with the new EPA regulation. After December 31, 2014, all PowerShare Mandatory participants with noncompliant generators had made that transition.

Using a survey, the evaluation team asked participants whether the recent EPA ruling would prevent them from participating in PowerShare. Of the 11 respondents who reported using a generator to reduce their loads, eight reported that they were either compliant or will become compliant and continue participating in PowerShare. Two respondents were not sure how their company responded.

PowerShare Voluntary

At the end of PY2015, there were two customers enrolled in only PowerShare Voluntary; the rest of the PowerShare Voluntary participants were also enrolled in PowerShare Mandatory. The program manager reported that the voluntary program is rarely called for two reasons. First, voluntary customers need to bid, but DEC can only make an offer the evening before an event. However, by that time, DEC's SOC needs to have already made decisions about which resources to bring in. Second, there may be low market interest as the program manager reported that DEC ran a test of the voluntary program in PY2014. At that time, there were 10 PowerShare Voluntary-only customers, and three responded to the offer. Although the program manager believed that the recent winter events could have decreased interest in the voluntary event, the low response and timing constraints led to DEC's decision to not use the voluntary program for economic purposes until the timing challenges have been addressed.

PowerShare CallOption®

DEC has found that commercial and industrial customers prefer to participate concurrently in PS-M and PS-V rather than CallOption for the opportunity of both emergency and economic dispatch scenarios. Therefore, the Company is currently evaluating the option of filing in both states to request a closure of the CallOption program.

Marketing

The program manager reported that in the past, PowerShare was marketed primarily by account executives to large customers with managed accounts. In the last two years, the program manager reported that DEC has engaged in an extensive effort to enroll medium-sized businesses, which are difficult to reach due to lack of data and contact information. To reach medium-sized customers, DEC has commenced a mass marketing campaign using bill inserts, letters, postcards, and emails. The program manager reported that DEC uses all channels because the company wanted to maximize awareness of the program. The program manager reported that emails have been the most important marketing tool, aside from direct customer interaction, and that email campaigns were conducted with the large managed accounts and medium-sized businesses. Account executives send emails to large customers asking those who are interested to contact them, and emails are also sent to medium-sized customers asking those who are interested to visit the PowerShare webpage or contact a business energy advisor if one is assigned.

The business energy advisors' role is to address the energy-saving needs of medium-sized business customers. The program manager reported that the business energy advisors originated in the energy efficiency products team, but are being trained on demand response programs so that they can help identify opportunities when PowerShare fits the operations of a medium-sized business. If a business energy advisor identifies an opportunity, the candidate is directed to the PowerShare program manager for further contact and review. The program manager will conduct more detailed estimates of potential savings and help estimate the appropriate load that can be curtailed.

Determining Operational Fit

The program manager reported that the most important criterion for PowerShare participation is the operational fit of a customer's business operations with events. An account executive reported that when talking with prospective participants, DEC provides an overview of the program along with a brochure on how the program works (see Attachment A). According to the account executive, for the companies, the decision to participate or not is a business decision: will this increase the bottom line? The account executive reported that for some customers, the PowerShare incentive can lower their annual energy bill by as much as 10%, offering significant savings. Customers must weigh that benefit against the costs of curtailing, which could prevent them from fulfilling production quotas.

The account executive reported that customers understand that demand reduction program participation makes a significant impact in helping DEC meet peak demand on cold mornings and hot afternoons, and she believed customers were glad to able to contribute to grid stability." The account executive and the customer discuss how well the customer's particular business operations would lend themselves to curtailment. The account executive reported that these conversations occur during multiple meetings because customers meet regularly with him to discuss issues including the cost of power and grid reliability. If customers are interested, the account executive will discuss scenarios that assume different averages for energy usage and peak energy usage and describe the potential savings in each scenario. For these scenarios, the account executive reviews the customer's past energy use, noting the times when the plant does a full shutdown (typically once or twice a year, on Independence Day and Christmas), and uses that to estimate the maximum possible PowerShare premium credit. If the customer cannot commit to a full shutdown during events, then the account executive will calculate the load they need in order to maintain certain levels of business operations. Next, the account executive will review the PowerShare terms and conditions with the customer and whether the company is paying into the rider that funds DEC's demand-side management programs. The account executive helps make sure the customer's meter will support PowerShare data and billing needs and gathers contact information for company employees responsible for receiving alerts and executing the shutdown during events. Throughout the year, the account executive will remind participants about PowerShare, including the spring test, and confirm the contact information of customers receiving event notifications.

Enrollment and Renewal

Enrollment in the Mandatory curtailment program requires several steps. The program manager reported that DEC first needs to check that the customer's meter can be used for PowerShare. Next, customers need to sign a contract, and then the program manager initiates an internal request to set up the customer's account for PowerShare participation. The account executive also plays a role and is responsible for entering the customer contact information into the customer database, where it is automatically uploaded into the event notification system.

For enrollment in PowerShare Generator, the process is slightly more complicated in that the generator needs to be submetered. To do this, DEC technical staff members need to assess the customer site to determine whether they have the appropriate equipment for submetering. The customer is responsible for installing the submeter. After the installation, DEC must conduct another visit to verify that the submeter was installed correctly. Only then can the program manager issue a contract and proceed with the internal requests.

Customers enroll in PowerShare with an initial three-year contract that automatically renews annually. The account executive reported that after the three-year contract ends, participants can terminate their contract within 60 days. The account executive reported that some customers were reconsidering their participation because it was difficult to curtail for two events in a row in the past two winters, but the lack of summer events had alleviated some of their concerns.

The lessons learned during the polar vortex conditions in the last two years led DEC to revise the PowerShare rider in PY2015, according to the program manager. The program manager reported that some customers incurred penalties because they needed to leave equipment running to prevent equipment from freezing. To avoid penalties, these customers would have had to raise their firm demand on their year-round contracts, which in turn would decrease the capacity they could offer DEC during summer events. DEC changed the rider so that a customer can have a contract with a different firm demand for the four-month summer season than for the rest of the year. As DEC expected, only companies that absolutely could not curtail loads to such levels would adjust their winter firm demand-levels, resulting in fewer than six participants changing their firm demand-levels for winter. The program manager considered this a success because the program change has had very little impact on resources available for winter, while offering flexibility to customers that need it and preserving DEC's summer capacity.

Also, DEC revised the rider so that a customer's ability to make changes to the contract aligned with the contract term. Previously, customers could lower increase their load reduction commitment at any time, but they had to wait 12 months before they could reduce their commitment without charge, even if the end of that 12-month waiting period was after the contract renewal date. With the change, customers can adjust contract commitments without charge when their contract period renews.

The program managers reported that they believe the PowerShare participants have contracts for appropriate load reductions. When asked about the loads in their contracts, 24 of 28 respondents in the participant survey believed that the targeted level of curtailment in their current contract was "about right" for their company. Of the rest, two said they could reduce more and two others said their target was "more than they wanted to provide."

Event Calls

There were four PowerShare Mandatory events in PY2015, called on January 8th and 9th and February 19th and 20th. There was only one PowerShare Generator event, on February 20th, at which time DEC also dispatched the PowerShare Voluntary program. At that time, there were only two Voluntary-only customers and neither responded. There were no PowerShare Voluntary-only events in PY2015.

DEC's SOC determines the need for events based upon estimates of operating reserves each day. These estimates are mainly derived from the temperature, day of the week, generational availability, wholesale purchases, and DSM capabilities. At EEA Level 1, all demand response programs except for PowerShare Generator are dispatched. At EEA Level 2, PowerShare Generator is dispatched as well. The system operators prioritize their calls according to DEC's different reserves. For example, the program manager reported that in the summer DEC will first dispatch Power Manager, the residential demand response program, because it can be called without any advance notice and has less impact on the customer. In contrast, non-residential programs like PowerShare are last to be called because of the greater impact that curtailment has on commercial and industrial customers.

Event Notifications

When the decision is made by the SOC to dispatch the PowerShare Mandatory program, the program manager will initiate the event by sending out the notifications through an automated notification system. Notifications can be sent via phone, text, email, fax and other methods to everyone on a contact list provided by the company. Notifications cease as soon as the customer responds. During the event season, the program manager and the account executive both report they are vigilant about the possibility of event calls, and they strive to provide customers with as much advance notification as possible. An account executive believed that the key to success in PowerShare is communications. He advocates the use of the notification system to issue event watches, and said that during events customers appreciate continuous updates on the event status and possible ending time, which he provides to them by phone.

Respondents in the participant survey were satisfied with the notification channels; none of the 31 respondents had suggestions for additional channels for event notification. Likewise, most respondents agreed that having day-ahead notice would be useful for their business operations. Most respondents did not have any other feedback for DEC on event communications. Two mentioned that DEC did a good job with notifications; another said that there was “a bit of over communication” and that “we don’t need to know all these hypotheticals.” A fourth respondent said there was a problem when DEC made a change to the way the company was notified, and they never received a notification. The customer reported that as a result, they did not receive their incentive (and did not mention receiving any penalty).

Settlement

The program manager and the account executive reported that for the most part customers were able to shed their loads. The account executive reported that in the last two years, the winter events during “polar vortex” conditions were challenging because some customers needed to keep their pipes from freezing, and therefore could not shed their loads.

The program manager reported that DEC does not yet provide live data on energy use, but said that DEC continues to investigate the feasibility of doing so. DEC is aware that there is a need for real-time or near real-time feedback for PowerShare Mandatory participants because they have contracts to curtail to certain levels. The program manager reported that currently, DEC calculates incentives according to how much load reduction PowerShare Generator participants provide because all generators used for PowerShare are submetered; data are available the next day. Load reduction for PowerShare Mandatory participants must be estimated based against their pro forma baseline.

Participant Experience

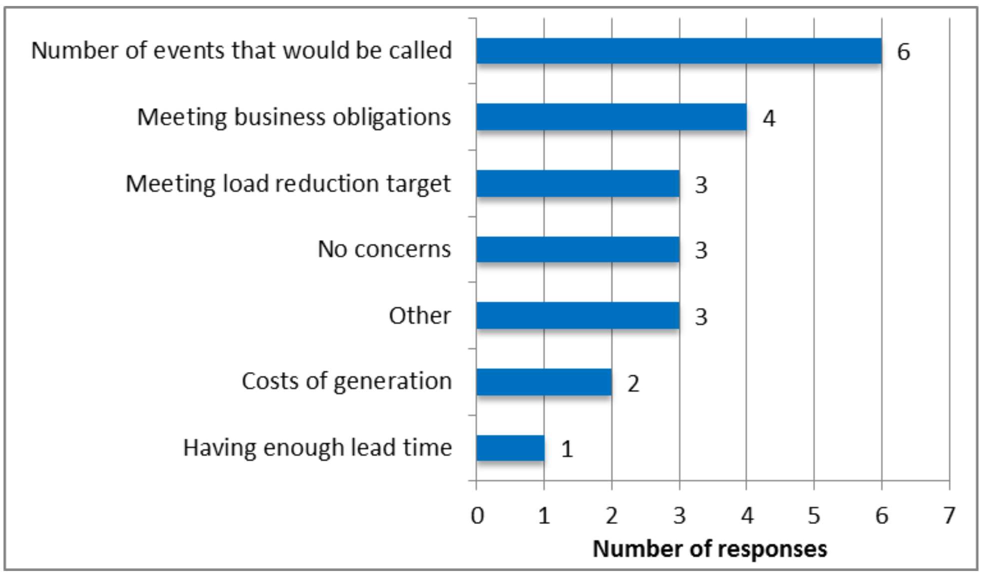
Respondents predominantly learned about PowerShare through a Duke Energy representative, as reported by 22 of 31 respondents. Five others did not know how they learned about the program, two others could not remember because their companies have been longtime participants, and one learned from a coworker. Respondents were also highly satisfied with the usefulness of the information that they received, with an average rating of 9.5 on a scale of 1 to 10, with 1 meaning "Almost nothing I needed" and 10 meaning "Everything I needed."

Decision-Making

Financial reasons were paramount in companies' decisions to participate in PowerShare: 28 of 31 respondents cited cost savings or the premium credit. Two respondents did not know why their companies decided to participate, and one company wanted to be in a partnership with Duke Energy. When asked about secondary reasons, three respondents mentioned their desire to "do the right thing" or to "be green," four others mentioned a financial reason, and the last two said they already had a generator.

One survey question addressed the companies' greatest concern about participating in PowerShare. The most frequent concern was the number of events that would be called, cited by six out of 20 respondents (Figure 1). The second most frequent concern was the disruption of business operations.

Figure 1: Concerns with PowerShare Participation (n=20)



Note: Multiple responses accepted.

Event Experiences

The evaluation team asked 12 respondents to recall how many emergency and economic events their businesses had been asked to respond to in 2015.[4] Only two gave the correct answer of four events. Eight believed there were fewer events (from zero to three events), and two believed there were more events (one of whom gave a "conservative" estimate that there were nine emergency events). Their answers were more reliable for economic events: seven reported "zero," three did not know, one

[4] These questions were added to the survey after some of the interviews were completed.

reported three events, and another reported 10 economic events. Because of the limited sample size, these results indicate possible confusion about the number of tests.

The evaluation team then asked respondents whether anything in the past event season served to decrease their concerns. Six respondents said their concerns have not changed, and four respondents said their concerns have decreased. Three said their concerns decreased because there were fewer events than expected, and the other said they became more experienced at responding to event calls. When asked what DEC could do to decrease these concerns, only five respondents offered recommendations, most of which indicated that those respondents did not understand the purpose of the PowerShare program: Two suggested fewer or no event calls, one wanted DEC to “fix” grid reliability, one wanted DEC to provide his company with generators, and the last one wanted day-ahead notification.

Of 28 respondents, 13 reported that they curtailed loads by shutting down business operations. Another 9 reported that they transferred loads to backup generators. Six others reported that they continue business operations but with a reduced load, for example, by shutting down some departments but not all of them. Only one respondent’s company was not successful in load reduction. When asked if there were any negative consequences of not reducing loads, the respondent reported that the company received a penalty.

Energy Profiler Online (EPO)

The evaluation team asked respondents about their awareness of EPO: 20 of 31 were aware of it and six were not; five respondents said the question was not applicable. When asked to rate how easy it was to use EPO, 21 respondents gave an average rating of 7.8, with responses ranging from 6 to 10. The evaluation team asked respondents who gave a rating lower than 8 how EPO could be changed to improve its ease of use. Of the four who responded, one wanted to be able to use EPO to verify load reduction with real-time feedback. Two said EPO could be more user-friendly, with one adding that he had to hook it up and dial in, which was a barrier. One respondent said that other applications seemed better.

Program Strengths

The program manager reported that he has been impressed by DEC customers’ ability to adapt to these changes. The program manager reported that DEC has made internal decisions about what information to communicate to participants under conditions of uncertainty to facilitate better communication about events. In PY2014, PowerShare program staff members collaborated with the account executives to conduct a review with each PowerShare participant regarding their past demand response participation, including a presentation reminding customers about the PowerShare program and why events are called. DEC has decided to continue this demand response review as an annual activity.

The evaluation team asked participants whether any aspect of PowerShare was working particularly well (multiple responses were accepted). Of 18 respondents, eight mentioned that they liked the premium credits offered by PowerShare. Seven others said that the communication and notifications about

PowerShare were working well: one respondent said, “[We like] the way they let us know. We get enough time to take care of what we need to take care of.” Three respondents appreciated the entire program, and three others credited their DEC representative, with one saying, “The Duke Energy account executives are super nice and help us out tremendously.” One respondent was pleased that there were too many events, and another liked being able to help benefit the community through load curtailment.

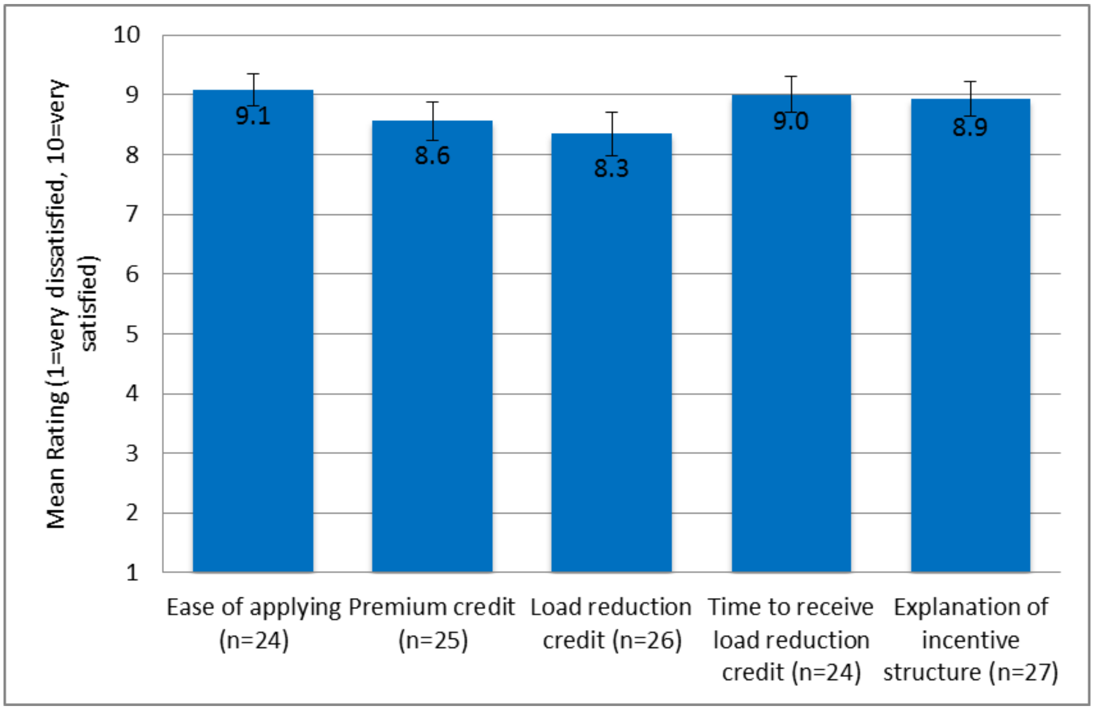
Participant Satisfaction Ratings

Enrollment and Incentives

Figure 2 shows that participants were highly satisfied with PowerShare program enrollment operations and incentives. Respondents were highly satisfied with the enrollment process, rating it an average 9.1 on a 10-point scale, where 1 indicates very dissatisfied and 10 indicates very satisfied. Three respondents gave a rating of 7 or lower, but when the interviewer followed up with a question about how satisfaction could be improved, only one had a recommendation, which was that DEC should improve its customer service.

Respondents were also highly satisfied with their monthly premium credit (8.6) and their load reduction credit (8.3). Three respondents who gave a rating of 7 or lower wanted a larger premium credit. Respondents were highly satisfied with the time it took to receive their load reduction credits, giving an average rating of 9.0; there were no suggestions for improvement. Respondents were highly satisfied with the explanation they received about the incentive structure, giving an average rating of 8.9. Only one respondent offered a suggestion for improvement, saying that he had not received any explanation of the incentive.

Figure 2. Mean Satisfaction with Enrollment and Incentives



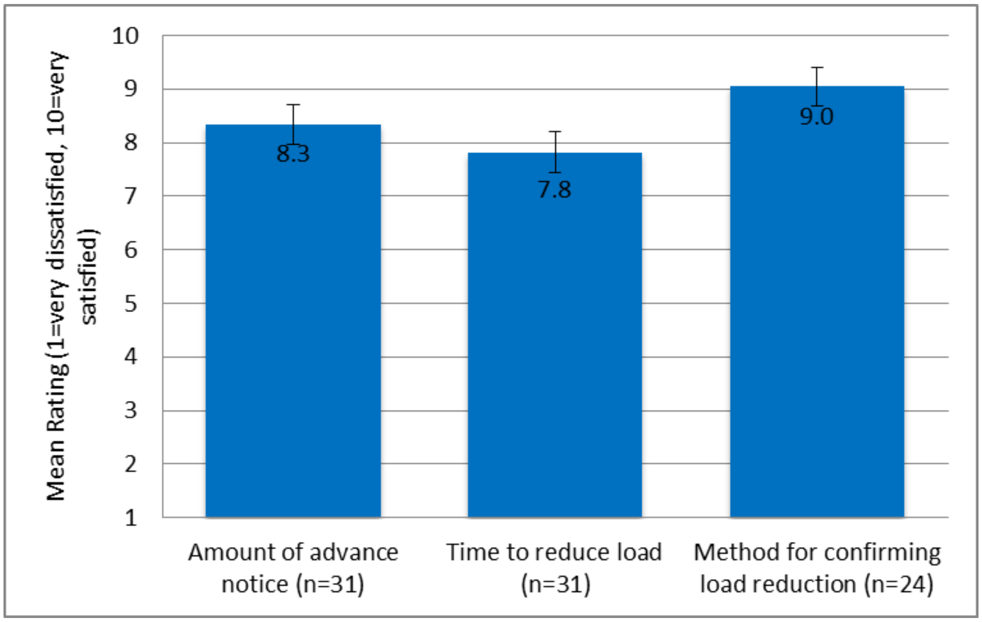
Note: Error bars indicate standard errors of the mean.

Event Calls

Figure 3 shows that participants had moderately high satisfaction with the amount of advance notice they received (average rating of 8.3) and the time they had to reduce their load. Eight respondents gave ratings lower than 8, seven of whom suggested that DEC give more advance notice. One respondent said that not everyone received their notifications for the last call, and suggested that DEC conduct bimonthly tests of their notification system to ensure that all intended recipients were receiving notifications. The program manager reported that although PowerShare participants are only guaranteed 30-minutes advance notice, DEC provided day-ahead notice for all four winter events that were called in January and February 2015.

Respondents gave slightly lower ratings (average 7.8) for the amount of time they had to reduce their loads. For the 11 who gave ratings lower than 8, the evaluation team asked for suggestions for improvement. A few respondents offered the suggestion of providing additional lead time. Respondents were highly satisfied with DEC's method of confirming load reduction, rating it an average of 9.0. Only two respondents rated load reduction confirmation methods lower than 8. They had no suggestions for improvement, but one had never received confirmation of the load reduction achieved, and another did not understand how the load reduction was calculated. These respondents seem to be in the minority.

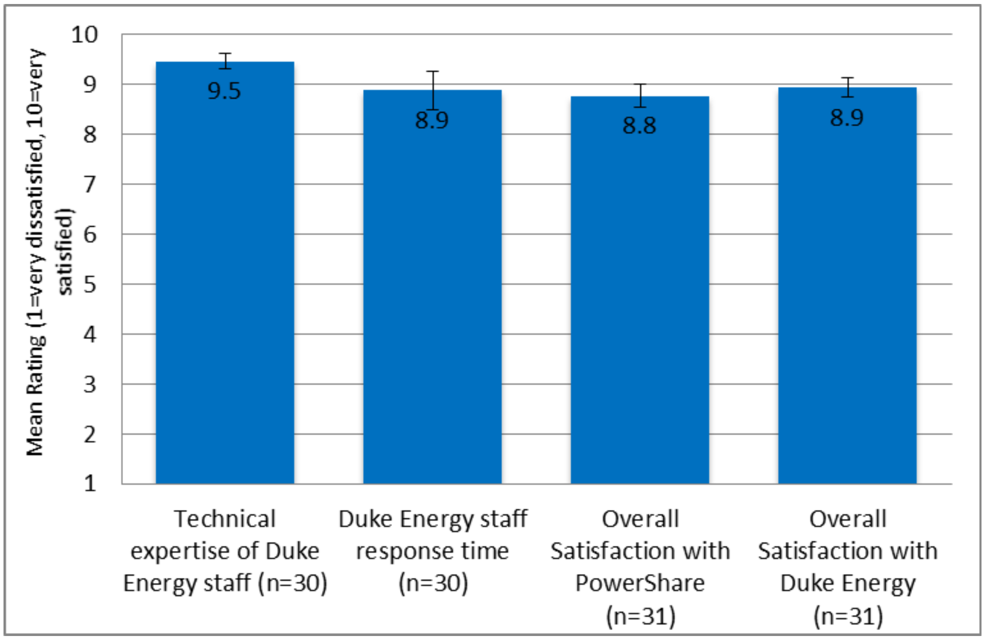
Figure 3. Mean Satisfaction with Events



Overall Satisfaction

Figure 4 shows that respondents were very pleased with the technical expertise of DEC staff members (average rating of 9.5). No one rated technical expertise lower than 8. Respondents were also highly satisfied with the time it took for DEC staff members to respond to questions or address issues (average rating of 8.9). Three respondents reported problems: one said his representative does not respond, another said DEC staff members needed to respond in a timely manner, and a third mentioned that their “local Duke Energy engineer” was not aware of a power outage.

Figure 4. Mean overall satisfaction



On the whole, respondents were highly satisfied with the PowerShare program (8.8) and with Duke Energy (8.9). There were no new improvement suggestions or substantive comments about PowerShare.

Change in Satisfaction Over Time

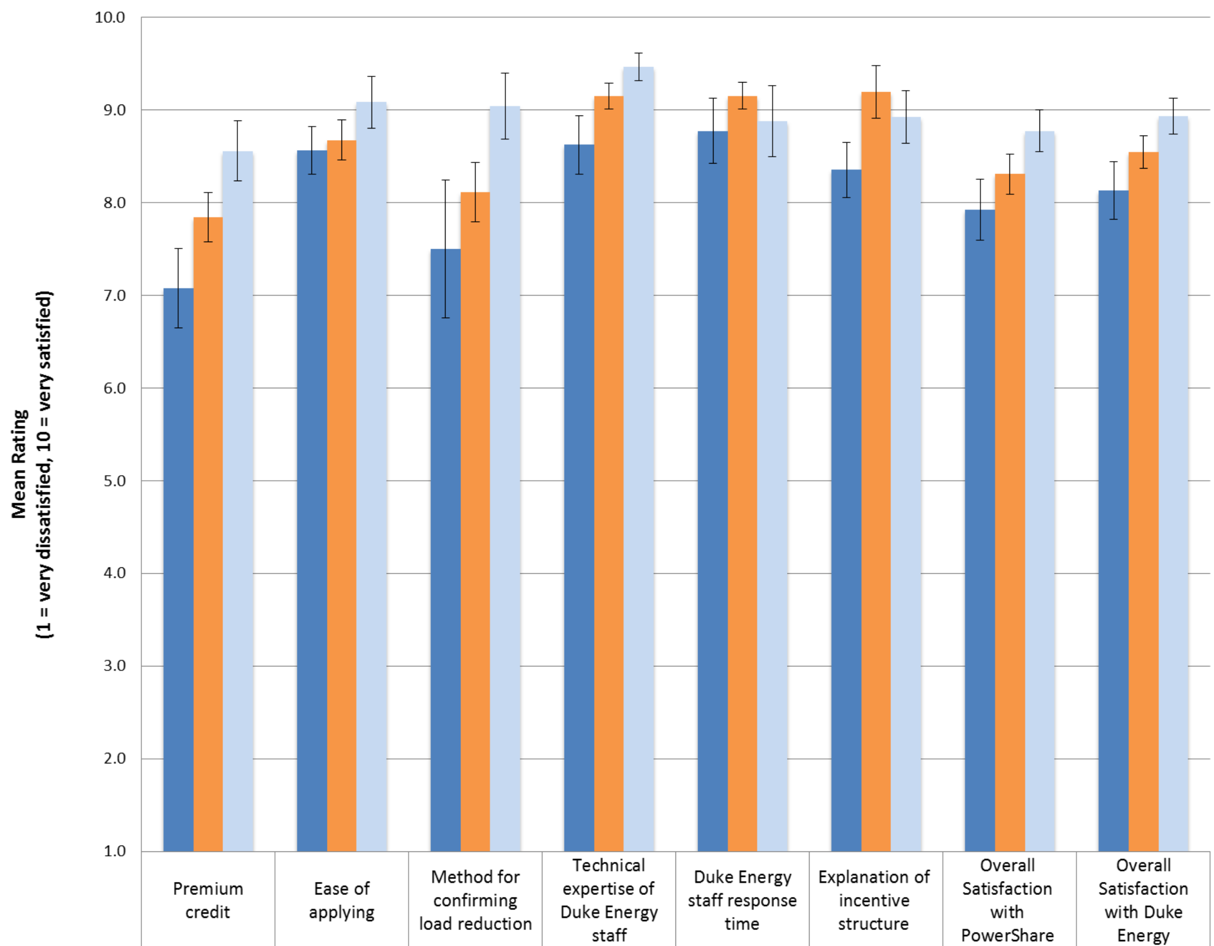
Figure 5 illustrates that PowerShare satisfaction has consistently increased in the years since the last two process evaluation studies in PY2011[5] and PY2013.[6] Satisfaction with the premium credit has increased even though the premium credit has not changed since the first evaluation. Participants are also more satisfied with how DEC confirms load reductions, although the program manager did not identify any changes to the process. Satisfaction with the technical expertise of DEC staff members continues to be high and has increased with each evaluation.

---

[5] Process Evaluation of the 2010 and 2011 PowerShare Program in North and South Carolina, TecMarket Works, 2012.

[6] Process Evaluation of the 2013–2014 PowerShare Program and Impact Evaluation for the 2013 PowerShare Program in the Carolina System, TecMarket Works, 2014.

Figure 5. PowerShare Satisfaction Ratings for PY2011, PY2013 and PY2015



	Premium credit	Ease of applying	Method for confirming load reduction	Technical expertise of Duke Energy staff	Duke Energy staff response time	Explanation of incentive structure	Overall Satisfaction with PowerShare	Overall Satisfaction with Duke Energy
PY2011 (n=20)	7.1	8.6	7.5	8.6	8.8	8.4	7.9	8.1
PY2013 (n=42)	7.8	8.7	8.1	9.2	9.2	9.2	8.3	8.5
PY2015 (n=31)	8.6	9.1	9.0	9.5	8.9	8.9	8.8	8.9

Future Program Challenges

Legislative Uncertainty

The DEC PowerShare program will most likely encounter regulatory uncertainty in the future. The recent EPA ruling included an exemption that allows noncompliant generators to be operated for up to 100 hours when there is an EEA Level 2 emergency. The program manager explained that the EPA is currently being sued to overturn that exemption and the EPA will present a decision by May 2016. Because of this uncertainty, DEC does not expect new PowerShare Generator participants to enroll in the first quarter of 2016, and there is a possibility that noncompliant generators might not be allowed to operate at all in the future.

Cadmus Review of Analytical Approach

Cadmus, as the third-party evaluator, reviewed the files for participation and impacts for the PowerShare program year 2015 provided by Duke Energy. A conservative approach was taken by the Duke Energy measurement and verification team to ensure accurate load reduction. The data reported here align with the information provided in the spreadsheets received. The methods reviewed are comparable with Cadmus' experience in other jurisdictions and confirmed as reliable estimates.

CADMUS

Appendix A: Management Interview Protocol

Interviewer: ____________________ Date of Interview: ______ Interview method: ____

Name: ____

Title: ____

Position description and general responsibilities:

____

____

We are conducting this interview to obtain your opinions about and experiences with the PowerShare Program for the Carolina System. We'll talk about the Program and its objectives, your thoughts on improving the program and its participation rates. As you may know, due to regulatory requirements Duke Energy needs to conduct periodic evaluations whether they are needed or not. Today's interview will take about an hour to complete. May we begin?

Program Overview

1. In your own words, please briefly describe the PowerShare Program's objectives. Are there any objectives at the participant level? What are they?
   Are there any objectives at the state portfolio level?

   Are there any objectives at the company level, across all the PowerShare states?

2. In your own words please describe how the PowerShare Program works and go over its design, marketing and operational approaches. Walk us through the participatory steps starting with a customer who knows nothing about the program.

3. Please explain the different PowerShare options that are available to Duke Energy customers along with their incentives.

4. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program? When did you take on this role?

5. Please describe for me the roles and responsibilities of vendors that are supporting Duke Energy's PowerShare program?

6. Are there any changes you would like to see in the vendors' roles or responsibilities that would improve the PowerShare program's operations?

Objectives

7. Have the PowerShare's objectives changed in the last year or so, and if so how? Why?

8. In your opinion, which objectives do you think are being, or will be, met?

9. Since the program objectives were devised, have there been any changes in external influences (such as market conditions) or internal influences that have affected the PowerShare program's operations?

10. Should the current objectives be revised in any way because of these changes that developed since the program objectives were devised? What changes would you put into place, and how would it affect the objectives?

Incentives

11. Do you think the incentives offered through the PowerShare Program are adequate enough to entice the C&I community to enroll in the program? Why or why not?

12. Do you think the customers understand the incentive levels and how they are calculated? Have there been any issues relating to the customers understanding the incentive approach or confusion over what they are paid? What can be done to minimize this confusion?

Marketing

13. What kinds of marketing, outreach and customer contact approaches do you use to make your customers aware of the program? Are there any changes to the program marketing that you think would increase participation?

14. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

15. What are the key market or operational barriers that impede a more efficient program operation or limit obtainable impacts?

16. What market information, research or market assessments are you using to identify market or segment-level barriers, and develop more effective or targeted operational mechanisms?

Overall PowerShare Management

17. Describe the use of any internal or outside program advisors, technical groups or organizations that have in the past or are currently helping you think through the program's approach or methods. How often do you use these resources? What do you use them for?

18. Do you think there should be changes made to the structure of the participation options?

Event calls

19. How do you track, manage, and monitor or evaluate customer response to the event calls?

20. For customers who do not shed as much load as anticipated, do you know why customers did not shed enough load?

21. Can you describe for me a picture of how customers react to a call? How fast do they learn of a call, what determines what they can do, how fast can they react?

22. How do you know if they reached their load shifting objectives?

23. Are there any market segments or customer types that the program is now serving that are not able to provide the load shed within the timelines and notification systems used today? What would you suggest should be done about this customer segment?

24. Overall, what about the PowerShare Program works well and why?

25. What doesn't work well and why? Do you think this discourages participation?

26. In what ways can the PowerShare Program's operations be improved?

27. If you could change any part of the program what would you change and why?

28. Are there any other issues or topics you think we should know about and discuss for this evaluation?

Appendix B: Participant Survey Protocol

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer satisfaction interview about the Power Share Program. May I speak with _____________ please?

We need your help. Duke Energy has given us your name as someone who might be able to share some of your experiences with the Power Share Program. We are not selling anything. We would like to conduct a short interview that will take about 15 minutes and all your answers will be kept confidential. This information will enable Duke to make improvements to the program and the application process.

Message for voicemail

Hello, my name is ______ from Cadmus Works. I am calling on behalf of Duke Energy to conduct a customer satisfaction interview about the Power Share Program. Duke Energy has given us your name as someone who might be able to share some of your experiences with the Power Share Program. We are an independent evaluation firm and we are not selling anything. We would like to conduct a short interview that will take about 15 minutes. All your answers will be kept confidential. This information will enable Duke to make improvements to the program and the application process.

If you can help, please call me at ______________________. If there is someone at your company who would be more appropriate for us to speak to, we would appreciate if you could let us know that as well.

OPTIONAL - only If the customer wishes confirmation from Duke.

If you would like to verify this request, please contact your account manager. Or, you can contact Rose Stoeckle, Manager of Measurement and Verification Ops, at Duke Energy.

IN-1. Would you be able to help us?

( ) Yes

( ) No

(If no)

IN-2. Can you please give me the name of someone else who might be the more appropriate person to tell us about your company's participation in Power Share?

____

CADMUS

ESTABLISHING QUESTIONS

ES-1. Would you please tell me what your company does and what your role is in your company?

____

ES-2a. Do you manage more than one site that participates in Power Share for your company?

( ) Yes

( ) No

DK

If yes,

ES-2b. How many sites?

____

Most of the questions you will be answering today are about Power Share in general, but if you manage sites that participate in Power Share differently from one another, please answer for your company's facility that is listed as ...

[Please fill in facility name from info sheet].

____

ES-4. In which option(s) did your company enroll?

Please select all that apply.

[ ] Mandatory Curtailment Option

[ ] Voluntary Curtailment Option

[ ] Generator Option

[ ] Call Option

ES-5. How long has your company been participating in the Power Share ?

____

INFORMATION-GATHERING PHASE

INFO-1. How did you first become aware of the Power Share Program?

( ) Duke Energy sent me a brochure

( ) A Duke Energy representative told me about it

( ) Duke Energy website

( ) I saw an ad in: __________

( ) Other: __________

( ) DK/NS

INFO-2. Please tell me how useful that source was in providing the information you needed to decide whether or not to participate. Please rate the usefulness of that source on a scale of 1 to 10, with 1 meaning "Almost nothing I needed", and 10 meaning "Everything I needed".

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

(If INFO-2 was less than 10, ask questions INFO-3a, 3b and 3c)

INFO-3a. Where else did you go to get information?

____

INFO-3b. What additional information were you seeking?

____

INFO-3c. Were you able to get the information you needed about the program's participation requirements and benefits?

( ) Yes

( ) No

( ) DK/NS

CALL OPTION

CO-1. I have some questions specifically about the Power Share CallOption Program. When you were learning about the Power Share Program, were you also presented with information about the Power Share CallOption Program?

(CallOption is a combination of emergency and economic events)

( ) Yes

( ) No

( ) DK/NS

CO-2a. Did your company enroll in the CallOption ?

( ) Yes

( ) No

( ) DK/NS

If CO-2a was "No", ask CO-2b and 2c

CO-2b. Can you please tell me why you decided that the CallOption was not right for your company? ____

CO-2c. What can Duke Energy do to make CallOption more attractive to your company?

____

DECISION MAKING

DM-1. What was the primary reason that you decided to participate in the Power Share Program?

____

DM-2. Was there a secondary reason that your company decided to enroll?

____

PARTICIPATION IN AN EMERGENCY OR ECONOMIC EVENT

EV-1b. How many Power Share <u>emergency</u> events has your business been asked to respond to in 2015?

( ) 0

( ) 1 or more *(enter number)*: __________

( ) DK/NS

EV-2b. How many Power Share <u>economic</u> events has your business been asked to respond to in 2015?

( ) 0

( ) 1 or more *(enter number)*: __________

( ) DK/NS

EV-3. In addition to phone calls, texts, and emails, is there another way in which you would like to be notified of events? __________

EV-3b. For some events, Duke Energy is able to send out a notice a day ahead of the event, to warn of the possibility that an event may occur. Can you please rate how useful it is for you to receive the "day ahead" notices, on a scale of 1 to 10, where 1 means "Not at all useful" and 10 means "Useful".

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA

EV-3c. Do you have any other feedback for Duke Energy on their event communication efforts?

____

(If EV-2 was 1 or more)

EV-4a. For the Economic events, did you decide to reduce energy use for every event, or did you decide to decline one or more events?

( ) Yes, I reduced energy for every event.

( ) No, I declined one or more events

( ) DK/NS

[If customer did reduce, EV4a=Yes]

EV-4b. Do you think you would have been able to reduce more? Why or why not?

____

[If customer declined to reduce, EV4a=No]

EV-4c. Why did you decline to reduce energy usage?

____

EV-5. What did you need to do at your facility to reduce load?

____

EV-6a. Was your company successful in reducing load?

( ) Yes

( ) No

( ) DK/NS

( ) NA

If No,

EV-6b. Were there any negative consequences of not reducing enough load?

____

Note to Interviewer:

When reading answers to EV-7 aloud, if customers answers Yes, immediately ask follow-up "Rarely, Sometimes, Always". Then proceed with EV-7 answers, if appropriate.

EV-7. As you know, Duke Energy provides a forecasted load pattern to you on EPO (Energy Profiler Online) the day before an economic event to help in your decision making process for a Voluntary Event. Do you review that load shape….

(Read choices aloud.)

[ ] **Never, I do not need to review the load shape before making the decision to participate or not.**

[ ] Before participating in a Curtailment Event?

[ ] During or immediately after a Curtailment Event?

[ ] Sometime after a Curtailment Event but before the bill comes?

[ ] After the monthly bill comes?

EV-7b. How often "Before participating in a Curtailment Event"?

( ) Rarely

( ) Sometimes

( ) Always

EV-7c. How often "During or immediately after a Curtailment Event"?

( ) Rarely

( ) Sometimes

( ) Always

EV-7d. How often "Sometime after a Curtailment Event but before the bill comes"?

( ) Rarely

( ) Sometimes

( ) Always

EV-7e. How often "After the monthly bill comes" ?

( ) Rarely

( ) Sometimes

( ) Always

EV-8. Please rate how easy is it for you to use EPO, on a scale of 1 to 10, where 1 means very difficult and 10 means very easy.

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

(If rating was less than 8)

EV-9. What can be done to make using EPO easier for you?

____

EV-10. Would you say the targeted level of load reduction you currently have with Duke Energy is ....

( ) **Much less than you can provide**

( ) Less than you can provide

( ) About right for your company

( ) More than you want to provide

( ) Much more than you want to provide

( ) DK/NS

EPA REGULATIONS

GEN-1. Do you turn on any generators as part of your load reduction strategy?

( ) Yes

( ) No

( ) DK/NS

If "Yes"

GEN-2. How has EPA's National Emissions Standards for Hazardous Air Pollutants that came into effect in January of 2015 affected your participation in the Power Share ? Would you say that...

(Please read choices aloud).

( ) **My company has, or will, retrofit engines and continue participating in Mandatory and/or Voluntary.**

( ) My company will stop participation in Mandatory and/or Voluntary, but continue to participate in the Power Share Generator option.

( ) My company will stop participation in Power Share entirely.

( ) Other: __________

IMPROVEMENTS

IMPR-1. While your company was deciding whether or not to enroll, what was the biggest concern about participating in Power Share?

____

IMPR-2a. During the past season, did anything happen to decrease your concern?

( ) Yes

( ) No

If YES

IMPR-2b. What happened?

____

If NO

IMPR-2c. What can Duke Energy do that would decrease your concern?

____

IMPR-3. How interested would you be in aggregating your accounts together, for Power Share purposes only, in order to optimize load curtailment strategies across several Duke Energy accounts? This would allow you to reduce a certain kilowatt across several sites, so that you could decide to curtail for one site and not for another, and still provide the agreed-upon load reduction. Would you be:

( ) **Not at all interested**

( ) Slightly interested

( ) Somewhat interested

( ) Very interested

( ) NA

IMPR-4. Is there anything about Power Share you would say was working exceptionally well? It's fine if there isn't.

____

IMPR-5. What doesn't work well and why?

____

SATISFACTION

We would like to ask you a few questions about your satisfaction with various aspects of the program. For these questions, we would like you to rate your satisfaction using a 1 to 10 scale where a 1 means that you are very dissatisfied with that aspect and a 10 means that you are very satisfied.

SAT-1. How would you rate your satisfaction with: The ease of applying for the program?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-1a. How can this be improved?

____

SAT-2. How would you rate your satisfaction with: The amount of the monthly premium credit provided by the program?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-2a. How can this be improved?

____

CADMUS

SAT-3. How would you rate your satisfaction with: The amount of the load reduction credit for the events in which you participated?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-3a. How can this be improved?

____

SAT-4. How would you rate your satisfaction with: The time it took for you to receive your load reduction credit?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-4a. How can this be improved?

____

SAT-5. How would you rate your satisfaction with: How clear the explanation of the Power Share incentive structure was?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-5a. How can this be improved?

____

SAT-6. How would you rate your satisfaction with: The amount of advance notice you had about the events?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-6a. How can this be improved?

____

SAT-7. How would you rate your satisfaction with: The time window in which you were required to reduce your load once you had received notification about the start of the event?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-7a. How can this be improved?

SAT-8. How would you rate your satisfaction with: Duke Energy's method for confirming how much load you reduced?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-8a. How can this be improved?

SAT-9. How would you rate your satisfaction with: The technical expertise of Duke Energy staff?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-9a. How can this be improved?

SAT-10. How would you rate your satisfaction with: The time it took for Duke Energy staff to respond to any questions or address any issues?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-10a. How can this be improved?

SAT-11. Considering all aspects of the program, how would you rate your overall satisfaction with the Power Share Program?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-11a. How can this be improved?

____

SAT-12. How would you rate your overall satisfaction with Duke Energy?

( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 ( ) 6 ( ) 7 ( ) 8 ( ) 9 ( ) 10 ( ) NA ( ) DK/NS

If rating was less than 8

SAT-12a. How can this be improved?

____

SAT-13 Does your company intend to stay in the Power Share program in the coming year?

( ) **Yes**

( ) No

( ) DK

SAT-13. Are there any other thoughts or comments you would like to share with Duke Energy management about the Power Share Program that we have not discussed already?

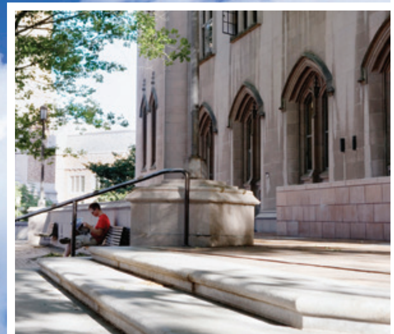
____

Thank you for taking this time to share your thoughts! We appreciate it very much.

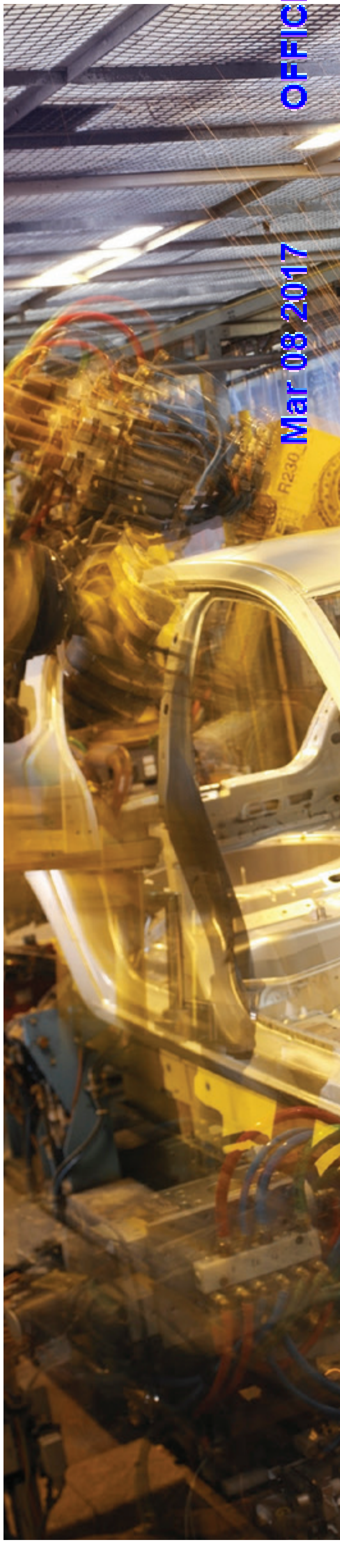
Appendix C: Duke Energy PowerShare Program Brochure

PowerShare®

DUKE ENERGY®



Carolinas



PowerShare®: Profit from curtailing your energy use.

PowerShare is Duke Energy's demand response program developed to reward your business for adjusting energy consumption levels during peak time periods.

One of the toughest challenges we face is balancing energy supply to meet our communities' growing needs. Building new generation facilities is costly, time-consuming and offers no immediate relief. Demand response programs are the cheapest, fastest and cleanest ways to meet energy demand while providing our business customers with a means to profit from their energy curtailment.

Participation in PowerShare provides economic and environmental benefits.

The program:

- Offers cost incentives to business customers who effectively manage their energy consumption.
- Helps customers reduce their energy usage, operating costs and carbon footprint
- Offers options and flexibility to determine load reduction in response to specific price signals.
- Helps maintain low energy rates by reducing the need for new generation plants
- Mitigates electrical emergencies, increases system reliability and reduces customer inconvenience.
- Reduces the need to run expensive generation plants during high demand, resulting in lower wholesale market prices and end-user savings.
- Provides an opportunity for customers to help shape future programs aligned to meet their business objectives.

With PowerShare, you choose the options that best fit your company's operations.

Mandatory Curtailment Option

Enrollment in the Mandatory Curtailment Option requires you to reduce and maintain load during each Mandatory Curtailment Period to the level specified in your PowerShare contract. Curtailment is activated when Duke Energy experiences capacity constraints. Capacity Credits are paid monthly and Curtailed Energy Credits are paid for the load curtailed during each event.

Voluntary Curtailment Option

Participation in the Voluntary Curtailment Option allows you to take part in Voluntary Curtailment Periods on a per-event basis. If you elect to participate in an event, you should reduce and maintain your load to a level you specify prior to the event. A Voluntary Curtailment Period is initiated at Duke Energy's discretion. Notification of the event is typically provided one business day in advance. Curtailed Energy Credits are paid for the load curtailed during each event.

Generator Curtailment Option

Enrollment in the Generator Curtailment Option requires the transfer of load from the Duke Energy power source to a private generation source during each Generator Curtailment Period. This option has been designed to comply with EPA's requirements for emergency generators.* A Generator Curtailment Period is implemented when Duke Energy experiences capacity constraints. Capacity and Energy Credits are paid for the load transferred to the generator during readiness tests and events.

CallOption

Participation in the CallOption program requires you to reduce and maintain a predetermined load during Emergency and Economic Curtailment Periods. In exchange for selling Duke Energy a "call option" on a portion of your load, you will receive a monthly credit on your energy bill. Load Reduction Credits are paid for the load curtailed during events.

For each of the above options, satisfactory compliance is required for continued participation and payment of credits. In certain situations, financial penalties are assessed for failure to perform.

** Duke Energy advises customers to consult with their state environmental agency to verify compliance with all EPA regulations and state permitting requirements.*

Mandatory Curtailment Option

Under the Mandatory Curtailment Option, Duke Energy may request that a customer curtail service when there are capacity constraints.

Participants:

- Must provide a minimum of 100 kilowatts (kW) of curtailable load.
- Agree to reduce and maintain load to the Firm Demand specified in their contract during each event.
- Are given a 30-minute notice (minimum) prior to activation using the customer's preferred communication channel (email, text message, phone, etc.).
- Are provided with a Capacity Credit of $3.50 per kW each month, even if there are no Curtailment Periods during the month.
- Are eligible for Curtailed Energy Credits of $0.10 per kilowatt-hour (kWh) during Curtailment Periods.

Mandatory Curtailment Periods will not exceed 10 hours per day and 100 hours per year.

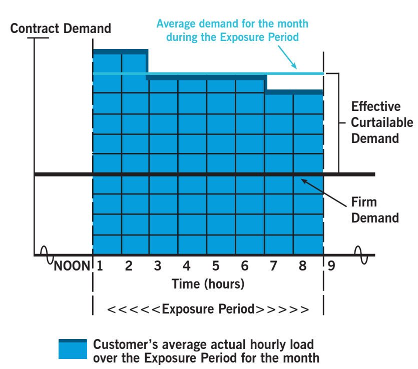
Capacity Credits are determined by multiplying the Effective Curtailable Demand by $3.50 per kW. The Effective Curtailable Demand is calculated by averaging the actual hourly load minus the Firm Demand over the Exposure Period.

Curtailed Energy Credits are based on the load curtailed between a Forecasted Demand and the Firm Demand level during each Curtailment Period.

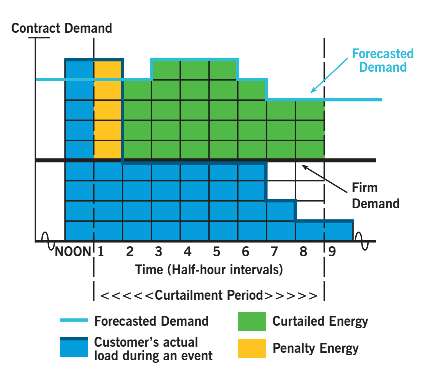
The Penalty Charge is $2 per kWh for load above the Firm Demand level during a Curtailment Period.

Customers on the Hourly Pricing (HP) rate are only eligible for the Mandatory Curtailment Option. Due to the design of Schedule HP, Capacity Credits and Curtailed Energy Credits for HP customers are not calculated in the same manner as other customers. Please contact your account manager for details.

Calculation of Monthly Capacity Credit



Calculation of Curtailed Energy Credits



Voluntary Curtailment Option

Under the Voluntary Curtailment Option, Duke Energy may offer customers an invitation to participate in a Voluntary Curtailment Period, which pays market-based Energy Credits to participants. This invitation is extended at times when curtailment is determined to be a cost-effective method of managing power demand under existing capacity and market conditions.

Participants:

- Are typically invited to participate in a Curtailment Period one business day in advance of the event.
- Choose to accept an invitation to participate in a Curtailment Period prior to the beginning of the event.
- Are required to provide a minimum of 100 kW of curtailable load.
- Agree to reduce and maintain load to the Firm Demand level, which is established prior to each Curtailment Period.
- Are eligible for Curtailed Energy Credits during Curtailment Periods.

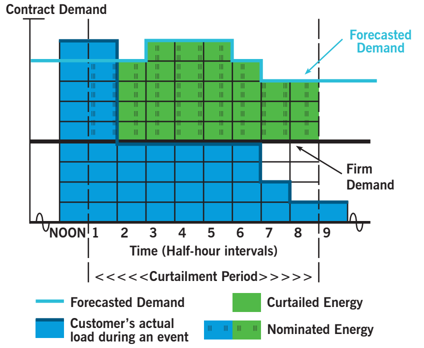
Invitations to participate in a Voluntary Curtailment Period will be made through the customer's communication channel of choice (email, text message, phone, etc.). The customer's nomination of a Firm Demand and Duke Energy's acceptance are processed through the My Duke Energy website. Nominations are accepted in the order they are received.

Voluntary Curtailment Periods are offered at the discretion of Duke Energy. The invitation to participate includes the start and stop times of the Curtailment Period, the hourly Energy Prices offered for the curtailed load, and the customer's forecasted demand.

Curtailed Energy Credits are based on load curtailed between a Forecasted Demand and the Firm Demand level during each Curtailment Period. They are paid only when 50 percent or more of the nominated energy is curtailed during a Curtailment Period.

Customers enrolled in the Mandatory Curtailment Option can also enroll in the Voluntary Curtailment Option. Mandatory and Voluntary Curtailment Periods may take place simultaneously. When this occurs, the calculation of the Curtailed Energy Credits associated with the Mandatory Event has priority and will occur prior to the calculation of the credits, if any, due for the Voluntary Event. Credits will not be paid twice for the same curtailed energy.

Calculation of Curtailed Energy Credits



Generator Curtailment Option

Under the Generator Curtailment Option, Duke Energy may request that a customer curtail service when there are capacity constraints.

Participants:

- Must transfer a minimum of 100 kW of load from the utility source to the generator during Curtailment Periods and monthly tests.
- Must specify a Maximum Curtailable Demand, which is the amount of load typically transferred from the utility source to the generator during Curtailment Periods and monthly tests.
- Is given a 15-minute notice (minimum) prior to activation using the customer's preferred communication channel (email, text message, phone, etc.).
- Is provided with an Average Generated Capacity Credit of $3.50 per kW, based on performance during tests and events.
- Is eligible for an Event Energy Credit of $0.10 per kWh during Curtailment Periods and monthly tests.

Generator Curtailment Periods, including tests and events, will not exceed 10 hours per day and 100 hours per year.

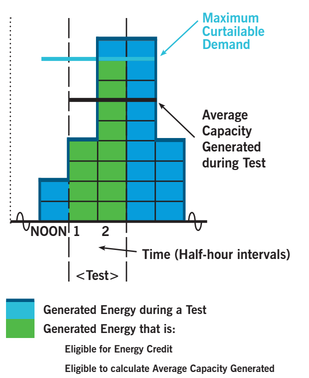
Average Generated Capacity Credits are determined by calculating the average capacity generated (see diagram below) during all Curtailment Periods and monthly tests up to the Maximum Curtailable Demand.

Event Energy Credits are based on the generated load up to the Maximum Curtailable Demand during each Curtailment Period and monthly readiness test.

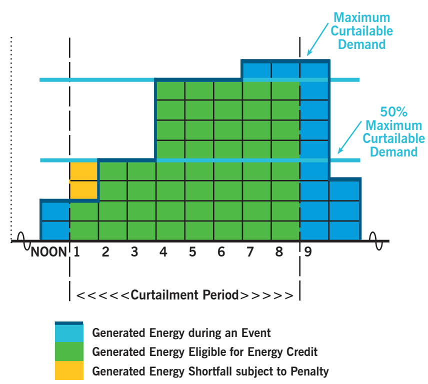
A penalty is charged for failure to deliver at least half of the committed load. The charge is $2 per kWh for the load shortfall below 50 percent of the Maximum Curtailable Demand during each Curtailment Period.

Participants in the Generator Curtailment Option are not eligible for the Mandatory Curtailment Option or the Voluntary Curtailment Option.

Calculation of Monthly Average Generator Capacity Credit and Energy Credit



Calculation of Energy Credits



CallOption

This PowerShare option is ideal for customers who are able to reduce and maintain a predetermined electrical load during Emergency and Economic Curtailment Periods. Participants receive Monthly Premium Credits, even if Duke Energy does not request or enforce a Load Reduction.

Under CallOption, participants:

- Must provide a minimum of 100 kW of curtailable load.
- Are given a Monthly Premium Credit for the curtailable load made available, based on the participation option selected.
- Agree to reduce and maintain load to a predetermined target level during Emergency and Economic Events. The target level is either the Firm Demand value or the value calculated by subtracting the Fixed Demand Reduction from the Proforma, hour by hour.
- Are obliged to participate in each Emergency Event called by Duke Energy; the maximum number is capped at five per year.
- Are paid Load Reduction Credits for curtailing energy during events.
- Are paid credits for energy curtailed in excess of the contractual commitment, up to 1,000 kWh for each hour of the event.

Participation Option	Maximum Number of Economic Curtailment Periods	Maximum Number of Emergency Curtailment Periods	Load Reduction Credit Rate for 2010*	Monthly Premium Credit Rate for 2010*	Contract Term
PS- 200/5	200	5	$0.045 per kWh	$4.17 per kW	N.C.: Three years, beginning Jan. 1 S.C.: One year, beginning June 1
PS-15/5	15			$2.50 per kW	
PS-10/5	10			$2.08 per kW	
PS- 5/5	5			$1.25 per kW	
PS- 0/5	0			$0.83 per kW	

*May be adjusted annually and reflected in the CallOption rider.

CallOption (continued)

Economic Curtailment Periods are initiated at Duke Energy's discretion. These events occur when Duke Energy anticipates a capacity situation that presents a financial opportunity to both the customer and the company.

Customers can choose their level of participation in order to maximize credits or reduce their exposure to events. Customers may also choose to "buy through" Economic Curtailment Periods.

Economic curtailment periods

During Economic Curtailment Periods, CallOption participants are:

- Given day-ahead notice to reduce load.
- Informed of the economic event by email and phone message.
- Asked to curtail eight hours during the day.
- Not required to curtail on weekends and defined holidays.
- Assessed Buy-Through Charges for failure to comply.

Please note: Emergency and Economic Curtailment Periods may occur at the same time.

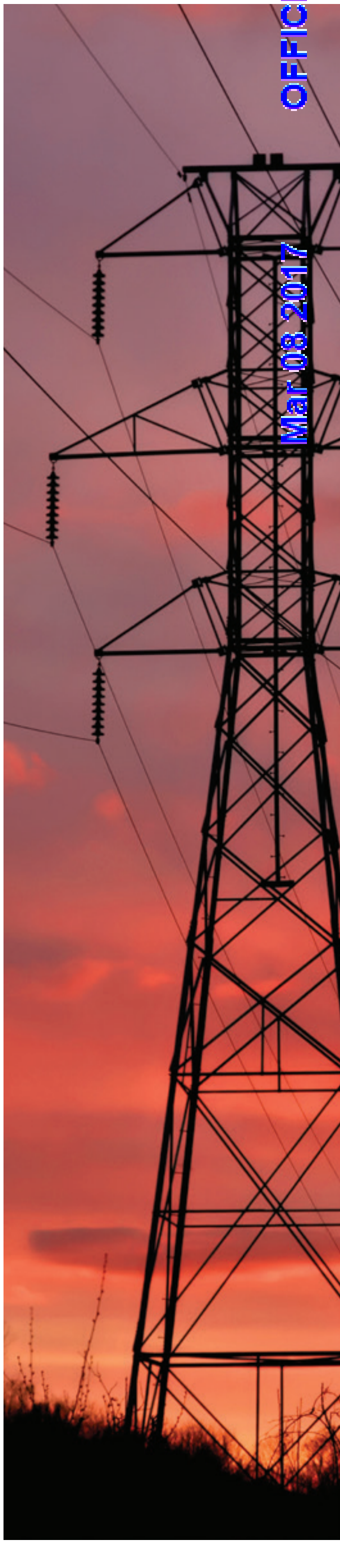
Economic Curtailment Periods for June through September are from 1 to 9 p.m. Economic Curtailment Periods for October through May are from 6 a.m. to 1 p.m. (for the PS-15/5 option only).

Emergency Curtailment Periods

During Emergency Curtailment Periods, CallOption customers:

- Are given a minimum of six hours' notice to reduce load.
- Are informed of the emergency event by email and phone message.
- May be required to curtail up to eight hours during the day.
- May be required to curtail on any day of the week.
- Are assessed Penalty Charges and loss of the Monthly Premium Credit for failure to comply.

Emergency curtailment periods are implemented when Duke Energy anticipates or experiences system capacity problems. The company requires CallOption customers to reduce their loads during all Emergency Curtailment Periods.



CallOption (continued)

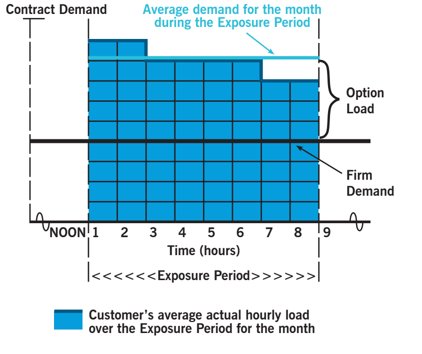
Credits and Penalties

Duke Energy determines customers' Monthly Premium Credits by calculating the Option Load (curtailable load) available during the Exposure Period for each weekday of the month. The Exposure Period is from 1 to 9 p.m. from June through September and from 6 a.m. to 1 p.m. from October through May.

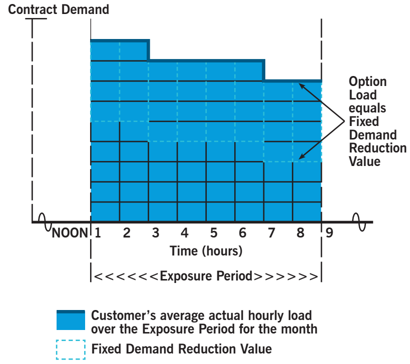
Load Reduction Credits are based on curtailed load down to 1,000 kW per hour beyond the demand level specified in the customer's agreement.

Penalty Charges and Buy-Through Charges are assessed for Non-Compliant Energy (any load above the Firm Demand value or the Proforma less the Fixed Demand Reduction value). These charges are based on Duke Energy's hourly prices under Schedule HP.

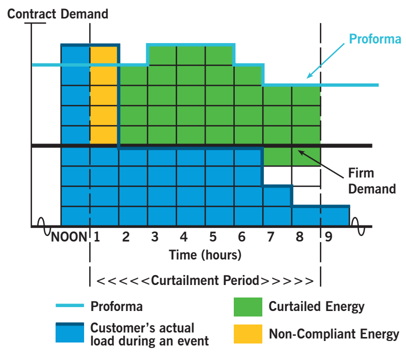
Calculation of Monthly Premium Credit for Firm Demand Option



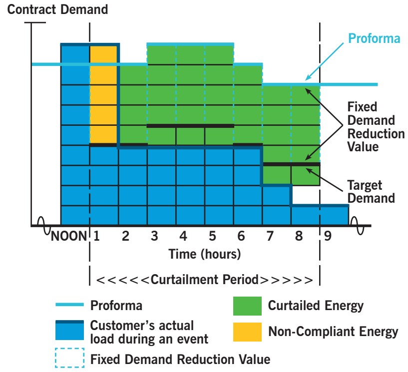
Calculation of Monthly Premium Credit for Fixed Demand Reduction Option



Calculation of Load Reduction Credits for Firm Demand Option



Calculation of Load Reduction Credits for Fixed Demand Reduction Option



PowerShare Reference and Comparison Chart

	Mandatory Curtailment	Voluntary Curtailment	Generator Curtailment	CallOption - Emergency Events	CallOption - Economic Events
Program Description	Customer agrees to curtail load to a contracted Firm Demand Level during all Curtailment Periods	Customer may elect to participate in a Curtailment Period, at which time a Firm Demand level is negotiated to which the customer may curtail and receive credits	Customer agrees to transfer load from the utility source to a generator during all Curtailment Periods and readiness tests	Customer agrees to curtail load to a contracted Firm Demand level, or to the Proforma less Fixed Demand Reduction level, during all Curtailment Periods	Customer may elect to curtail load to a contracted Firm Demand level, or to the Proforma less Fixed Demand Reduction level, during all Curtailment Periods
Eligibility Based on Rate Schedule	Available to customers served on rate schedules LGS, I, OPT, MP and HP	Same as the Mandatory Curtailment Option except not available to customers on Schedule HP	Same as the Voluntary Curtailment Option	Same as the Voluntary Curtailment Option	
Ineligibility Based on Riders	Not available to customers served under IS, SG, SCG, NM, PSC or the PowerShare Generator Curtailment Option	Same as the Mandatory Curtailment Option	Not available to customers served under IS, SG, SCG, NM, PSC or the PowerShare Mandatory or Voluntary Curtailment Option	Not available to customers served under IS, SG, SCG, NM or PS	
Contract Term	3-year initial term with automatic 1-year renewals	1-year initial term with automatic 1-year renewals	3-year initial term with automatic 1-year renewals	N.C.: 3-year term beginning on Jan. 1 of each year S.C.: 1-year term beginning on June 1 of each year	
Curtailment Minimums	Curtail a minimum of 100 kW	Curtail a minimum of 100 kW	Transfer a minimum of 100 kW	Curtail a minimum of 100 kW	
Monthly Facility Fees	$40 per month	$40 per month (waived if customer is also enrolled in the Mandatory Curtailment Option)	$155 per month	$0	
Monthly Capacity/ Premium Credit Rate	$3.50/kW/month	$0	$3.50/kW/month during monthly tests or Curtailment Periods	PS – 0/5: $0.83/kW/month PS – 5/5: $1.25/kW/month PS – 10/5: $2.08/kW/month PS – 15/5: $2.50/kW/month PS – 200/5: $4.17/kW/month	

PowerShare Reference and Comparison Chart

	Mandatory Curtailment	Voluntary Curtailment	Generator Curtailment	CallOption - Emergency Events	CallOption - Economic Events
Curtailed Energy/ Load Reduction Credit Rate	$0.10 per kWh during Curtailment Periods	Set by Duke Energy prior to the Curtailment Period and based on Schedule HP hourly prices	$0.10 per kWh during Curtailment Periods and tests	$0.045 per kWh during Events	
Reason for Curtailment	For Duke Energy capacity constraints only	For Duke Energy capacity constraints or mutual economic opportunities	For Duke Energy capacity constraints only	For Duke Energy capacity constraints only	For Duke Energy capacity constraints or mutual economic opportunities
Number of Curtailment Periods	Limited to 10 hours per event and 100 hours per year	At Duke Energy's discretion	Limited to 10 hours per event and 100 hours per year	Limited to 5 events per year for all Options	Limited to: PS–0/5: 0 events PS–5/5: 5 events PS–10/5: 10 events PS–15/5: 15 events PS–200/5: 200 events
Curtailment Period Times	Any day, any time, but limited to 10 hours per day	Any day, any time	Any day, any time, but limited to 10 hours per day	Any day, any time, but limited to 8 hours per day	Any nonholiday weekday during these times: 1-9 p.m. in summer 6 a.m. to 1 p.m. in non-summer
Curtailment Period Notification Procedures	Notification sent a minimum of 30 minutes prior to event using primary phone, email, secondary phone and text	Invitations to participate sent prior to event using primary phone, email, secondary phone and text	Same as the Mandatory Curtailment Option, except 15-minute advance notice	Same as the Mandatory Curtailment Option, except 6-hour advance notice for all options but PS–200/5, which provides a 30-minute advance notice	Same as the Mandatory Curtailment Option, except day-ahead advance notice
Penalty or Buy-through Charges	$2 per kWh for energy above Firm Demand level	None	$2 per kWh for energy shortfall below 50% of Maximum Curtailable Demand	Penalty Charge based on the Schedule HP hourly energy price for all energy above Firm Demand Level, or Profoma less Fixed Demand Reduction level	Buy-through charge based on the Schedule HP hourly energy price for all energy above Firm Demand Level, or Profoma less Fixed Demand Reduction level

Glossary of Key Terms

Buy-through Charge – Charge for energy used during an Economic Event that is above the Firm Demand, or above the Proforma demand less the Fixed Demand Reduction.

Capacity Credits or Monthly Premium Credits – Credits based on a potential or actual reduction in a facility's electrical demand. Calculation of the credit varies by Participation Option.

Curtailment – Reduction of the electrical demand supplied by Duke Energy.

Curtailment Period – Period of time that a customer participating in a program is expected to curtail load.

Demand Response or Demand-Side Management – Widely-accepted industry terms used to categorize the process of optimizing efficiencies through a form of energy management. Actions are required by the customer to change the amount or timing of consumption during periods specified by Duke Energy.

Economic Curtailment Period or Event – Period of time that a customer participating in CallOption is called on to curtail load. The Event is declared by Duke Energy when the company anticipates a capacity situation that presents a financial opportunity to both the customer and the company.

Emergency Curtailment Period or Event – Period of time that a customer participating in CallOption is called on and obligated to curtail load. The Event is declared by Duke Energy when the company experiences or anticipates capacity constraints.

Energy Credits or Load Reduction Credits – Compensatory incentive for reducing load during Curtailment Periods/Events.

Energy Profiler Online (EPO) – Web-based software application that permits the viewing of usage and event information.

Exposure Period – Hours of overall peak demand during which curtailment is most likely. Exposure Period hours vary seasonally. Actual Curtailment Periods may occur outside of Exposure Periods.

Firm Demand – Portion of the Contract Demand that is not subject to interruption.

Fixed Demand Reduction – Portion of the Proforma demand that the customer commits to curtail during Curtailment Periods.

Forecasted Demand or Proforma – Estimated hourly demand that a customer would normally exhibit in the absence of curtailment. The values are calculated using the customer's historical hourly meter data.

Nominated Energy – Amount of energy that falls between the Forecasted Demand and the Firm Demand during a Curtailment Period.

Non-Compliant Energy – Energy consumed during an Event that is above the Firm Demand, or above the Proforma less the Fixed Demand Reduction value.

Option Load – Amount of available load eligible for Monthly Premium Credits under the Firm Demand or Fixed Demand Reduction options, which occur during the Exposure Period hours each month.

Participation Option – One of the five CallOption options that require a customer to participate in no more than five Emergency Events and zero, five, 10, 15 or 200 Economic Events.

Penalty Charge – Charge for non-compliant energy used during Events.

Schedule HP – Rate schedule HP (Hourly Pricing) for Incremental Load. Applicable for North Carolina and South Carolina.

Voluntary Curtailment Period – Period of time that a customer electing to participate in a Voluntary Option Event is asked to curtail its load.

DUKE ENERGY®

Save Energy and Water Kit Program

Revised April 12, 2016

Evaluation, Measurement, & Verification for Duke Energy Carolinas

This page left blank.

CADMUS

Prepared by:
Jake Wise
Anna Carvill
Sara Wist
Danielle Kolp
Maggie Buffum

Cadmus

CADMUS

Table of Contents

CADMUS

CADMUS

Evaluation Summary

Duke Energy engaged Cadmus to perform process and impact evaluations of the Save Energy and Water Kit Program (SEWKP). This report provides findings for the evaluation period from May 13, 2014 through February 27, 2015, for the Duke Energy Carolinas (DEC) jurisdiction only.

The SEWKP was approved as a component of the Energy Efficient Appliances and Devices residential program. The SEWKP was launched in May 2014 and was deployed in North and South Carolina (the Carolinas).

The SEWKP was designed to increase energy efficiency by offering residential customers energy-efficient water fixtures and water pipe insulation to install in high-use fixtures within their homes, thereby extending the market penetration of energy-efficient water measures. The overall program strategy is to reach residential customers who have not adopted energy-efficient water devices. DEC will continue to educate customers about the benefits of energy-efficient water devices while addressing barriers for consumers who have not participated in the program.

Evaluation Objectives

Cadmus sought to document program operations, identify areas for improving program implementation, gauge customer satisfaction with the program, and estimate program energy savings and demand reduction. Table 1 lists the key process and impact evaluation research questions.

Table 1. Evaluation Research Questions

Key Questions	Methods and Data Collection
Process Questions	
What is the level of participation?	Analysis of program participation records provided by DEC.
What are the installation rates for various measures and participants' satisfaction with these measures?	Analysis of survey respondent data.
Are there any recommendations for program process improvements?	Analysis of implementer and program management interviews, and of survey respondent data.
Impact Questions	
What are the measure installation rates and program savings?	Savings analysis using survey respondent results to feed technical reference manual impact calculation algorithms.
What is the program net-to-gross ratio (i.e., freeridership and spillover)?	Estimates calculated from survey responses.
Are there any recommendations for program impact improvements?	Based on all of the above.

CADMUS

High-Level Impact Findings

This section summarizes Cadmus' key impact findings for the evaluation period.

Cadmus conducted a savings analysis to estimate the relative savings contributions from items provided in the SEWKP kit, along with a net-to-gross (NTG) analysis accounting for freeridership and spillover adjustments. Table 2 presents the total savings details for SEWKP measures per kit, and Table 3 presents the savings details for the entire kit.

Table 2. Save Energy and Water Kit Measure Savings Details

Metric	Energy-Efficient Showerhead 1.5 GPM	Kitchen Aerator 1.0 GPM	Bathroom Aerator 1.0 GPM	Pipe Wrap
Average In-Service Rate	62%	51%	25%	36%
Evaluated Gross Summer Coincident kW per Unit*	0.010	0.027	0.006	0.013
Evaluated Gross kWh per Unit*	294	183	6.45	112
NTG Percentage	91.7%	95.6%	95.0%	91.0%
Evaluated Net Summer Coincident kW Per Unit	0.010	0.026	0.006	0.012
Evaluated Net kWh Per Unit	269.3	175.2	6.1	101.5
Measure Life (Years)	10	9	9	15
Effective Useful Life Net kWh Per Unit	2,694	1,577	55	1,522
* Gross kW or kWh per Unit represents weighted average per Unit Gross kW or kWh savings, adjusted for electric water heater saturation and ISR.				

Table 3. Save Energy and Water Kit Program Kit Savings Details

Metric	Small Kit	Medium Kit	Large Kit
Kit Contents	1 showerhead 1 kitchen aerator 3 bathroom aerators 1 pipe wrap	2 showerheads 1 kitchen aerator 5 bathroom aerators 1 pipe wrap	3 showerheads 1 kitchen aerator 7 bathroom aerators 1 pipe wrap
In-Service Rate of Kit Contents	42%	39%	37%
Weighted Average Gross Summer Coincident kW per Kit*	0.076	0.093	0.086
Weighted Average Gross kWh per Kit*	759	889	710
NTG Percentage kW	93.9%	93.9%	93.9%
NTG Percentage kWh	92.6%	92.6%	92.6%
Weighted Average Net Summer Coincident kW Per Kit	0.071	0.087	0.081
Weighted Average Net kWh Per Kit	703	823	657
Measure Life (Years)**	10.4	10.3	10.4
Effective Useful Life Net kWh Kit	7,306	8,478	6,834

* Gross kW or kWh per Kit represents per Kit Gross kW or kWh savings, adjusted for electric water heater saturation and ISR.

** To calculate the entire kit measures' effective useful lives (EULs), Cadmus used a weighted average derived from the kWh savings and EULs of individual kit items.

Gross Impacts

As a component of the larger Energy Efficient Appliances and Devices Program, SEWKP does not have filed savings goals specific to the kit measures. The evaluated gross energy savings and demand reductions are shown in Table 4 and Table 5, respectively.

Table 4. Program Projected, Claimed, and Evaluated Gross Energy Impacts

Program	Gross Savings Goal (kWh)	Gross Reported Savings (kWh)	Total Gross Evaluated Savings (kWh)	Per Participant Gross Savings (kWh)
SEWKP	N/A	N/A	11,487,423	814

Table 5. Program Projected, Claimed, and Evaluated Gross Peak Demand Impacts

Program	Gross Savings Goal (kW)	Gross Reported Savings (kW)	Total Gross Summer Coincident Evaluated Savings (kW)	Per Participant Gross Savings (kW)
SEWKP	N/A	N/A	1,197	0.085

CADMUS

Net Impacts

Based on 14,117 SEWKP kits being delivered to the DEC service territory during the evaluation period, the program achieved overall net energy savings and demand reduction of 10,632,251 kWh and 1,124 kW, respectively, as shown in Table 6 and Table 7. On a per-participant basis, the program realized net energy savings of 753 kWh and a net peak demand reduction of 0.080 kW.

Table 6. Program Net Energy Impacts

Program	Total Net Savings (kWh)	Per Participant Net Savings (kWh)
SEWKP	10,632,251	753

Table 7. Program Net Summer Coincident Peak Demand Impacts

Program	Total Net Savings (kW)	Per Participant Net Savings (kW)
SEWKP	1,124	0.080

Evaluation Parameters

Cadmus used participant survey responses to conduct the SEWKP impact evaluation. Table 8 lists this activity's parameters, along with the estimated precision.

Table 8. Evaluated Parameter with Value, Units, Precision, and Confidence

Program	Parameter	Value	Units	Confidence/Precision*
SEWKP	Participant survey responses	Varies by question	Varies by question	±6.7% precision at the 90% confidence interval
* Based on sample size of 150 surveys and population of 14,117 participants. C/P for each question or combination of questions will vary.				

Table 9 lists the start and end dates for the impact evaluation activities.

Table 9. Sample Period Start and End Dates

Evaluation Component	Sample Period	Dates Conducted	Total Conducted
Stakeholder Interviews	–	May 26 and June 3, 2015	2
Participant Surveys (to inform savings and NTG analysis)	April 1, 2014–February 15, 2015	June 18–June 25, 2015	150

High-Level Process Findings

The section summarizes Cadmus' key process findings for the evaluation period.

Stakeholder Feedback

Cadmus focused the interviews with program stakeholders (program management and implementation staff) on elements of program process and delivery, which have fundamentally remained unchanged since program inception in the spring of 2014. Stakeholders reported that the program ran smoothly, they communicated frequently with each other, and that the program successfully reached participation goals.

Stakeholders reported minimal challenges with the SEWKP this year. Both program and implementer staff discussed the merits of establishing an online store in the future. No inventory or logistical challenges are anticipated from allowing participants to customize their kit measures.

Participant Feedback

Cadmus asked survey respondents a series of questions designed to inform the process and impact evaluation efforts. As shown in Table 10, we focused the survey on verifying measure installation, assessing participating customers' decision making, and gathering household characteristics.

Table 10. Survey Instrument Detail

Survey Topic	Question Description	Question Count as % of Total Survey
Verification	Primarily installation and use of the kit items	34%
Attribution	Participation likelihood and indirect effects	24%
Demographics	Household and customer characteristics	22%
Satisfaction	Program features and delivery	15%
Marketing and Awareness	Communication channel, mode, and customer motivation	5%

Survey respondents most often reported installing the showerheads and kitchen aerators included in the SEWKP kits (with installation rates greater than 60% and 50%, respectively). Customer respondents reported lower installation rates for the bathroom aerator (34%) and pipe insulation (36%).

Of customer respondents who did not currently have the measures installed (either because they never installed the measures or installed and subsequently removed the measures), only a few (less than 3%) cited an explanation, as shown in Table 11.

Table 11. Reasons Provided for Not Installing Kit Measures

Measure	Survey Response
Showerheads	Does not fit/would have to change pipes Does not work with handheld shower fixture
Kitchen Aerators	Does not fit on faucet Does not work with water filter Low flow/not enough water pressure
Bathroom Aerators	Does not fit on faucet Low flow/not enough water pressure

Surveyed customer respondents reported high satisfaction ratings across all categories:[1]

- Overall satisfaction with kit measures (76%—high satisfaction).
- Overall satisfaction with the SEWKP (83%—high satisfaction).
- Overall satisfaction with DEC (78%—high satisfaction).

Installation Rates

Table 12 shows the achieved installation rates of kit measures provided to survey respondents. The original program assumption was a 75% installation rate for each measure.

Table 12. Installation Rates by Measure

Measure	Installation Rate
Showerheads	62%
Kitchen Aerators	51%
Bathroom Aerators	25%
Pipe Wrap	36%

Conclusions and Recommendations

Cadmus' evaluation revealed a few areas for potential improvements. This section, which summarizes our conclusions resulting from process and impact evaluation activities, provides potential areas DEC could explore to further refine program operations or expand program benefits.

1. ***Conclusion:*** **Program communication and delivery proved positive and effective.** The program manager and implementer clearly indicated that the program functions well. According to stakeholders, frequent and reciprocal communications aided in the program success of exceeding its participation goals.

   Recommendation: Given that the program functions well, continue using the same program delivery mechanism and processes and continue to contract with vendors, Energy Federation Incorporated (EFI), and Direct Options. Proceed with the planned expansion into two newly proposed jurisdictions.

2. ***Conclusion:*** **The program achieved high customer satisfaction levels.** Surveyed customers reported high satisfactions levels with kit measures, the program, and DEC, yielding results of 76%, 83%, and 78%, respectively.

   Recommendation: Continue to field customer satisfaction (CSAT) cards and react quickly to feedback provided.

---

[1] Cadmus measured satisfaction on a scale from 0 to 10, with 0 being "very dissatisfied" and 10 being "very satisfied." Then we defined satisfaction by ranges: high 8–10; moderate 5–7; and low 0–4. For example, 76% of customer respondents provided a score between 8 and 10 for their overall satisfaction with kit items, making overall satisfaction with the kit high.

3. ***Conclusion:* Asymmetry occurs in the program kit measure counts and information.** The number of bathroom aerators provided to survey respondents differed from the number reported. Such asymmetry presents implications for the realization rate. For this evaluation, Cadmus used the number of bathroom aerators provided to customers of three, five, and seven for small, medium, and large kits, respectively. This assumption yielded a lower realization rate for that measure than when using the reported numbers of two, four, and five.

   Recommendation: While the reported number of bathroom aerators arose from a conservative estimate of measures likely installed, which is prudent to ensuring accurate savings analysis results, Cadmus recommends that DEC provide a number of bathroom aerators equivalent to the number reported. This approach is consistent with that used for other DEC programs and is industry standard practice.

4. ***Conclusion:* The program successfully encourages energy-saving behaviors among survey respondents, and may lead them to increase energy savings by installing additional quantities of items.** Survey respondents did not indicate a strong correlation between receiving a kit with more measures and having higher installation rates. The results showed the same installation rate for showerheads in the medium and large kit, with relatively lower installation rates for bathroom and kitchen aerators in the large kits. Based on these data, providing more measures may not necessarily translate into more installations, and there are diminishing returns for the large kit configuration.

   Recommendation: Consider streamlining the quantity of kit items and reallocating resources away from the large kit.

5. ***Conclusion:* Customer respondents and the implementer favored having an online store.** Surveys revealed that over 70% of customer respondents would likely install showerheads if they could choose the color or finish. Establishing an online store present three benefits: (1) increasing CSAT by allowing customization (as validated by CSAT responses requesting this); (2) reducing delivery time through an expedited shipping process; and (3) providing indirect exposure and potential advertising of other programs via the one-stop-shop aspect of an online store.

   Recommendation: Proceed with implementing an online store that allows participants to self-register and customize the color and/or finish of their kit measures. Leverage this online channel to further capture participants' motivations to conserve resources: customer survey respondents most often indicated wanting to upgrade water heaters and install lighting measures. Additionally, it would be beneficial to track the number of enrollment requests received via business reply cards (BRC) versus call-in versus an online store. As the entry method drives the delivery costs, that cost could be greatly reduced through an online store that allows near real-time enrollments.

6. ***Conclusion:* The adoption of a 75% in-service rate (ISR) across all measures is not realistic.** The reported installations of kit measures are each less than 75%, with showerheads at 62%, kitchen at aerators at 51%, bathroom aerators at 25%, and pipe wrap at 36%.

Recommendation: Assign kit measure-specific ISRs.

7. **Conclusion: The original reported savings estimates undervalue showerhead and kitchen aerator savings and overvalue bathroom aerator and pipe wrap savings.** Energy savings and demand reduction are primarily a function of the technical reference manual (TRM) used and, to some degree, of the data collected from survey respondents.

   Recommendation: Re-evaluate the impact assumptions for kit measures. Leverage new values into program planning and execution.

Introduction

Program Description

Free of charge, DEC provides showerheads, aerators, and insulated pipe wrap to eligible, residential customers via a BRC. DEC markets the program solely through a BRC direct-mail campaign, subject to program eligibility requirements. To be eligible, a customer must not have received a program kit as a result of participating in a past campaign, they must not reside in a multifamily dwelling, and they must have an electric water heater.

At this time, DEC does not wish to market the program to customers who are not eligible; therefore, they only send BRCs to prescreened, eligible customers. In the future, DEC has expressed interest in expanding the program into two new jurisdictions (Duke Energy Progress and Duke Energy Indiana), and adding a web-based ordering platform.

By opting in, confirming they have an electric water heater, and asserting they will install the measures, customers can have a kit shipped directly to their home, free of charge. DEC markets the kits by presenting the free offer by mail or through phone ordering options and providing free home delivery. Customers receive a small, medium, or large kit with varying amounts of the following devices: energy-efficient (1.0 gpm) bath and kitchen aerators; 1.5 gpm energy-efficient showerheads; and water heater pipe wrap and Teflon tape. The kit also includes energy-saving educational materials, directions, and items to help with installation.

Table 13 shows the available measure bundles, with the actual size for each customer based on the number of full bathrooms in their home.

CADMUS

Table 13. Measure Kit Configurations

Small: 1 Full Bath (0-1,200 SF)	Medium: 2 Full Baths (1,201-2,800 SF)	Large: 3 Full Baths (1,201-2,800 SF)
Kit Bundle #1: • 1 Showerhead • 3 Bath Aerators (additional aerators for double sinks or half bath) ▪ 2 reported to EE* • 1 Kitchen Aerator • 1 Roll Plumbers Tape • Informational Flyer • Rubber Jar Opener • 15' of Insulated Pipe Wrap (enough to cover 5' of pipe) ▪ 5' reported to EE* Cost: $12.71**	Kit Bundle #2: • 2 Showerheads • 5 Bath Aerators (additional aerators for double sinks or half bath) ▪ 4 reported to EE* • 1 Kitchen Aerator • 2 Rolls Plumbers Tape • Informational Flyer • Rubber Jar Opener • 15' of Insulated Pipe Wrap (enough to cover 5' of pipe) ▪ 5' reported to EE* Cost: $16.92**	Kit Bundle #3: • 3 Showerheads • 7 Bath Aerators (additional aerators for double sinks or half bath) ▪ 5 reported to EE* • 1 Kitchen Aerator • 3 Rolls Plumbers Tape • Informational Flyer • Rubber Jar Opener • 15' of Insulated Pipe Wrap (enough to cover 5' of pipe) ▪ 5' reported to EE* Cost: $21.09**

* For bath aerators and insulated pipe wrap, DEC adopted a conservative approach, providing more measures to customers than it reports in the Energy Efficiency (EE) database.
** Kit costs provided by EFI.

Program Design and Goals

DEC designed the SEWKP to increase residential customers' energy efficiency by offering them energy-efficient water fixtures and water pipe insulation to install in high-use fixtures within their homes, thereby extending the market penetration of energy-efficient water measures.

DEC's primary goal with the SEWKP is to reach residential customers who have not adopted energy-efficient water devices. In an interview, the program manager said DEC looks at programs holistically by taking a portfolio approach to achieving targets. DEC will continue to educate customers about the benefits of energy-efficient water devices while addressing barriers for consumers who have not participated in the program. Additionally, DEC strives to meet the following goals through the program:

- Achieve participation targets set by jurisdiction (Kentucky, North Carolina, Ohio, and South Carolina).[2]
- Achieve target participation and energy impacts through delivery of SEWKP kits and through participant installation of energy-saving measures in eligible households.
- Create program sustainability by reaching new participants every year who have not received a SEWKP kit in the previous three years.

[2] SEWKP participation goals were included in the larger Energy Efficient Appliances and Devices Program.

CADMUS

Table 14 and Table 15 list program goals and achievements for the two Carolina jurisdictions in 2014 and 2015.

Table 14. 2014 Save Energy and Water Kit Program Participation Achievement*

Market Size	Eligible Participants (A)	BRCs Mailed (B)	Kits Shipped (C)	Market Penetration (B/A)	Take Rate (C/B)	Percentage of Eligible Participants (A/Total line A)	Percentage of Total Kits Shipped (C/Total line C)
NC	333,872	44,833	6,446	13%	14%	74%	72%
SC	115,281	16,414	2,485	14%	15%	26%	28%
Total	**449,153**	**61,247**	**8,931**	**14%**	**15%**	**100%**	**100%**

* Source: These program achievements are with respect to internal goals set by DEC (2014: 6,934; data represents April to December 2014).

Table 15. 2015 Save Energy and Water Program Kit Participation Achievement*

Market Size	Eligible Participants (A)	BRCs Mailed (B)	Kits Shipped (C)	Market Penetration (B/A)	Take Rate (C/B)	Percentage of Eligible Participants (A/Total line A)	Percentage of Total Kits Shipped (C/Total line C)
NC	333,872	35,850	9,667	11%	27%	74%	73%
SC	115,281	12,379	3,500	11%	28%	26%	27%
Total	**449,153**	**48,229**	**13,167**	**11%**	**27%**	**100%**	**100%**

* Source: These program achievements are with respect to internal goals set by DEC (2015: 13,385; data represents January 1 to July 15, 2015).

Evaluation Methodology

In evaluating DEC's SEWKP, Cadmus identified the following objectives:

- Estimate energy savings and demand reduction resulting from installing SEWKP Kit measures through savings analysis;
- Assess freeridership and spillover through participant surveys;
- Assess program performance against goals; and
- Assess participant experience, satisfaction, and decision-making motivations.

Stakeholder Interviews

Cadmus interviewed one program management staff member and one implementation staff member to capture insights about program operations and challenges:

- SEWKP Program Manager: (May 26, 2015)
- EFI Program Manager: (June 3, 2015)

Participant Surveys

Cadmus designed participant surveys to cover process and impact evaluation topics, including the following:

- Use of SEWKP kit items;
- Energy-saving behavior changes;
- Freeridership;
- Spillover;
- Decision making; and
- Satisfaction

Cadmus conducted surveys by telephone and analyzed the survey responses. We attempted to contact 2,770 customers who received a SEWKP kit between May 13, 2014, and February 27, 2015, according to program records. Of those, 150 respondents completed the survey, for a response rate of 5.4%. The survey sampling methodology achieved precision of ±6.7% at the 90% confidence interval, based on the total of 14,117 participants receiving a SEWKP kit during the evaluation period.

Savings Analysis

Cadmus conducted a savings analysis to determine the SEWKP kits' contribution to household gross energy savings. We collected data through participant surveys and used energy-savings algorithms taken from the Mid-Atlantic and Illinois TRMs.[3] We then used the analysis results, in conjunction with the NTG analysis, to estimate net energy savings for items included in the kits.

Net-to-Gross Analysis

To inform savings calculations, Cadmus conducted a NTG analysis. We used participant surveys to collect the data necessary to estimate participant freeridership and spillover.

Cadmus calculated the NTG estimate at the program level using participant survey responses. We estimated measure-level freeridership, then weighted each measure-type freeridership estimate by its proportion of the total evaluated gross population energy savings. These values summed to an overall program-level freeridership estimate. We calculated spillover separately from freeridership, based on participants' level of attribution of the program's influence on additional actions they took outside the program to save energy.

Cadmus calculated freeridership estimates for showerheads, aerators, and water heater and pipe insulation based on participants' intentions to purchase and use these energy-efficient measures before receiving them through the program. We used survey questions to delineate between survey respondents who indicated an intention to purchase and install these measures in the program's absence, but who would not have done so, and those who would have followed through and acquired these measures in the program's absence. We also used survey questions to determine *when* participants would have acquired these measures in the program's absence.

In assessing freeridership, we asked customer respondents a series of questions about whether they would have purchased and installed any of the high-efficiency kit measures within the next year in the program's absence. Table 16 presents freeridership questions administered to survey respondents along with the response options, skip patterns, and scoring decrements associated with each question. Text in parentheses indicate a program skip in the survey for that given response option. If a response option does not have a trailing value in parentheses, then we asked the next question of the participant. Values in brackets indicate the freeridership scoring we applied to a respondent's initial freeridership estimate of 100%.[4] We considered all respondents freeriders at the outset of the analysis, then gave them the opportunity to prove as non-freeriders through their answers to the questions in Table 16

---

[3] Cadmus relied primarily on the Mid-Atlantic TRM (and Illinois TRM for aerators as it distinguishes between kitchen n bathroom as Mid-Atlantic did not) for the savings analysis; however, we avoided using deemed values in favor of primary data whenever possible. Because this analysis relied, in part, on participant responses, results may have been affected by self-selection bias, false-response bias, or positive-result bias.

[4] Cadmus based the freeridership scoring on the probability assessment provided in: Nation Action Plan for Energy Efficiency. *Handbook on DSM Evaluation.* Pg. 75, Table 5-1. 2007. Available online: http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf

CADMUS

Table 16. Freeridership Questions, Response Options, Skip Patterns, and Scoring Decrements

E1. If these items were not offered by the Save Energy and Water Kit Program from DEC, would you have …	E2. Let me make sure I understand. When you say you would not have installed the same equipment or made the same upgrades, do you mean that you…	E3. Which water-efficiency upgrades or installations would you still have made on your own if you had not participated in the Save Energy and Water Kit Program? [Multiple selections allowed]	E4. For the equipment that you indicated you would have installed or upgraded without the Save Energy and Water Kit Program, when did you make that decision? Would you say it was…	E5. (IF E4=2 ASK E5) So is it correct that you decided to install or upgrade these energy-saving measures or items after you learned about the Save Energy and Water Kit Program?	E6. (IF E5=2, ask E6. otherwise, skip to next section) When did you make the decision to install the package of equipment or make the upgrade(s)? Was it…	E7. If the program had not been available, would you have made the improvement (or all the improvements)…	*E8. When you say you would have installed [KIT MEASURE] on your own, without the program, would you have installed the same number of [KIT MEASURE] that you installed from the DEC kit?
1. Installed ALL of the energy-efficient equipment or made upgrades on your own (SKIP TO E4)	1. Would not have installed ANY of the equipment or made any upgrades at all [-100%]	1. Energy-efficient showerhead	1. Before you learned of the Save Energy and Water Kit Program (SKIP TO E7)	1. Yes [-100%]	1. Before you learned about the Save Energy and Water Kit Program	1. At roughly the same time [-0%]	Yes [-0%]
2. Installed NONE of the energy-efficient equipment or none of the upgrades on your own	2. Or, that you would have installed SOME of the equipment or made some of the upgrades	2. Kitchen and bathroom faucet aerators	2. After you learned about the program	2. No	2. After you learned about the program, but before you received the kit in the mail [-0%]	2. Within a few months [-25%]	No (-50%)

CADMUS

E1. If these items were not offered by the Save Energy and Water Kit Program from DEC, would you have …	E2. Let me make sure I understand. When you say you would not have installed the same equipment or made the same upgrades, do you mean that you…	E3. Which water-efficiency upgrades or installations would you still have made on your own if you had not participated in the Save Energy and Water Kit Program? [Multiple selections allowed]	E4. For the equipment that you indicated you would have installed or upgraded without the Save Energy and Water Kit Program, when did you make that decision? Would you say it was…	E5. (IF E4=2 ASK E5) So is it correct that you decided to install or upgrade these energy-saving measures or items after you learned about the Save Energy and Water Kit Program?	E6. (IF E5=2, ask E6. otherwise, skip to next section) When did you make the decision to install the package of equipment or make the upgrade(s)? Was it…	E7. If the program had not been available, would you have made the improvement (or all the improvements)…	*E8. When you say you would have installed [KIT MEASURE] on your own, without the program, would you have installed the same number of [KIT MEASURE] that you installed from the DEC kit?
3. Installed SOME of the equipment or made some of the upgrades on your own (SKIP TO E3)	98-99. DK-RF (SKIP TO NEXT SECTION)	3. Pipe insulation	98-99. DK-RF (SKIP TO E7)	98-99. DK-RF [-100%]	98-99. DK-RF	3. Within a year [-50%]	98-99. DK-RF [-25%]
98-99. DK-RF (SKIP TO E3)		98-99. DK-RF				4. More than a year out [-100%]	
						5. Never [-100%]	
						98-99. DK-RF [-25%]	

* Asked for each kit measure selected in question E3.

Cadmus weighted the measure-level freeridership estimates by verified measure installations, and weighted the overall program-level freeridership estimate by the relative proportion of each measure-level freerider estimate to the total evaluated gross program population energy savings.

Spillover occurs when participants purchase energy-efficient measures or adopt energy-efficient practices due to participation in an energy efficiency program, but choose not to participate (or otherwise are unable to participate) in an incentive program for those particular measures. These customers' savings are not credited to the program until a spillover assessment has been conducted.

Cadmus used the self-report surveys to assess participant spillover. We asked respondents about energy-efficient products and if they installed any high-efficiency products in their home since participating in the program. If survey respondents had made energy-efficient improvements and/or purchased products, we asked how important the program was on their purchasing decisions ("not at all," "not too," "somewhat," or "very" important).

Cadmus estimated energy savings for measures that survey respondents said the program proved "very important" in their decision to purchase.[5] We calculated the spillover percentage for a measure by dividing the sum of additional spillover savings reported by participants across the whole program by the total reported gross program savings achieved by program survey respondents, as shown in the equation below:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure Evaluated Gross kWh Savings for All Survey Respondents}}{\sum \text{Program Measure Evaluated Gross kWh Savings for All Survey Respondents}}$$

Program Comparison

Although this is the first evaluation of the SEWKP, Cadmus has previously evaluated residential water measures provided by other DEC programs and is currently evaluating the National Theatre for Children Schools Program. While these school kit programs differ in delivery and full kit content from SEWKP, the comparison provides some context for the program.

The following recent evaluations by Cadmus are of programs in the Carolina System that include residential water measures:

- *Process and Impact Evaluation of the 2013–2014 Residential Neighborhood Program in the Carolina System* (November 2014)
- *Impact Evaluation of the Energy Efficiency for Schools Program (The National Theatre for Children (NTC)) in the Carolina System* (August 2013)
- *Process Evaluation of the Energy Efficiency for Schools Program (The National Theatre for Children (NTC)) in the Carolina System* (November 2012)

[5] We estimated savings for non-like program measures using the Mid-Atlantic TRM v5.0.

CADMUS

Process Evaluation Findings

This chapter presents Cadmus' process evaluation findings for DEC's SEWKP kits. The findings are divided into two sections: stakeholder interviews and participant surveys. Table 17lists the primary evaluation activities and the dates they were conducted.

Table 17. Process Evaluation Data Collection and Analysis

Evaluation Component	Dates of Data Collection	Total Conducted
Stakeholder Interviews	May 26–June 3, 2015	2
Participant Surveys	June 18–25, 2015	150

Stakeholder Interviews

Cadmus interviewed program stakeholders to gain an in-depth understanding of the program and to identify its successes and challenges. Discussion results follow, presented by topic.

Communication

Program staff and partners reported communicating on a regular basis, with communications being positive and effective. DEC conducts weekly conference calls with EFI to discuss CSAT survey results, call center volumes and associated escalations, and inventory levels. During those meetings, EFI reports to DEC regarding issues identified during the week, and DEC shares results from CSAT card responses. In addition, EFI stated that kit conversion rate forecasts greatly aided in their ability to maintain adequate inventory levels and to frontload kit assembly.

Program Delivery

SEWKP delivers kits to eligible single-family home dwellers (SFHDs). They begin the delivery process by sending a monthly mailer to the DEC jurisdiction—North Carolina, and South Carolina—inquiring as to the presence of an electric water heater in a household. If the respondent has an electric water heater, has not previously participated in SEWKP, and has not previously participated in a similar program (e.g., Home Energy House Call or related low-income or K-12 program), the respondent is deemed eligible to participate.

Per the workflow shown in Figure 1, DEC compiles a list of eligible SFHDs, reconciles this with customer demographic data (e.g., number and square footage of bathrooms) and, based on these data, configures participant-specific kits. DEC sends the list of participants and associated kit configurations to Direct Options, which generates and mails out BRCs, each with a unique ID and barcode, to the eligible population. In parallel, EFI receives the list of participants and associated kit configurations, and uploads this into their Kit Manager database. EFI then orders a measure inventory and begins preassembling kits, based on conversion rate forecasts provided by DEC.

Upon receiving the BRC, a customer may choose one of two options for program enrollment:

- Return the completed BRC via mail; or
- Call the EFI support center at the number provided on the BRC.

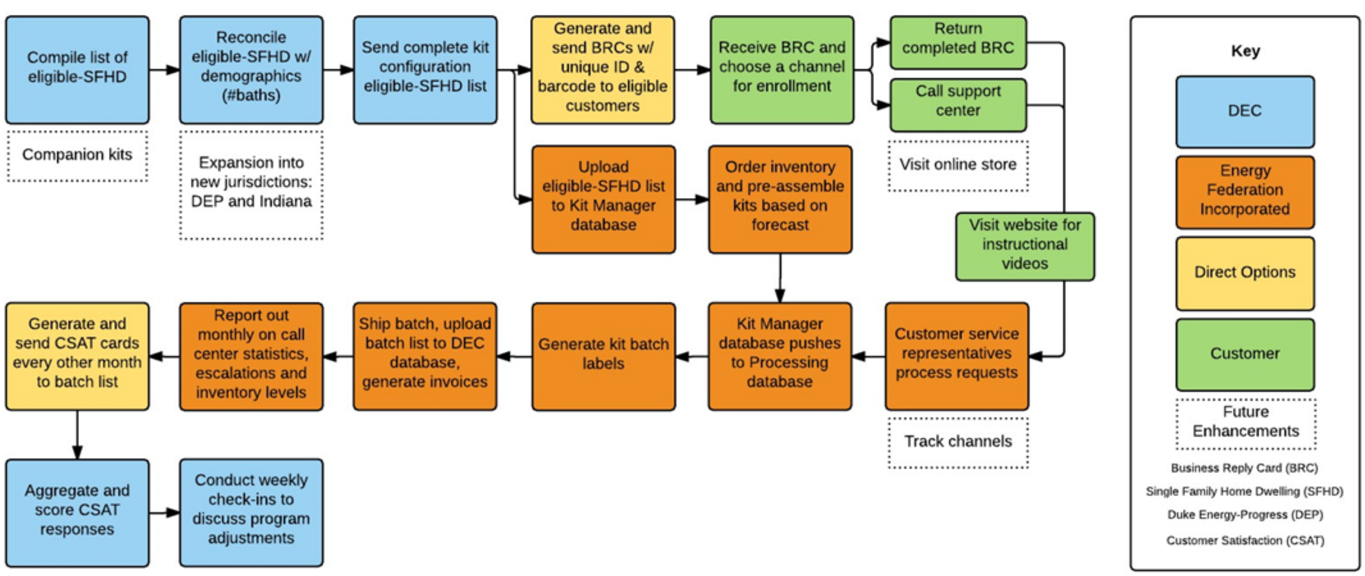
The BRC also includes a website URL (duke-energy.com/savewater/) that provides instructional videos to aid in installation.

For both methods, an EFI customer service representative processes the enrollment requests, entering these into the EFI Kit Manager database, which pushes these to the Processing database. This results in the generation of a label for each kit in the batch. EFI ships the batch of kits upon reaching a pallet threshold, uploads the batch list to DEC's database, and generates an invoice for the batch. The entire process takes four to six weeks.

On a monthly basis, EFI provides reports of call center volumes and escalations and of inventory levels. Direct Options generates and mails CSAT cards every other month to the batch list after kits have been sent. DEC scores and aggregates CSAT responses, using these data points to inform program adjustments (along with metrics discussed in weekly calls between DEC and EFI).

Figure 1. Program Delivery Process

Duke Energy Save Energy and Water Kit Program: As- Is Workflow



CADMUS

DEC plans to expand the program in two ways:

1. Home Energy House Call, Low Income, and K12 programs' participants that receive measures, but not entire kits will be sent companion kits to provide the whole bundle of measures for installation.
2. In addition to continuing the program in Kentucky, North Carolina, Ohio, and South Carolina, expanding the program into Duke Energy Progress during Q4-2015 and into Indiana on January 1, 2016.

DEC is also developing plans to provide customers with a third enrollment option: visiting an online store to register themselves, select customized measure colors or finishes (such as for showerheads), and otherwise upgrade their kits.

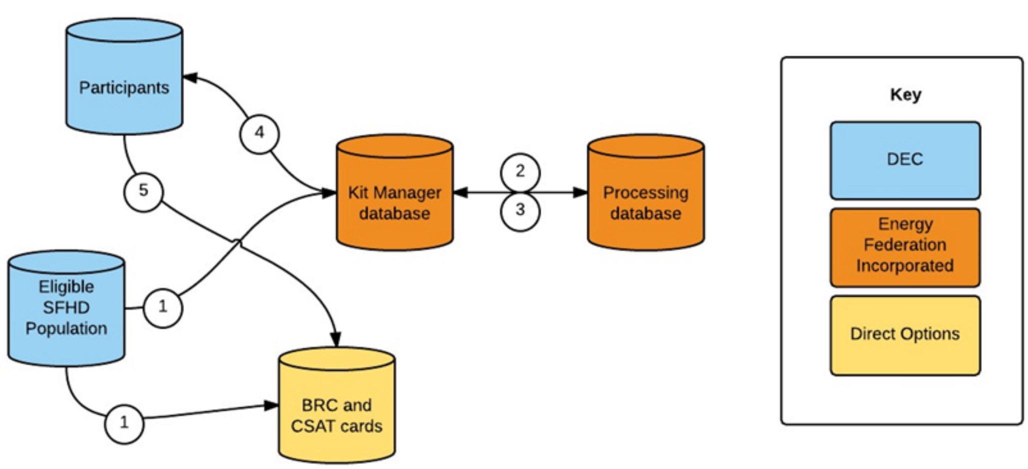
Promotion and Marketing

Eligible customers receive a BRC containing a description of kit items, information regarding electric water heater consumption, and an opportunity to reduce their monthly energy bills by signing up for a free SEWKP kit. No other promotion or marketing have been discussed.

DEC and Implementer Data Tracking

As shown in Figure 2, DEC maintains a database of eligible and participating SFHDs. As the first step in the process, DEC simultaneously provides a list of eligible SFHDs to EFI and Direct Options. When EFI's call center receives a phone request for enrollment or a BRC via mail, it inputs the data into its Kit Manager database. EFI uploads DEC's eligible SFHD list data to its Kit Manager database and joins that population data with a verified list of participants it tracks in its Processing database. In the Processing database, EFI collects the following data attributes: unique identifier, name, phone, premise and mailing address, registration date, record created date, kit type, and shipping date. Interviewees did not identify issues regarding data availability or tracking.

Figure 2. Data Flow



Market Barriers and Program Challenges

Program and implementer staff agreed that the program functions well and they receive sufficient resources. Although program uptake started slowly, with a 13.2% adoption rate in 2014, this rate more than doubled in 2015. Those interviewed agreed that much of the program success stems from its simplicity: it serves as a well-supported do-it-yourself program. The BRC highlights the installation process, as do the kit materials and instructional videos available online.

Program Feedback and Suggestions

Program and implementation staff provided feedback and suggestions about program elements that worked well and about possible changes.

Both program and implementer staff discussed the merits of establishing an online store. Benefits from pursuing this option include (but are not limited to):

- Increasing CSAT by allowing customization (validated by CSAT responses requesting this ability);
- Reducing delivery time through an expedited shipping process; and
- Indirect exposure to other programs through the online store's one-stop shopping aspect.

The implementer noted that the kit measures are now a couple years old, and better products may be on the market to increase customer receptivity. The implementer does not anticipate inventory or logistical challenges due to customization resulting from the launch of an online store.

Additionally, both respondents discussed the benefits of tracking the number of enrollment requests received via BRC versus call-in, as the entry method drives delivery costs, which would likely be greatly reduced through an online store allowing for near real-time enrollment.

Program staff are responsive to CSAT scores. For example, when customers notified DEC that aerators did not fit, program staff revised the BRC and kit language to include instructions for requesting an adapter.

Participant Surveys

Cadmus surveyed 150 randomly selected DEC customers who received a SEWKP kit (105 customers from North Carolina and 45 customers from South Carolina). This section presents results by topic. Except where noted, Cadmus excluded "don't know" and "refused" responses, reflected in accompanying n-values.

Save Energy and Water Program Kit

Cadmus asked survey respondents about their experiences with the SEWKP kit, including their recollection of receiving kit items, using them, and their satisfaction with the items.

DEC sends the kits in small, medium, and large bundle configurations, each of which includes different numbers of items as outlined above in Table 13. Nearly one-half of surveyed participants received a small kit (47%, n=150), while 9% received a large kit. According to program records, the 150 surveyed participants received a total of 244 showerheads and 788 faucet aerators through the program.

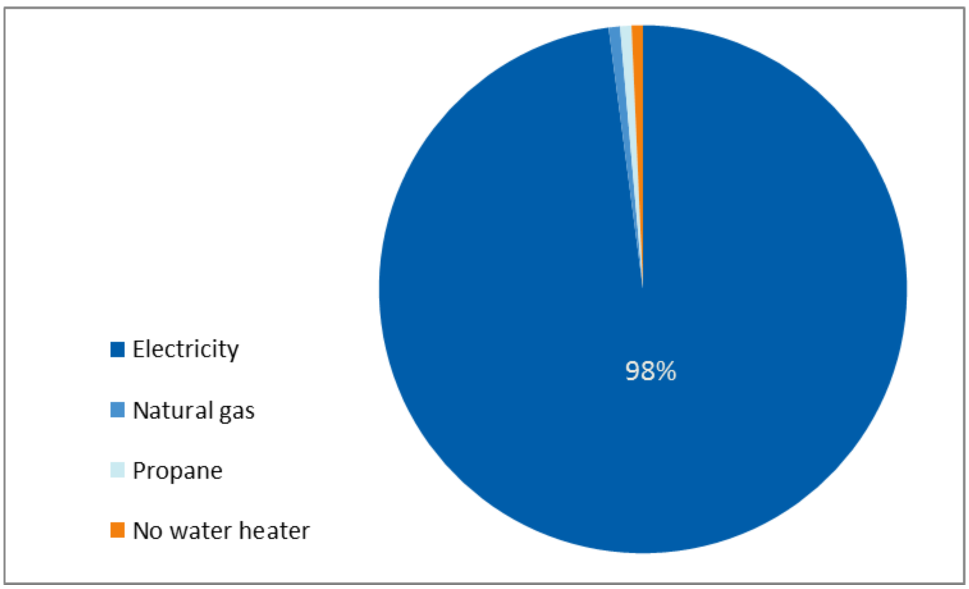
Table 18. Kit Configurations Received by Survey Participants

Kit Configuration	Showerheads in Kit	Bathroom Aerators in Kit	Kitchen Aerators in Kit	Count of Surveyed Participants	Percentage of Surveyed Participants*
Small kit	1	3	1	70	47
Medium kit	2	5	1	66	44
Large kit	3	7	1	14	9
Total	**244**	**638**	**150**	**150**	**100**

* The percentage of survey participants provided with a small, medium, or large kit configuration aligned with the population: 44% (small), 46% (medium), and 10% (large).

DEC targets households for the SEWKP that heat water with electricity, and 98% (n=144) of participants confirmed they have an electric hot water heater (Figure 3).

Figure 3. Fuel Source for Hot Water Heating



Source: Participant Survey Question B1. What is the fuel used by your water heater? (n=144)

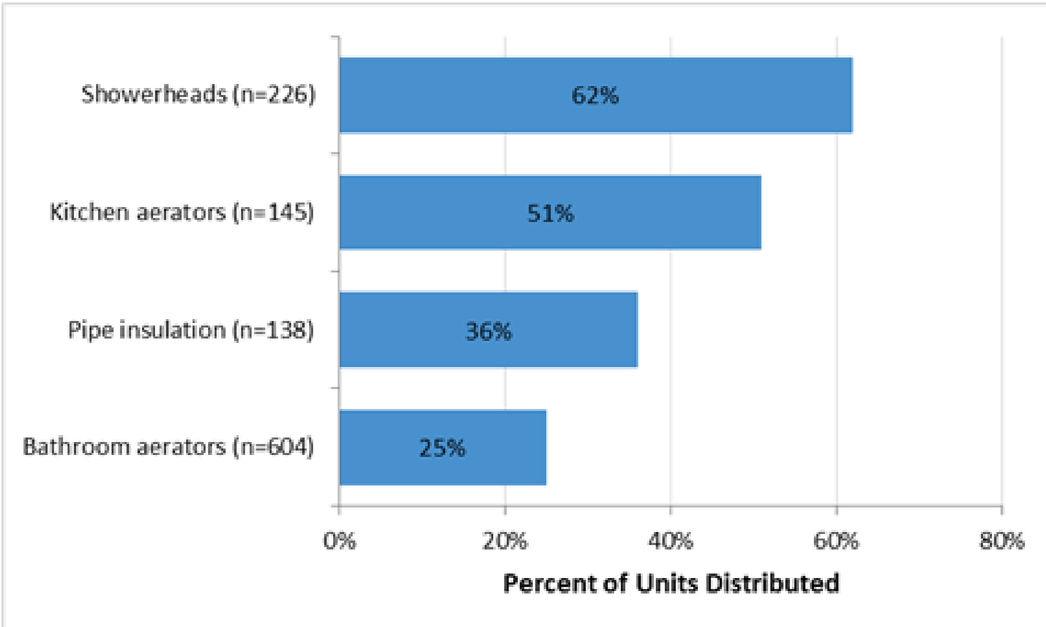
Use of Kit Measures

Cadmus asked survey respondents a series of questions regarding their use of kit measures. Specifically, we asked participants to indicate the following:

- The number of measures currently installed.
- Whether they had attempted to install any measures not currently installed.
- What problems they encountered if unsuccessful in installing a measure.

Participants most often reported installing showerheads included in the kits (62%, n=226 showerheads), as shown in Figure 4. One-half of kitchen aerators (51%, n=145 aerators) and only one-quarter of bathroom aerators (25%, n=604 aerators) were installed. Approximately one-third of participants installed the pipe insulation (36%, n=138). Note that the figure shows the percentage of a measure, not the percentage of people; for example, 62% of the 226 showerheads shipped to these 150 survey respondents were installed.

Figure 4. Installation Rates of Water-Saving Kit Measures

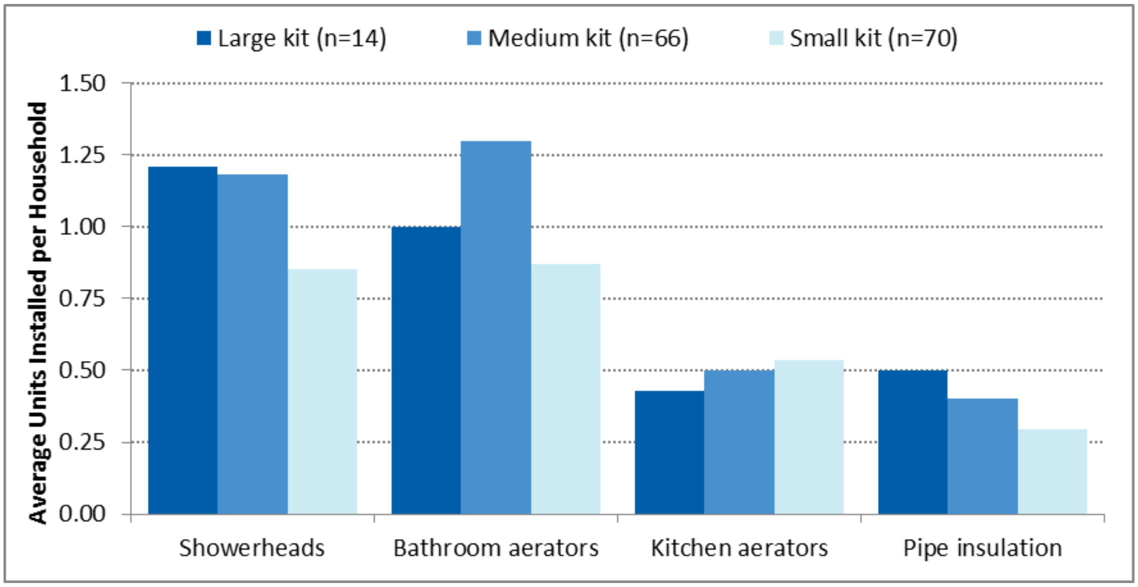


Source: Participant Survey Questions. Is the [item] / how many [items] that you received in the Save Energy and Water Kit Program kit are currently installed in your home? (n=150)

Figure 5 indicates that participants who received the large kit bundle did not install more items. Participants who received three showerheads installed an average of 1.2 per household, the same amount as those who received two showerheads. Customers who received the large kit bundle actually installed fewer bathroom aerators (an average of 1.0 of seven provided in this kit) than those who received the medium kit bundle (an average of 1.3 of five provided in this kit).

CADMUS

Figure 5. Installation of Kit Measures by Kit Configuration



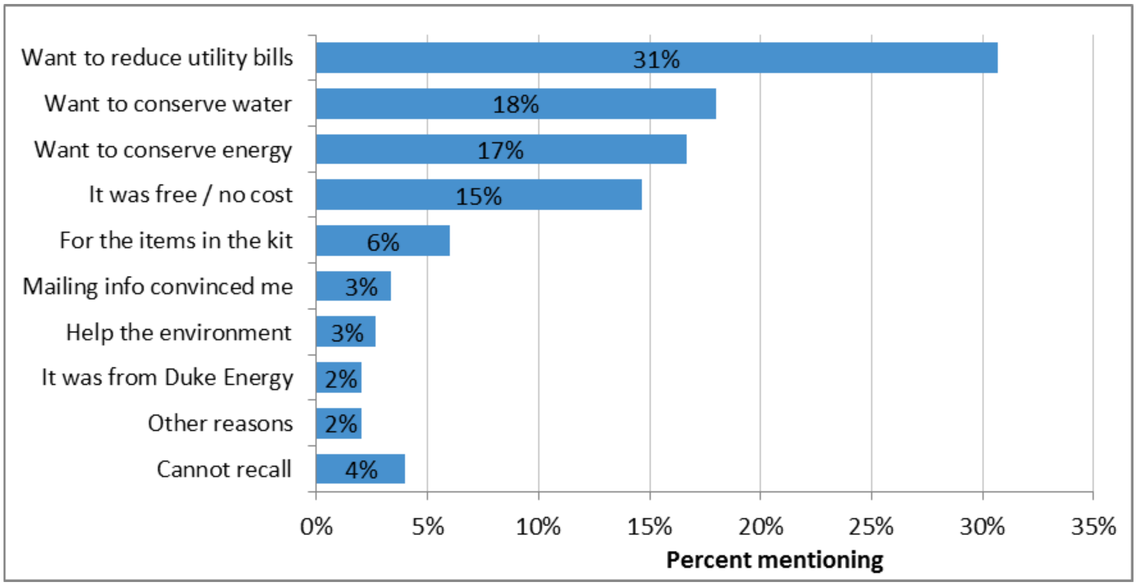
Source: Participant Survey Questions. Is the [item] / how many [items] that you received from the Save Energy and Water Kit Program kit are currently installed in your home? (n=150)

The participant survey, provided in Appendix B, contains further details regarding the installation and use of items in the SEWKP kits.

Program Awareness and Participation

As shown in Figure 6, customers' most commonly cited reason for choosing a SEWKP kit was to save money on utility bills, followed by wanting to conserve water and energy, and the lack of out-of-pocket costs. Ninety-six percent of participants (n=150) could state a reason for participating.

Figure 6. Main Reason for Participating in the Save Energy and Water Kit Program



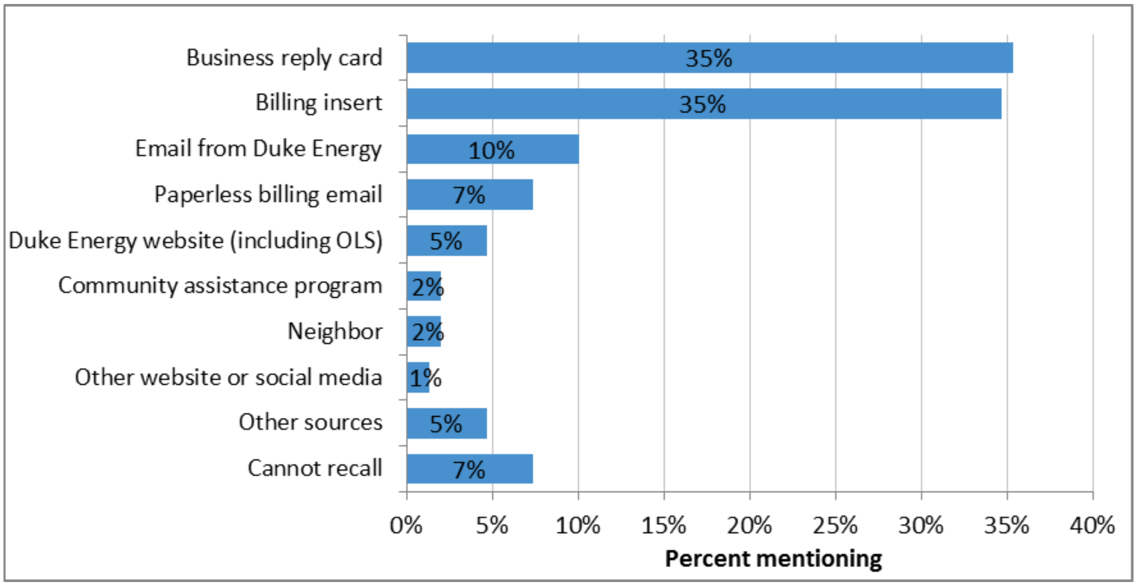
Source: Participant Survey Question C2. Please think back to the time when you were deciding to participate in the Save Energy and Water Kit Program. What was the main reason you decided to take advantage of this offer? (n=150)

As shown in Figure 7, most customers who participated in SEWKP stated they learned of the program from BRCs and bill inserts[6] from DEC, with e-mail and DEC's website being the next most common sources. Ninety-three percent (n=150) of customers receiving a SEWKP kit could recall how they first heard about the program.

[6] DEC did not provide bill inserts and e-mails as a marketing element of this program. It is likely that survey respondents confused the BRC with a bill insert.

CADMUS

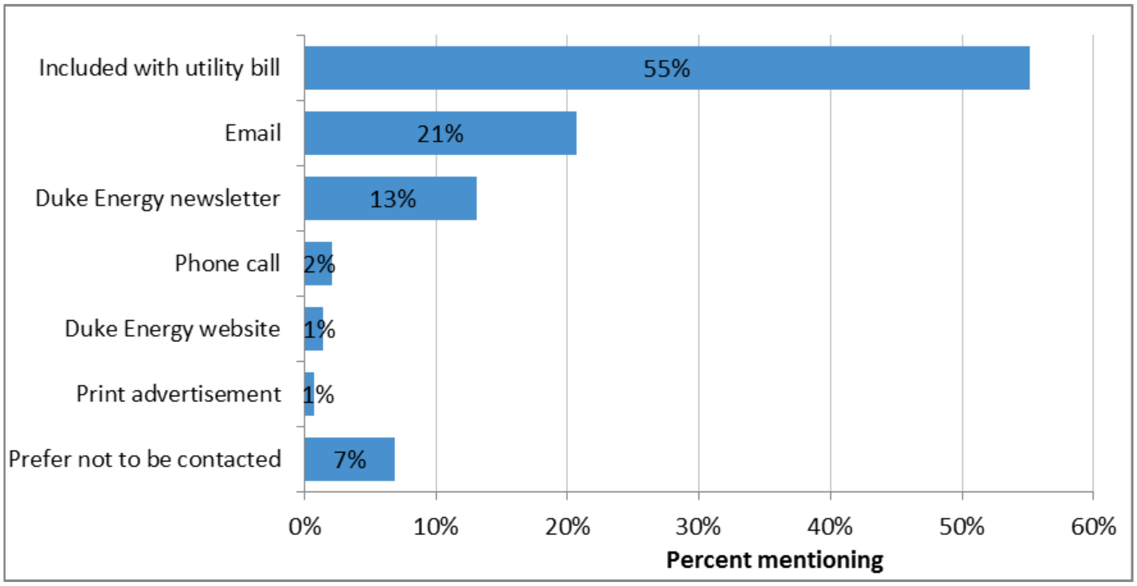
Figure 7. How Customers Became Aware of the Save Energy and Water Kit Program



Source: Participant Survey Question C1: How did you first hear about the Save Energy and Water Kit Program? (n=150; multiple responses permitted; percentages are of total number of survey respondents and exceed 100%). Note: OLS represents online services

As shown in Figure 8, when asked which method they prefer for receiving information to help save on utility bills, customers most commonly (55%; n=145) cited information included with their utility bills, although 21% prefer e-mail and 13% prefer to read about it in a DEC newsletter. Very few customers cited phone calls, the DEC website, or traditional advertising, and only 7% said they do not want to receive such information.

Figure 8. Survey Respondents' Preferred Method for Receiving Information



Source: Participant Survey Question C3. If you are interested in receiving additional information that could help you save money on your bill, what is your preferred method to receive that information? (n=145)

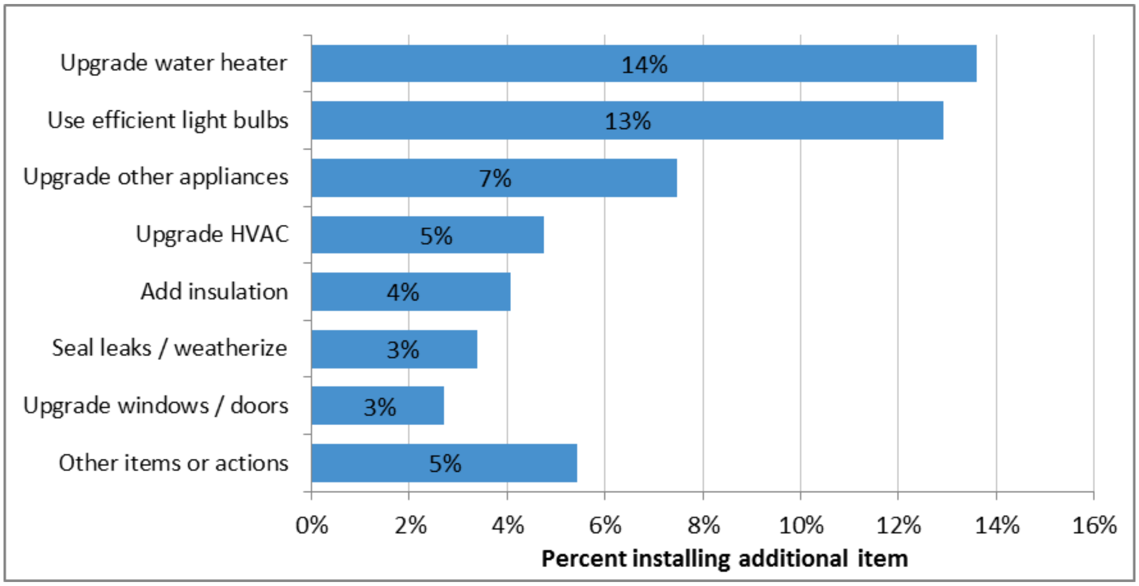
Although very few customers cited DEC's website as a preferred source for learning about ways to save on utility bills, 37% (n=148) of surveyed participants reported visiting the website to find more information about the SEWKP kit.

Additional Measures Installed Since Receiving Kit

As shown in Figure 9, Cadmus asked participants if they installed additional energy efficiency measures after receiving the program kit: 35%[7] (n=147) said they had, including 14% who upgraded to a more efficient electric water heater (the most frequent additional action taken).

[7] This 35% represents those who reported installing an additional measure and who reported what they installed. At first, 41% said they installed additional measures, but 10 of these survey respondents said "none" when asked which specific measures they installed.

Figure 9. Installation of Additional Items Since Participating in the Program



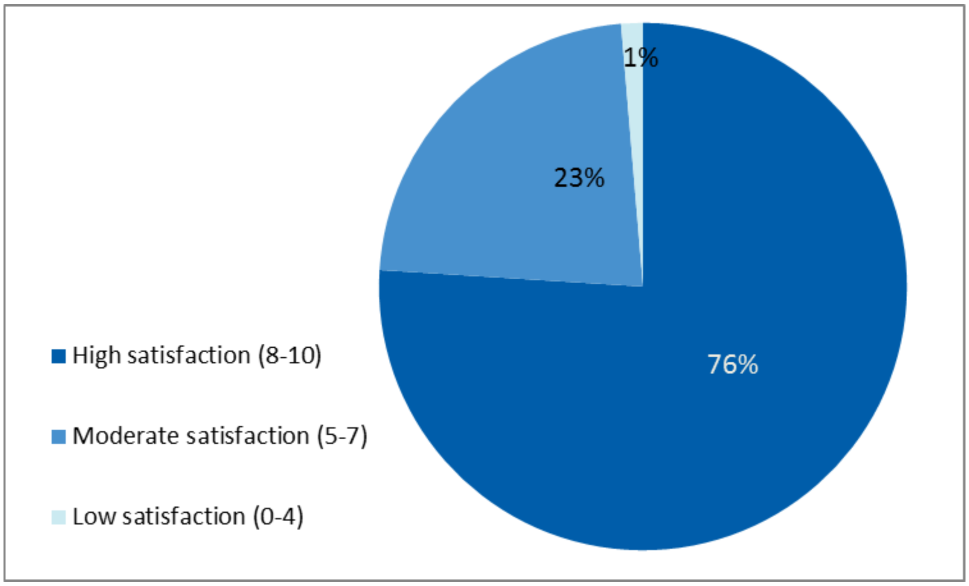
Source: Participant Survey Questions F1: Since participating in the program, have you installed any energy-efficient equipment or made other changes to improve the energy efficiency of your home, changes for which you did NOT receive a rebate or otherwise provided for free? F2: Was one of the improvements an upgrade to a more energy-efficient water heater? F4: What other energy-efficient improvements have you made? (n=147; multiple responses permitted; percentages are of total number of survey respondents)

Satisfaction

Program Satisfaction, Improvements, and Benefits

Cadmus asked participants to rate their satisfaction with kit measures on a 0 to 10-point scale, where 0 indicated being “extremely dissatisfied” and 10 indicated being “extremely satisfied.” As shown in Figure 10, 76% of survey respondents (n=150) provided a satisfaction rating of 8 or higher, including 47% who rated the kit measures as a 10. Only 1% of survey respondents gave a program satisfaction rating of 4 or lower; these two participants said their dissatisfaction resulted from not being able to use all kit items.

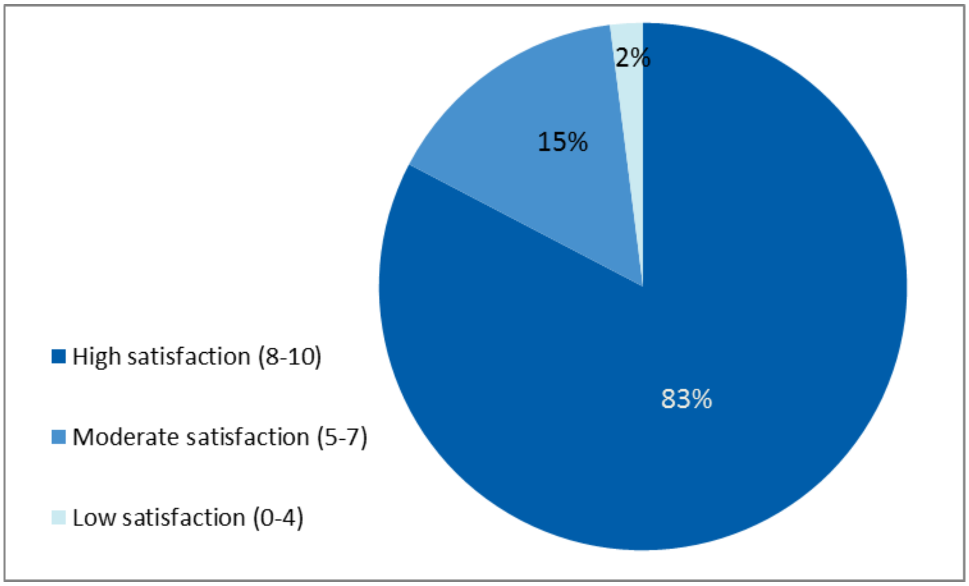
Figure 10. Overall Satisfaction with Measures in the Program Kit



Source: Participant Survey Question D1: On a scale from 0 to 10, with 0 being *very dissatisfied* and 10 being *very satisfied*, what is your overall satisfaction with the items that were provided in the Save Energy and Water Kit Program kit? (n=150)

Cadmus also asked surveys participants to rate their satisfaction with the SEWKP overall. As shown in Figure 11, 83% of survey respondents (n=150) provided a satisfaction rating of 8 or higher, including 53% who rated the program a 10. Only 2% of survey respondents rated the program a 4 or lower. Two of these three participants said their dissatisfaction resulted from not being able to use all kit items, while the third participant complained that their utility bill was not lower than before program participation.

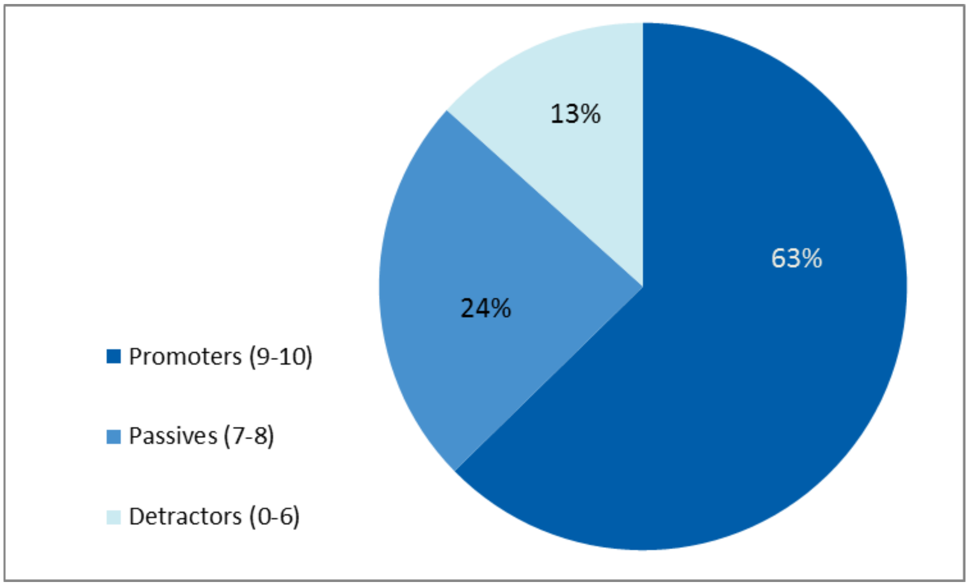
Figure 11. Overall Satisfaction with the Save Energy and Water Kit Program



Source: Participant Survey Question D3: Using the same scale from 0 to 10, overall, how would you rate the Save Energy and Water Kit Program? (n=150)

Participants rated the likelihood they would recommend the SEWKP to others, also on a 0-to-10 scale, with 0 being "not at all likely to recommend" and 10 being "extremely likely to recommend." As shown in Figure 12, 63% of survey respondents (n=150) provided a recommendation score of 9 or 10, 57% of whom rated this as a 10. Only 13% of survey respondents rated their likelihood of recommending the program as a 6 or lower.

Figure 12. Likelihood of Recommending the Save Energy and Water Kit Program



Source: Participant Survey Question D10: On a 0 to 10 scale, with 0 meaning you are "not at all likely to recommend," and 10 meaning you are "very likely to recommend," how likely are you to recommend the program to a friend? (n=150)

When asked for suggestions to improve the program, 14% (n=150) of surveyed participants responded. Table 19summarizes their suggestions, showing that several customers suggesting measures or equipment the program could offer (although many of these suggested items would not be appropriate for a mail order kit program due to size and expense). Multiple customers suggested having more functions (e.g., adjustability) or options (e.g., design, fit) for faucet aerators and showerheads. Three survey respondents (2%; n=150) requested a larger quantity of a kit measure (two who wanted more aerators and one who wanted more pipe insulation tape).

Table 19. Participant Suggestions to Improve the Save Energy and Water Kit Program

Suggestion	Count of Responses (n=21)
Offer items not currently included in kit: • Water-saving attachment for outdoor hose • Water-saving toilet devices • Water heater blanket • "Efficient water pumps" • "Hot water circulator" • LEDs • "It seemed like the kit was incomplete"	7
More functionality/options for aerators and showerheads	4
Include a larger quantity of a measure already included in the kit: • Faucet aerators (2 customers) • Pipe insulation tape (1 customer)	3
Lower bills/information about saving money on bills	3
Higher water pressure/higher flow aerators and showerheads	2
Send out more kits/get more customers to participate	2

When specifically asked what other equipment or upgrades could be included in the kits, 23% (n=150) made the suggestions summarized in Table 20, most frequently suggesting lighting and weather-stripping/air-sealing measures.

Table 20. Participant Suggestions for Additional Equipment or Upgrades to Include in the Save Energy and Water Kit Program

Suggested Equipment or Upgrade	Count of Responses (n=35)
Efficient light bulbs (CFL, LED)	10
Weather-stripping/air-sealing	6
Efficient water heaters	4
Insulation	3
Lighting occupancy sensors	2
HVAC or ventilation filters	2
Appliance upgrades other than water heaters	2
Solar panels/solar-powered measures	2
A tool or app to monitor HVAC usage	2

CADMUS

Suggested Equipment or Upgrade	Count of Responses (n=35)
Home audit/energy assessment	2
Other suggestions (one mention each): • More showerheads • Toilet "flapper" to conserve water • New windows • Efficient phone chargers	4

Note: Some survey respondents made multiple suggestions; therefore, the number of responses exceeds the number of survey respondents (n=35).

When asked if their energy or water usage had changed since installing items from the SEWKP kit, 39% (n=136) said they noticed a difference. Forty-four survey respondents specified these changes, as summarized in Table 21. Most of these participants noticed a decrease in their utility bills, while three participants reported improved water flow, two said their hot water lasted longer, and two said installing the kit items fixed a leaky faucet or showerhead.

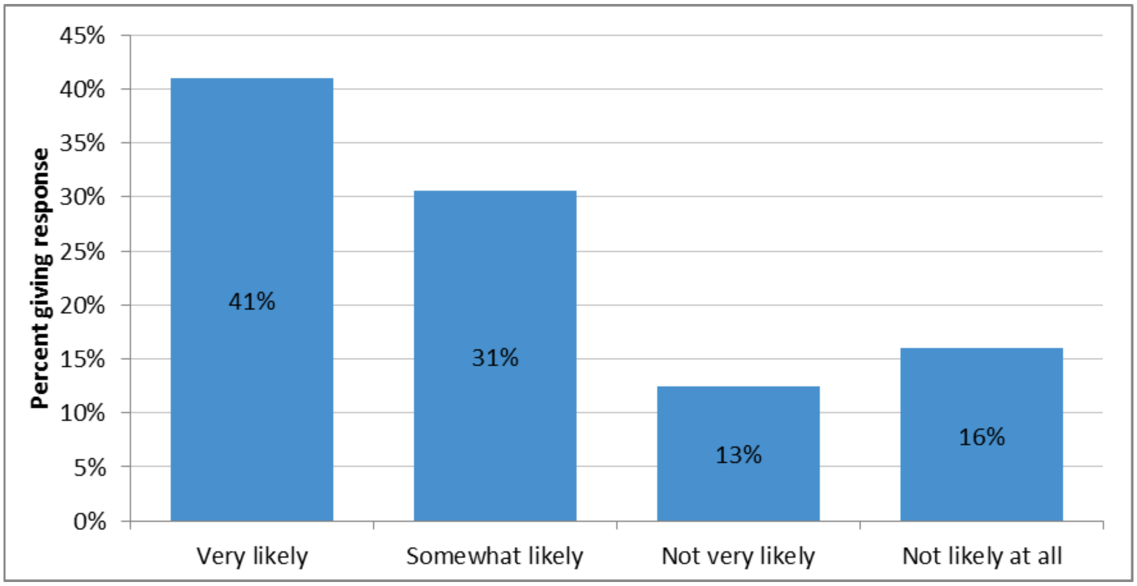
Table 21. Changes in Home Energy Usage Noticed Since Participating in the Save Energy and Water Kit Program

Response	Count of Responses (n=44)
Lower utility bills	34
Using less water	6
Water flow from faucets/shower is better	3
Hot water lasts longer	2
Using less energy	2
Installing kit measure fixed a leak	2
Home is warmer in winter	1

Note: Some survey respondents cited multiple reasons; therefore, the number of responses exceeds the number of survey respondents (n=44).

Cadmus asked participants if an online store that would allow them to choose different models of energy-efficient showerheads would make them more likely to install these showerheads. As shown in Figure 13, 41% (n=144) said this would make them very likely to install the showerheads, and another 31% said it would make them somewhat more likely.

Figure 13. Likelihood that an Online Store Offering Choices Would Increase the Likelihood of Installing Energy-Efficient Showerheads

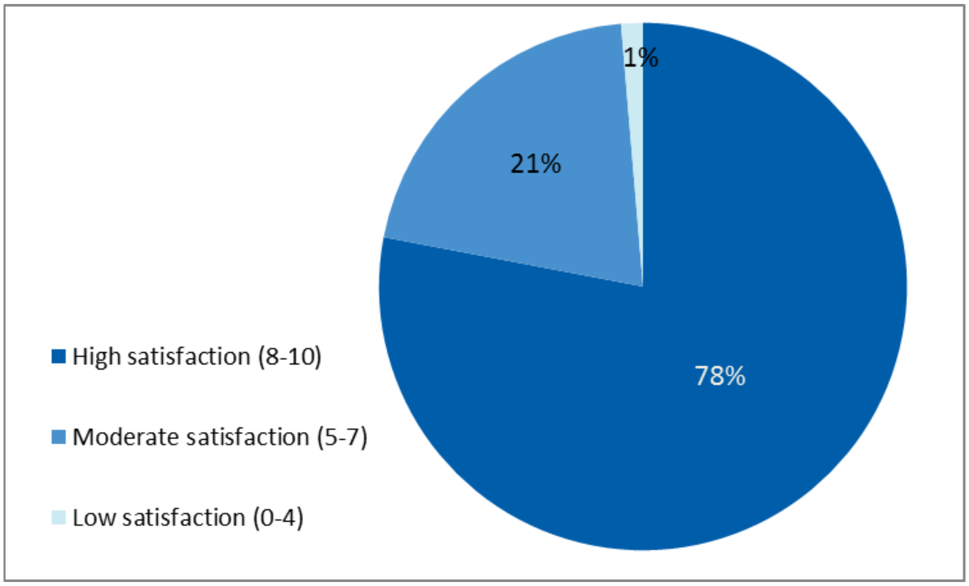


Source: Participant Survey Question D7: In the future, would the presence of an online store where you could pick the color or finish of your showerhead increase the likelihood of you actually installing more of these types of showerheads? (n=144)

Utility Satisfaction

Cadmus also asked participants to rate their satisfaction with DEC as an energy provider. As shown in Figure 14, 78% of survey respondents (n=150) provided a satisfaction rating of 8 or higher, which includes 49% who rated DEC as a 10. Only 1% of survey respondents rated their satisfaction with DEC at 4 or lower. The two survey respondents who gave DEC a low satisfaction rating both cited increasing energy costs as the reason for their dissatisfaction.

Figure 14. Overall Satisfaction with DEC



Source: Participant Survey Question D5: Using the same scale from 0 to 10, overall, how would you rate DEC as your energy provider? (n=150)

CADMUS

Impact Evaluation Findings

This section presents the results of Cadmus' impact evaluation of the DEC SEWKP, divided into four sections: Gross Program Savings, Total Gross Verified Savings, Net-to-Gross Findings, and Net Program Savings. Table 22 lists the primary evaluation activities and dates.

Table 22. Impact Evaluation Data Collection and Analysis

Evaluation Component	Participation Dates	Data Source(s)	Dates of Data Collection/Analysis
Savings Analysis	April 1, 2014 - February 15, 2015	• Participant surveys (n=150) • Mid-Atlantic TRM • Illinois TRM • Ohio Draft TRM	June-July 2015
NTG Analysis	April 1, 2014 - February 15, 2015	• Participant surveys (n=150)	June-July 2015

Gross Program Savings

Cadmus used TRM assumed values to determine household energy savings resulting from using items included in the SEWKP kit. This section presents savings analysis details and high-level results for the showerheads, faucet aerators, and pipe wrap included in the kits.

Electric Water Heater Saturation

DEC claims SEWKP electricity savings from the reduction in water use from electric water heaters. Cadmus asked surveyed participants to verify their water heating fuel, and 97.9% indicating having an electric water heater. We applied this percentage to weight each measures' savings to reflect actual electricity program savings.

Energy-Efficient Showerhead

The program kits included either one, two, or three showerheads (based on kit configuration). Survey results indicated that, overall, participants installed 62% of the showerheads provided in the kits. The program achieved realization rates of 205% and 91% for energy savings (kWh) and demand reduction (kW), respectively. This section details equations and survey averages used to determine *ex post* savings, and reports quantities and savings verified.

CADMUS

Equation

The Mid-Atlantic TRM[8] defines the equation below to calculate energy savings associated with replacing one showerhead with one energy-efficient showerhead, as defined in Table 23 below.

$$\left[\frac{\left(\left(\frac{GPMbase - GPMlow}{GPMbase}\right) * \#\frac{people}{household} * \frac{gallons}{day} * \frac{days}{year}\right)}{\#\frac{showerheads}{household}}\right] * \frac{\rho * (TempSH - TempIN) * \left(\frac{MMBtu}{Btu}\right)}{\frac{DHW\ RE}{\left[\frac{MMBtu}{kWh}\right]}} * ISR$$
$$* \ Electric\ Water\ Heater\ Saturation$$

Cadmus asked survey respondents how many showers are taken per week for each energy-efficient showerhead, as well as how long, on average, these showers last. This information was used to estimate the number of gallons used per year for one showerhead, as referenced in Table 24. Cadmus adapted the Mid-Atlantic TRM to reflect the surveyed variables, resulting in the equation below.

$$\left(\left(\frac{GPMbase - GPMlow}{GPMbase}\right) * \#\frac{showers}{week} * \frac{minutes}{shower} * \frac{weeks}{year} * GPMbase\right) * \frac{\rho * (TempSH - TempIN) * \left(\frac{MMBtu}{Btu}\right)}{\frac{DHW\ RE}{\left[\frac{MMBtu}{kWh}\right]}} * ISR$$
$$* \ Electric\ Water\ Heater\ Saturation$$

The Mid-Atlantic TRM calculates summer coincident kW savings using the formula below. The number of hours is defined as "average number of hours per year spent using showerhead" (Mid-Atlantic Technical Reference Manual). Cadmus used the average survey responses for the number of showers taken per week per showerhead and the average number of minutes per shower to determine annual hours of use.

$$\frac{kWh * CF}{hours}$$

Table 23. Variables in the Energy Savings Calculation for Showerheads

Variable	Value		Source	Description
$GPMbase$	2.2		Mid-Atlantic TRM	Assumed flow rate of original showerhead; gallons/minute
$GPMlow$	1.5		Program Specification	Flow rate of kit showerhead; gallons/minute
$\frac{showers}{week}$	First Showerhead	11	Survey	Average number of showers per week
	Second Showerhead	9		
	Third Showerhead	1		
$\frac{minutes}{shower}$	First Showerhead	12	Survey	Average number of minutes per shower
	Second Showerhead	12		
	Third Showerhead	5		

8 Northeast Energy Efficiency Partnerships, Inc. *Mid-Atlantic Technical Reference Manual*. 2015. Available online: http://www.neep.org/mid-atlantic-technical-reference-manual-v5

$\frac{days}{year}$	365		Convention	Number of days in the year
ρ	8.33		Convention	Density of water; gallons/pound
$TempSH$	105°F		Mid-Atlantic TRM	Assumed temperature of water used for shower
$TempIN$	60.9°F		Mid-Atlantic TRM	Assumed temperature of water entering house
$\frac{Btu}{MMBtu}$	1,000,000		Convention	Conversion factor from Btu to MMBtu
$DHW\ RE$	0.98		Mid-Atlantic TRM	Recovery efficiency of electric water heater
$\frac{MMBtu}{kWh}$	0.003412		Convention	Conversion factor from MMBtu to kWh
$Summer\ CF$	0.00371		Mid-Atlantic TRM	Coincidence Factor
Electric Water Heater Saturation	97.9%		Survey	Proportion of homes in program with an electric water heater
ISR	First Showerhead	83%	Survey	Average in-service rate per showerhead
	Second Showerhead	60%		
	Third Showerhead	40%		
$Hours$	First Showerhead	118	Survey	Average hours of use per year per showerhead.
	Second Showerhead	90		
	Third Showerhead	4		

Survey-Averaged Values

When possible, Cadmus used averaged survey responses in place of TRM assumed values to provide recent, regional values, tailored to DEC's service territory. While we did not specifically ask surveyed participants for the average number of people per household, average gallons per day consumed per person, or average number of showerheads per household, we asked other questions to determine the gallons consumed per year per showerhead and the average yearly hours-of-use per showerhead. Specifically, we did ask slightly modified survey questions regarding the number of showers and the average length of showers to produce the necessary values (using more intuitively answered questions). Table 24 shows survey-averaged results for these values.

CADMUS

Table 24. Survey Average Results per Showerhead Installed

Number of Showerheads	Average Showers per Week	Average Minutes per Shower*	Average Gallons per Week	Average Gallons per Year	Average Hours-of-Use per Year
First Showerhead	11	12	300	15,594	118
Second Showerhead	9	12	229	11,924	90
Third Showerhead	1	5	11	572	4

.

Cadmus determined showerhead ISRs for households receiving one showerhead, two showerheads, and three showerheads. Overall, survey respondents installed 62% of the showerheads they received through the SEWKP. This ISR decreased with each additional showerhead provided in the kit. Table 25 presents the specific results.

Table 25. Showerhead In-Service Rates

Showerheads Provided	Total Showerheads Reported*	Total Showerheads Verified	Average Showerheads Installed	Average In-Service Rate
1	58	48	0.83	83%
2	126	75	1.19	60%
3	42	17	1.21	40%
Total	**226**	**140**	**1.04**	**62%**

* Reported totals based on the number of responses that could be verified (not including “don’t know” responses and responses where the value verified was greater than the value reported), and may not sum to the total number of measures reported in the tracking database.

Cadmus found a number of discrepancies when comparing the reported quantities of showerheads from the SEWKP tracking database to quantities reported by survey respondents. Ten survey respondents verified installing two or three showerheads, while DEC reported sending a kit with only one showerhead. One respondent verified installing three showerheads when DEC reported sending a kit with only two showerheads. To provide the best possible estimate of savings, Cadmus removed these survey respondents from average ISR calculations.

Gross Verified Savings

Cadmus verified 205% of energy savings (kWh) and 91% of demand reduction (kW) from expected savings values. Table 26 shows savings and realization rates by the number of reported showerheads. In addition to the showerhead savings per kit, the table also provides the total aggregate showerhead savings.

Table 26. Showerhead Reported and Gross Verified Savings

Showerheads Provided	Reported Savings (kWh)	Reported Savings (Summer Coincident kW)	Verified Savings (kWh)	Verified Savings (Summer Coincident kW)	Realization Rate (kWh)	Realization Rate (kW)
1	144	0.0115	442	0.0139	308%	121%
2	287	0.0229	561	0.0200	195%	87%
3	431	0.0344	389	0.0204	90%	59%
Average Per Showerhead	144	0.0115	294	0.0104	205%	91%
All Showerheads	**3,384,726**	**270.4690**	**6,929,387**	**244.9420**	**205%**	**91%**

Faucet Aerators

SEWKP kits included one kitchen faucet aerator and either three, five, or seven bathroom faucet aerators. Survey results indicate that participants installed 51% of kitchen faucet aerators provided in the kits, providing program realization rates of 300% and 556% for energy savings (kWh) and demand reduction (kW), respectively. Participants installed bathroom faucet aerators at a lower rate (25% overall). Realization rates for bathroom aerators were 9% and 108% of energy savings (kWh) and demand reduction (kW), respectively. This section details TRM equations and survey averages used to determine *ex post* savings, and reports quantities and verified gross savings.

Equation

Cadmus used the equation below, from the Illinois TRM,[9] to find total energy savings per faucet aerator, and to determine results separately for kitchen and bathroom faucet aerators. Table 27 describes the variables in this equation.

$$ElecDHW * \left[\frac{\left((GPMbase * Lbase - GPMlow * Llow) * \frac{\#\,people}{household} * \frac{days}{year} * DF\right)}{\frac{\#\,faucets}{household}}\right] * EPGelec * ISR$$

9 Illinois Commerce Commission. *Illinois Technical Reference Manual for Energy Efficiency*. 2015. (Note: equations are the same for the 2014 and 2015 TRM.) Available online: http://www.icc.illinois.gov/electricity/TRM.aspx

Table 27. Variables in the Energy Savings Calculation for Faucet Aerators

Variable	Kitchen	Bathroom	Source	Description
$ElecDHW$	97.9%	97.9%	Survey	Proportion of water heating supplied by electric resistance
$GPMbase$	2.2	2.2	Illinois TRM	Assumed gallons per minute of the original faucet aerator
$Lbase$	4.5	1.6	Illinois TRM	Average minutes of daily use per person of original faucet aerator
$GPMlow$	1.0	1.0	Program Specification	Gallons per minute of faucet aerator provided in kit
$Llow$	4.5	1.6	Illinois TRM	Average minutes of daily use per person of faucet aerator provided in kit
$\frac{\#people}{household}$	2.56	2.56	Illinois TRM	Average number of people per house, single family
$\frac{days}{year}$	365.25	365.25	Convention	Average number of days in a year
DF	75%	90%	Illinois TRM	Drain factor
$\frac{\#faucets}{household}$	1.0	2.83	Illinois TRM	Average number of faucets per household
$EPGelec$	0.0969	0.0795	Illinois TRM	Energy per gallon of water used by faucet supplied by electric water heater; kWh/gallon
ISR	51%	Three Aerators 29% Five Aerators 26% Seven Aerators 14%	Survey	In-service rate
$Summer\ CF$	0.0220	0.0220	Illinois TRM	Summer coincidence factor

Survey-Averaged Values

Cadmus averaged survey responses to determine kitchen and bathroom faucet aerator ISRs. Table 28 shows the overall rates for kitchen and bathroom faucet aerators separately, with different ISRs for bathroom faucet aerators based on the quantity provided in the kit. Consistent with showerheads, bathroom faucet aerator ISRs decrease as more units are included in the kit.

Table 28. Faucet Aerator In-Service Rates

Faucet Aerators Provided	Total Faucet Aerators Reported*	Total Faucet Aerators Verified	Average Faucet Aerators Installed	Average In-Service Rate
Kitchen Aerator	**145**	**74**	**0.51**	**51%**
Bathroom Aerators	**604**	**152**	**0.93**	**25%**
Bathroom Aerator (3)	198	57	0.86	29%
Bathroom Aerator (5)	315	82	1.30	26%
Bathroom Aerator (7)	91	13	1.00	14%

* Reported totals are based on the number of responses that could be verified (totals do not include “don’t know” responses and responses with verified values greater than the value reported), and may not sum to the total number of measures reported in the tracking database.

Cadmus found one discrepancy between the quantity of bathroom faucet aerators in the SEWKP tracking database and the quantity a survey respondent claimed receiving. One participant verified installing four bathroom faucet aerators, while DEC reported sending the participant only three bathroom faucet aerators. To provide the best estimate of savings possible, Cadmus removed this respondent from average ISR calculations.

Gross Verified Savings

Cadmus verified 300% of energy savings (kWh) and 556% of demand reduction (kW) for kitchen faucet aerators compared to expected savings. Bathroom faucet aerators achieved lower realization rates of 9% for energy savings (kWh) and 108% for demand reduction (kW). Table 29 shows savings and realization rates by the number of reported faucet aerators. In addition to the aerators per kit savings, the table also provides the total aggregate kitchen and bathroom aerator savings.

CADMUS

Table 29. Faucet Aerators Reported and Gross Verified Savings

Faucet Aerators Provided	Reported Savings (kWh)	Reported Savings (Summer Coincident kW)	Verified Savings (kWh)	Verified Savings (Summer Coincident kW)*	Realization Rate (kWh)	Realization Rate (kW)
Average per Kitchen Aerator	61	0.0049	183	0.0272	300%	556%
All Kitchen Aerators	**863,129**	**68.9715**	**2,588,641**	**383.8057**	**300%**	**556%**
Bathroom Aerators (3)*	220	0.0176	22	0.0220	10%	125%
Bathroom Aerators (5)*	367	0.0293	34	0.0332	9%	113%
Bathroom Aerators (7)*	514	0.0410	26	0.0255	5%	62%
Average per Bathroom Aerator	73	0.0059	6	0.0063	9%	108%
All Bathroom Aerators	**4,495,851**	**359.2575**	**395,017**	**388.4662**	**9%**	**108%**

* Per participant receiving the corresponding number of bathroom faucet aerators.

Pipe Wrap

Every SEWKP kit included 15 feet of pipe wrap (enough to cover five linear feet of pipe). Survey results indicated that participants installed 36% of the pipe wrap provided in the kits, resulting in realization rates of 72% for energy savings (kWh) and 103% for demand reduction (kW). This section details the equations and survey averages used to determine *ex post* savings, and reports quantities and verified savings.

Equation

The Mid-Atlantic TRM provided the pipe wrap equation, which was used to determine the total energy savings for pipe wrap installed. Table 30 describes the equation variables.

$$\frac{\left(\frac{1}{Rexist} - \frac{1}{Rnew}\right) * (L * C) * \Delta T * \frac{Hours}{year}}{\eta DHW/(Btu/kWh)} * ISR * Electric\ Water\ Heater\ Saturation$$

Table 30. Variables in Energy Savings Calculation for Pipe Wrap

Variable	Value	Source	Description
$Rexist$	1.0	Mid-Atlantic TRM	Assumed R-value of existing pipe (no insulation)
$Rnew$	3.0	Program Specification	R-value of pipe wrap provided in kit
L	5.0	Program Specification	Length of pipe wrap installed; feet
C	0.55	Survey	Circumference of pipe; feet (2.12 inches)
ΔT	65°F	Mid-Atlantic TRM	Temperature difference between water in pipe and ambient air
$\frac{Hours}{year}$	8,760	Convention	Hours per year
ηDHW	0.98	Convention	DHW recovery efficiency
Btu/kWh	3,413	Convention	Conversion factor from Btu to kWh
ISR	36%	Survey	In-Service Rate
Electric Water Heater Saturation	97.9%	Survey	Proportion of homes in program with an electric water heater

Survey-Averaged Results

Cadmus used survey averages to determine the ISR for pipe wrap provided in the kit and to verify the diameter of pipes on which pipe wrap was installed. The average ISR for pipe wrap was 36% among survey respondents. Cadmus used the question, "Is any of the pipe insulation from the kit currently installed on your hot water pipes?" to determine the ISR; If a participant answered "yes," we assumed they installed all 5 feet of pipe wrap; we did not verify the specific amount installed. On average, participants insulated pipes that are 2.12 inches in diameter. Cadmus converted this survey-averaged value to circumference for use in the savings equation. Table 31 shows reported and verified quantities of pipe wrap.

Table 31. Pipe Wrap In-Service Rate and Diameter

Pipe Wrap (feet) Provided	Total Pipe Wrap Reported*	Total Pipe Wrap Verified*	Average In-Service Rate	Average Diameter of Pipe (inches)
5	138	50	36%	2.12

* Count of participants, not feet of pipe wrap.

Gross Verified Savings

Cadmus verified 72% of energy savings (kWh) and 103% of demand reduction (kW) for pipe wrap. Table 32 shows reported and verified savings for pipe wrap across all participants.

Table 32. Pipe Wrap Reported and Verified Savings

Pipe Wrap Provided	Reported Savings (kWh)	Reported Savings (Summer Coincident kW)	Verified Savings (kWh)	Verified Savings (kW)	Realization Rate (kWh)	Realization Rate (kW)
Per Unit of Pipe Wrap (5 feet)	154	0.0123	112	0.0127	72%	103%
All Pipe Wrap	2,173,360	173.6703	1,574,378	179.7235	72%	103%

Total Gross Verified Savings

Table 33 presents reported and gross verified savings and corresponding realization rates. Although individual measure realization rates vary, the program overall realized 105% of energy savings and 137% of demand reduction compared to reported values. Showerheads produced the largest savings, based on the survey-reported information on shower length and frequency, followed by kitchen aerators, which exhibited twice the installation rate of bathroom faucet aerators.[10]

Table 33. Program Gross Verified Savings

Measure	Reported		Gross Verified		Realization Rates	
	Energy Savings (kWh)	Demand Reduction (Summer Coincident kW)	Energy Savings (kWh)	Demand Reduction (Summer Coincident kW)	Energy Savings (kWh)	Demand Reduction (kW)
Showerheads	3,384,726	270	6,929,387	245	205%	91%
Kitchen Aerators	863,129	69	2,588,641	384	300%	556%
Bathroom Aerators	4,495,851	359	395,017	388	9%	108%
Pipe Wrap	2,173,360	174	1,574,378	180	72%	103%
Total	**10,917,067**	**872**	**11,487,423**	**1,197**	**105%**	**137%**

Net-to-Gross Findings

Freeridership

For energy-efficient showerheads, faucet aerators, and pipe insulation, Cadmus estimated freeridership using participant responses to the survey freeridership questions (shown in Table 34). This section details those freeridership questions, response options, and scoring approach. Cadmus calculated

10 The Illinois TRM assumes three times the hot water usage in a kitchen than in a bathroom.

freeridership separately for each program measure, and weighted each measure-level estimate by the evaluated *ex post* gross population energy savings to arrive at an overall program freeridership estimate of 8.1%.

Table 34. Freeridership for Program Kit Measures

Measure	Evaluated *Ex Post* Gross Population kWh Savings	n	Freeridership
Showerheads	6,929,387	62	9.0%*
Kitchen Aerators	2,588,641	34	5.1%*
Bathroom Aerators	395,017	37	5.7%*
Pipe Wrap	1,574,378	46	9.7%*
Overall	**11,487,423**	**N/A**	**8.1%****

* Weighted by verified measure installations.

** Weighted by evaluated *ex post* gross population energy savings.

Table 35 contains the number of survey respondents by measure who were estimated at a freeridership level greater than zero. Cadmus used these survey respondents' answers to when they would have installed the measure on their own in the absence of the program to determine their final freeridership estimate.

Table 35. Freeriders by Measure

Timing Response	Freeridership	Showerhead (n)	Bathroom Aerator (n)	Kitchen Aerator (n)	Pipe Insulation (n)
At roughly the same time	100%	2	0	0	2
Within a few months	75%	3	1	1	1
Within a year	50%	2	2	2	2
Don't know	25%	2	0	0	0
Total	**N/A**	**9**	**3**	**3**	**5**

Spillover

Spillover occurs when participants choose to purchase energy-efficient measures or adopt energy-efficient practices due to participation in an energy efficiency program, but choose not to participate (or otherwise are unable to participate) in an incentive program for those particular measures. These customers' savings are not automatically credited to the program.

Cadmus used the self-report surveys to assess participant spillover. We asked participants about energy-efficient products and if they installed any high-efficiency products in their home since participating in the program. If survey respondents made energy-efficient improvements and/or purchased products, we asked how important the program was in their purchasing decision ("not at all," "not too," "somewhat," or "very" important).

Cadmus estimated[11] energy savings for measures the participants' said the program was "very important" in their decision to purchase. We calculated spillover percentage by dividing the sum of additional spillover savings reported by participants across the whole program by the total reported gross program savings achieved by program survey respondents (as reported in the customer survey), as shown in the following equation:

$$Spillover\ \% = \frac{\sum \text{Spillover Measure Evaluated Gross kWh Savings for All Survey Respondents}}{\sum \text{Program Measure Evaluated Gross kWh Savings for All Survey Respondents}}$$

Table 36 shows the quantities and total calculated spillover savings attributed to the program. We calculated the spillover percentage by dividing survey sample spillover kWh savings by survey sample gross program kWh savings. Cadmus estimated spillover for the program kits as 0.7% of the survey sample gross program savings.

Table 36. Spillover for Program Kit Items

Spillover Measure	Number of Survey Respondents	Total kWh Savings*
Air Conditioner	4	792.6
Refrigerator	1	49.1
Total Spillover kWh Savings		841.7
Total Survey Sample Program kWh		121,764
Spillover Percentage Estimate		**0.69%**

* We estimated savings for non-like program measures using the Mid-Atlantic TRM Manual v5.0.

Net Program Savings

Cadmus weighted the overall program NTG estimates of 92.6% for kWh energy savings and 93.9% for kW demand reduction by *ex post* gross population energy savings and demand reduction, respectively, as shown in Table 37 and Table 38. Net electricity savings provided by SEWKP in its first year were 10.5 GWh and 1.1 MW.

[11] We estimated savings for non-like program measures using the Mid-Atlantic TRM Manual v5.0.

CADMUS

Table 37. Net Energy Savings for Program Kit Items

Measure	Evaluated *Ex Post* Gross Population kWh Energy Savings	n	Freeridership	Spillover	NTG	Evaluated *Ex Post* Net Population kWh Energy Savings
Showerheads	6,929,387	62	9.0%*	0.69%	91.7%	6,351,050
Kitchen Aerators	2,588,641	34	5.1%*		95.5%	2,473,263
Bathroom Aerators	395,017	37	5.7%*		95.0%	375,383
Pipe Wrap	1,574,378	46	9.7%*		91.0%	1,432,554
Overall	**11,487,423**	**N/A**	**8.1%****	**0.69%**	**92.6%**	**10,632,251**

* Weighted by verified measure installations.

** Weighted by evaluated *ex post* gross population kWh energy savings.

Table 38. Net Demand Reduction for Program Kit Items

Measure	Evaluated *Ex Post* Gross Population Summer Coincident kW Demand Reduction	n	Freeridership	Spillover	NTG	Evaluated *Ex Post* Net Population Summer Coincident kW Demand Reduction
Showerheads	245	62	9.0%*	0.69%	91.7%	224
Kitchen Aerators	384	34	5.1%*		95.5%	367
Bathroom Aerators	388	37	5.7%*		95.0%	369
Pipe Wrap	180	46	9.7%*		91.0%	164
Overall	**1,197**	**N/A**	**6.8%****	**0.69%**	**93.9%**	**1,124**

* Weighted by verified measure installations.

** Weighted by evaluated *ex post* gross population kW demand reduction.

CADMUS

Summary Form

DUKE ENERGY®

Save Energy and Water Kit Program

Completed EMV Fact Sheet
2015 Evaluation – Cadmus

Program Description

SEWKP is designed to increase energy efficiency by offering residential customers energy-efficient water fixtures and water pipe insulation to install in high-use fixtures within their homes. Participants in this DIY program receive free measure kits upon mail-in request.

Date	November 18, 2015
Region(s)	NC, SC
Evaluation Period	May 2014 to February 2015
Gross Energy Savings (kWh)	10,228,421
Coincident kW impact	n/a
Measure life	various
Net Energy Savings (kWh)	10,487,704
Process Evaluation	Yes
Previous Evaluation(s)	No

CADMUS

Appendix A. Participant Household Characteristics and Demographics

Table 39. Participant Household Characteristics and Demographics

Household Characteristics	Valid Responses	n value / Percentage
Homeownership Status		**n=141**
Homeowner	114	81%
Renter	27	19%
Type of Home		**n=137**
Single-family home, detached construction	75	55%
Single-family home, manufactured or modular	25	18%
Single-family mobile home	18	13%
Two- or three-family attached home	6	4%
Apartment home (4+ families)	9	7%
Condominium	3	2%
Other	1	1%
Home Age		**n=124**
Built before 1959	9	7%
1960 – 1969	8	6%
1970 – 1979	19	15%
1980 – 1989	24	19%
1990 – 1999	28	23%
2000 – 2005	22	18%
2006 – present	14	11%
Above Ground Living Space		**n=126**
Less than 1,000 square feet	17	13%
1,001 – 2,000 square feet	69	55%
2,001 – 3,000 square feet	21	17%
3,001 – 4,000 square feet	8	6%
4,001 – 5,000 square feet	0	0%
More than 5,000 square feet	11	9%
Below Ground Finished Living Space		**n=109**
None	64	59%
Less than 1,000 square feet	29	27%
1,001 – 2,000 square feet	9	83%
2,001 – 3,000 square feet	3	3%
3,001 – 4,000 square feet	1	1%
4,001 – 5,000 square feet	1	1%
More than 5,000 square feet	2	2%

CADMUS

Household Characteristics	Valid Responses	n value / Percentage
Water Heater Age		**n=115**
0 – 4 years	46	40%
5 – 9 years	30	26%
10 – 14 years	28	24%
15 – 19 years	6	5%
More than 19 years	5	4%
Number of People Living in the Household		**n=138**
1	27	20%
2	52	38%
3	23	17%
4	19	14%
5	16	12%
6 or more	1	1%
Number of Teenagers (Age 13 to 19) in Household		**n=112**
Zero	79	71%
1	25	22%
2	3	3%
3	2	2%
4	3	3%
5 or more	0	0%
Age of Respondent		**n=131**
18 – 34	20	15%
35 – 49	25	19%
50 – 59	33	25%
60 – 64	18	14%
65 – 74	21	16%
75 or older	14	11%
Annual Household Income		**n=136**
Under $15,000	9	7%
$15,000 - $29,999	15	11%
$30,000 - $49,999	33	24%
$50,000 - $74,999	16	12%
$75,000 - $99,999	7	5%
Over $100,000	10	7%
Prefer not to answer	46	34%

Appendix B. Save Energy and Water Kit Program Participant Survey

May I speak with **(INSERT NAME ON LIST)**
(IF NO NAME ABOVE, SAY:) the head of household or other decision maker in your home.

Hello, my name is ______, with VuPoint Research, an evaluation firm calling on behalf of Duke Energy. We are conducting a follow-up survey with those who have recently participated in Duke Energy's Save Energy and Water Kit Program.

If you were a participant of the program Duke would like to offer you a $10 gift card to participate in this short survey.

(IF PERSON DOES NOT RECOGNIZE THE PROGRAM, SAY:) The Save Energy and Water Kit Program ("SEWKP") is designed to increase the energy efficiency of residential customers by offering customers low flow water fixtures and water pipe insulation to install in high-use fixtures within their homes.

(IF NECESSARY, SAY:) I'm not selling anything, we are only exploring the impact of energy-efficiency programs offered in your area. Your responses will be kept confidential.

(IF NECESSARY, SAY:) This survey should take about 15-25 minutes of your time.

(DO NOT READ UNLESS ASKED:) If you would like to talk with someone from Duke Energy about this study, feel free to call Frankie Diersing at 513-287-4096, or Duke Energy Ohio Customer Service at 800.544.6900.

(IF NECESSARY, SAY:) Studies like this help Duke Energy better understand its customers' needs and interest in energy-efficiency programs and services. Your participation is important to help Duke Energy make decisions about how they offer these programs to their customers.

[Survey transition language]: This first set of questions are designed to determine your involvement and participation in the program.

Screeners

A1. Were you involved in the decision to participate in the Save Energy and Water Kit Program?
- A. Yes
- B. No **(ASK FOR THIS PERSON AND REPEAT INTRO) (IF NOT AVAILABLE, OBTAIN NAME AND SCHEDULE CALLBACK)**
- (Don't know)
- (Refused) **(Thank and terminate)**

[IF "DK" IN A1 THEN SKIP TO A3]

A2. This program was provided through Duke Energy. In this program, customers receive a business reply card in the mail offering a kit containing water-saving items such as showerheads, aerators and pipe insulation. To participate in the program, you would have filled out and returned the card and the water-saving kit would have been shipped to your home for free. Do you recall receiving a free kit of water-saving items sent by Duke Energy?
- A. Yes
- B. No **(Thank and terminate)**
- (Don't know) **(Thank and terminate)**

CADMUS

(Refused) **(Thank and terminate)**

A3. Just to confirm, Duke Energy records indicate that you received the following: **(Read from sample; check boxes of those they confirm)**

A. Low-flow showerhead [ ]
B. Kitchen and Bathroom faucet aerators [ ]
C. Pipe insulation [ ]
D. Plumber's tape [ ]
E. Informational flyer [ ]
F. Rubber jar opener [ ]
(Don't know)
(Refused)

Verification

First I have a few questions regarding water use in your home.

A4. What is the fuel used by your water heater? **(CHECK ALL THAT APPLY)**

A. (Electricity)
B. (Natural Gas)
C. (Oil)
D. (Propane)
E. Other **(SPECIFY:___________)**
F. (No water heater)
(Don't know)
(Refused)

A5. How many of the low-flow showerheads that you received from the Save Energy and Water Kit are currently installed in your home?

A. (One showerhead)
B. (Two showerheads)
C. (Three showerheads)
D. (None have been installed) **SKIP TO B13**
(Don't know) **SKIP TO B13**
(Refused) **SKIP TO B15**

[IF "one showerhead" IN B2 THEN ASK B3]

A6. Typically how many showers per week are taken using this showerhead?

A. **(RECORD RESPONSE:______________)**
(Don't know)
(Refused)

A7. Can you give me your best guess on how long the average shower length is for this shower? Please just give me your best guess at the average number of minutes, taking into consideration the shower lengths of all the other users in the household.

A. **(RECORD RESPONSE:______________)**
(Don't know)
(Refused)

[IF "two showerheads" OR "three showerheads" IN B1 THEN ASK B5]

A8. Typically how many showers per week are taken using the showerhead that gets used most often in your household?

A. **(RECORD RESPONSE:______________)**

CADMUS

(Don't know)
(Refused)

A9. Can you give me your best guess on how long the average shower length is for this shower? Please just give me your best guess at the average number of minutes, taking into consideration the shower lengths of all the other users in the household.
A. **(RECORD RESPONSE:_______________)**
(Don't know)
(Refused)

[IF "two showerheads" OR "three showerheads" IN B1 THEN ASK B7]

A10. How many showers per week are typically taken using the second showerhead?
A. **(RECORD RESPONSE:_______________)**
(Don't know)
(Refused)

A11. And again for this shower, can you give me your best guess on how long the average shower length is, in minutes, for this shower for all users?
A. **(RECORD RESPONSE:_______________)**
(Don't know)
(Refused)

[IF "three showerheads" IN B1 THEN ASK B9]

A12. And how many showers per week are typically taken using the third showerhead?
A. **(RECORD RESPONSE:_______________)**
(Don't know)
(Refused)

A13. And finally for this third shower, can you give me your best guess on how long the average shower length is in minutes for this shower for all users?
A. **(RECORD RESPONSE:_______________)**
(Don't know)
(Refused)

A14. Did the showerhead(s) you installed from the kit replace (an)other low-flow showerhead(s) or (a) regular showerhead(s)?
A. (At least one kit item replaced another low-flow showerhead)
B. (No kit items replaced low-flow showerhead(s) / all replaced regular-flow)
(Don't know)
(Refused)

[IF "YES" IN B11 AND ("two showerheads" OR "three showerheads" IN B1) THEN ASK B12]

A15. How many previously-installed low-flow showerheads were replaced by showerheads from the kit?
A. (One showerhead)
B. (Two showerheads)
C. (Three showerheads)
(Don't know)
(Refused)

CADMUS

[IF NUMBER OF SHOWERHEADS FROM PROGRAM RECORDS IS GREATER THAN THE NUMBER OF SHOWERHEADS INSTALLED IN B1 – OR IF "don't know" IN B1 - THEN ASK B13]

A16. For the showerheads that you received with the kit and which are not currently installed, did you try to install them??

A. Yes
B. No
(Don't know)
(Refused)

[IF "YES" IN B13 THEN ASK B14]

A17. Why (is it/are they) not currently installed? **(OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)**

A18. Is the kitchen faucet aerator that you received from the kit currently installed in your home?

A. Yes
B. No
(Don't know)
(Refused)

[IF "YES" IN B15 THEN ASK B16]

A19. Did the faucet in your kitchen already have an aerator that had to be removed before installing the aerator provided by the kit?

A. Yes
B. No
(Don't know)
(Refused)

[IF "NO" IN B15 THEN ASK B17]

A20. Did you try to install the kitchen aerator that you received with the kit?

A. Yes
B. No
(Don't know)
(Refused)

[IF "YES" IN B17 THEN ASK B18]

A21. Why (is it/are they) not currently installed? **(OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)**

A22. How many of the bathroom faucet aerators that you received from the kit are currently installed in your home?

A. (One aerator)
B. (Two aerators)
C. (Three aerators)
D. (Four aerators)
E. (Five aerators)
F. (None have been installed) **SKIP TO B22**
(Don't know) **SKIP TO B22**
(Refused) **SKIP TO B24**

[IF "one or more" (RESPONSES 1-5) IN B19 ASK B20]

A23. Did you have to remove any aerators from your bathroom faucets before installing the aerator(s) provided by the kit?

A. Yes
B. No
(Don't know)
(Refused)

[IF "YES" IN B20 AND "two or more" (RESPONSES 2-5) IN B19 THEN ASK B21]

A24. How many previously-installed bathroom aerators were replaced by aerators from the kit?
A. (One aerator)
B. (Two aerators)
C. (Three aerators)
D. (Four aerators)
E. (Five aerators)
(Don't know)
(Refused)

[IF NUMBER OF BATHROOM AERATORS FROM PROGRAM RECORDS IS GREATER THAN THE NUMBER INSTALLED IN B19 – OR IF "don't know" IN B19 - THEN ASK B22]

A25. For the bathroom aerators that you received with the kit and which are not currently installed, did you try to install them?
A. Yes
B. No
(Don't know)
(Refused)

[IF "YES" IN B22 THEN ASK B23]

A26. Why (is it/are they) not currently installed? **(OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)**

A27. Is any of the pipe insulation from the kit currently installed on your hot water pipes?
A. Yes
B. No
(Don't know) **SKIP TO SECTION C**
(Refused) **SKIP TO SECTION C**

[IF "YES" IN B24 THEN ASK B25]

A28. How much of the pipe insulation that you received from the kit is currently installed? Would you say . . .
A. All, or almost all, of it;
B. About 75% of it;
C. About half of it;
D. or about 25% of it?
(Don't know)
(Refused)

[IF "YES" IN B24 THEN ASK B26]

A29. When you installed the pipe insulation that you received with the kit, did you replace old insulation that was already there, or add insulation where there previously wasn't any, or both?
A. (Just replaced old insulation)
B. (Just installed new insulation)
C. (Both - some kit insulation replaced old insulation AND some was installed where there wasn't previously insulation)
(Don't know)
(Refused)

CADMUS

[IF "YES" IN B24 THEN ASK B27

A30. What is the diameter of the pipe that you insulated?

A. **(RECORD DIAMETER IN INCHES: ____)**
(Don't Know)
(Refused)

[IF "NO" IN B24 THEN ASK B28]

A31. Did you try to install any of the pipe insulation that you received with the kit?

A. Yes
B. No
(Don't know)
(Refused)

[IF "NO" IN B28 THEN ASK B29]

A32. Why were you not able to install the pipe insulation in your home? **(OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)**

[Survey transition language]: This next set of questions are designed to gauge your awareness and overall satisfaction with the program.

Process Batteries

Marketing and Awareness

A33. How did you first hear about the Save Energy and Water Kit program? **(OPEN-ENDED) (PROBE FOR SPECIFICS) DO NOT READ**

(IF "AD" ASK:) Where was that? What type of ad?
(IF "INTERNET" OR "WEBSITE," SPECIFY WHICH WEBSITE)
(IF "EMAIL," SPECIFY IF FROM DUKE ENERGY OR ANOTHER SOURCE)

A. (Business Reply Card in the mail (separate from bill))
B. (Billing insert/information (with my bill)
C. (Email from Duke Energy)
D. (Paperless billing email)
E. (Neighbor)
F. (Saw message while accessing my account online)
G. (Community Assistance Program/assistance agency)
H. (Social media (Facebook, Twitter))
I. (Other website **(SPECIFY:____________________)**
J. (Other: **(SPECIFY:___________________________)**
(Don't know)
(Refused)

A34. Please think back to the time when you were deciding to participate in the Save Energy and Water Kit Program. What was the main reason why you decided to take advantage of this offer? **(OPEN-ENDED) (PROBE FOR SPECIFICS) DO NOT READ**

A. (To receive the water-saving kit / for the kit items)
B. (Because it was free / no cost to participate)
C. (The information provided in the mailing convinced me)
D. (Because it was from Duke Energy / I trust Duke Energy)

E. (Because of past experience with another Duke Energy program)
5b: specify program: __________________

F. (Recommendation of someone other than Duke Energy)
5c: specify source: __________________

G. (Want to reduce utility bills)
H. (Want to conserve energy)
I. (Want to conserve water)
J. (Want to help the environment / "green" concerns)
(Don't know)
(Refused)

A35. If you were interested in receiving additional information that could help you save money on your bill, what is your preferred method to receive the information? **(OPEN-ENDED) (PROBE FOR SPECIFICS) DO NOT READ (IF "IN THE MAIL," ASK:)** In your bill, through a customer newsletter, or a letter addressed to you?
A. (Community event/fair)
B. (Email)
C. (In my utility bill)
D. (Phone call)
E. (Print advertisement)
F. (Duke Energy's website)
G. (Duke Energy Newsletter)
H. (None)
(Don't know)
(Refused)

A36. You may have already mentioned it, but have you visited Duke Energy's website, for information about the Save Energy and Water Kit Program?
A. Yes
B. No
(Don't know)
(Refused)

Satisfaction

A37. On a scale from 0 to 10 with zero being very dissatisfied and 10 being very satisfied, what is your overall satisfaction with the items that were provided in the Save Energy and Water Kit Program?

A38. **[If D1=4 or less]** And what is the reason for your rating?

A39. Using the same scale from 0 to 10, overall, how would you rate the Save Energy and Water Kit Program?

A40. **[If D3=4 or less]** And what is the reason for your rating?

A41. Using the same scale from 0 to 10, overall, how would you rate Duke Energy as your energy provider?

A42. **[If D5=4 or less]** And what is the reason for your rating?

A43. In the future, would the presence of an online store where you could pick the color, or finish, of your showerhead increase the likelihood of you actually installing more of these types of showerheads?
A. Very likely

B. Somewhat likely
C. Not very likely
D. Not likely at all
(Don't know)
(Refused)

1.

A44. Do you have any recommendations to improve the Save Energy and Water Kit Program?

A. Yes **[RECORD ANSWER]**
B. No
(Don't know)
(Refused)

A45. Since your home improvements were installed, have you noticed any changes in your home's energy use compared to before the home improvements were made?

A. Yes **[RECORD ANSWER]**
B. No
(Don't Know)
(Refused)

A46. On a 0 to 10 scale, with 0 meaning you are NOT AT ALL LIKELY to recommend, and 10 meaning you are VERY LIKELY to recommend, how likely are you to recommend the program to a friend?

A. **(ENTER A NUMBER FROM 0 to 10: ____)**
(Don't Know)
(Refused)

A47. Are there any other equipment or upgrades you think would be beneficial for the program to include as one of the energy improvements?

(OPEN-ENDED)

A. Yes **(SPECIFY:________________)**
B. No
98. (Don't know)
99. (Refused)

[Survey transition language]: The following questions are to learn more about the home improvements you made directly through, or as a result of, Duke Energy's Save Energy and Water Kit Program.

Attribution

Freeridership

A48. As we discussed, as part of this program, you installed **(INSERT ALL "YES" RESPONSES FROM A3 RESPONSES)**. If these items were not offered by the Save Energy and Water Kit Program from Duke Energy, would you have … **(READ RESPONSES, IF NECESSARY – PROBE FOR BEST GUESS)**

A. Installed ALL of the energy efficient equipment or made upgrades on your own **(SKIP TO E4)**
B. Installed NONE of the energy efficient equipment or none of the upgrades on your own
C. Or, installed SOME of the equipment or made some of the upgrades on your own **(SKIP TO E3)**
98. (Don't know) **(SKIP TO E3)**
99. (Refused) **(SKIP TO E3)**

A49. Let me make sure I understand. When you say you would ***not*** have installed the same equipment or made the same upgrades, do you mean that you… **(READ RESPONSES)**

A. Would not have installed ANY of the equipment or made any upgrades at all **(SKIP TO SECTION F)**
B. Or, that you would have installed SOME of the equipment or made some of the upgrades
(Don't know) **(SKIP TO SECTION F)**

99. (Refused) **(SKIP TO SECTION F)**

A50. Which water-efficiency upgrades or installations would you still have made on your own if you hadn't participated in the Save Energy and Water Kit Program? **(OPEN-ENDED)**

A. **(RECORD RESPONSE:______________)**
(Don't know)
(Refused)

A51. For the equipment that you indicated you would have installed or upgraded without the Save Energy and Water Kit Program, when did you make that decision? Would you say it was…**(READ RESPONSES)**

A. Before you learned of the Save Energy and Water Kit Program **(SKIP TO E7)**
B. After you learned about the program
(Don't know) **(SKIP TO E7)**
(Refused) **(SKIP TO E7)**

A52. **(IF E4=2 ASK E5)** So is it correct that you decided to install or upgrade these energy-saving measures or items after you learned about the Save Energy and Water Kit Program? **(OPEN-ENDED)**

A. Yes **(SKIP TO SECTION F)**
B. No **(SKIP TO E6)**
98. (Don't know) **(SKIP TO SECTION F)**
99. (Refused) **(SKIP TO SECTION F)**

A53. **(IF E5=2, ASK E6. OTHERWISE, SKIP TO SECTION F)** When did you make the decision to install the package of equipment or make the upgrade (s)? Was it… **(READ RESPONSES)**

A. Before you learned about the Save Energy and Water Kit Program
B. After you learned about the program, but before you received the kit in the mail **(SKIP TO SECTION F)**
(Don't know)
(Refused)

A54. If the program had not been available, would you have made the improvement (or all the improvements) **[READ OPTIONS]**?

1. At roughly the same time?
2. Within a few months?
3. Within a year?
4. More than a year out?
5. Never?

(Don't know)
(Refused)

[IF E3= "Showerheads," "Aerators," ASK E8- E9 FOR EACH APPLICABLE MEASURE, OTHERWISE SKIP TO SECTION F)

A55. When you say you would have installed **[E3 RESPONSE]** on your own, without the program, would you have installed the same number of items that you installed from the Duke Energy kit?

A. Yes
B. No
(Don't know)
(Refused)

A56. **(IF E8=2, ASK E9, OTHERWISE SKIP TO SECTION F)** How many would you have installed? [Record number for each measure] **(RECORD RESPONSE:_**

A. Showerheads:_____

CADMUS

B. Aerators:_____
C. Pipewrap feet:________)
(Don't know)
(Refused)

Spillover

A57. Since participating in the program, have you installed any energy efficient equipment or made other changes to improve the energy efficiency of your home, changes for which you did NOT receive a rebate or otherwise provided for free? Improvements may include things such as energy efficient appliances like water heaters, or insulation activities. **(OPEN-ENDED)**

A. Yes
B. No **(SKIP TO SECTION G)**
(Don't know) **(SKIP TO SECTION G)**
(Refused) **(SKIP TO SECTION G)**

A58. What equipment or upgrades were they? If you have made more than one upgrade I'll ask you about them one at a time. What was the first upgrade? **(OPEN-ENDED, PROBE FOR SPECIFICS)**

A. Water heater
B. CFLs
C. LEDs
D. Other **(SPECIFY:___________)**
(Don't know) **(SKIP TO SECTION G)**
(Refused) **(SKIP TO SECTION G)**

A59. **[IF F2=1, ASK F3. OTHERWISE, SKIP TO LANGUAGE BEFORE F4]**
What was the next upgrade? **(OPEN-ENDED, PROBE FOR SPECIFICS)**

A. Water heater
B. Other **(SPECIFY:___________)**
C. (Don't know) **(SKIP TO SECTION G)**
(Refused) **(SKIP TO SECTION G)**

[IF F2 or F3=1, ASK F4. OTHERWISE, SKIP TO LANGUAGE BEFORE F5]

A60. Is the **(RESPONSE FROM F2 or F3)** you installed fueled with gas or electric? **(OPEN-ENDED)**

A. Gas
B. Electric
(Don't know)
(Refused)

[IF F2 or F3=2, ASK F5. OTHERWISE, SKIP TO LANGUAGE BEFORE F7]

A61. How many did you install? **(OPEN-ENDED, IF NECESSARY – PROBE FOR BEST GUESS, RECORD #)**

2. **(RECORD RESPONSE:_________________)**
3.

A62. Did you receive any rebates or incentives for this installation?

A. Yes
B. No
(Don't know)
(Refused)

[IF F6=1, ASK F7]

A63. Which utility or rebate program provided the incentive? **(OPEN-ENDED)**

A. **(RECORD RESPONSE:_________________)**

(Don't know)
(Refused)

A64. And how did the Save Energy and Water Kit Program influence your decision to do this? Was it **(READ RESPONSES)**
- A. Very important
- B. Somewhat important
- C. Not very important
- D. Or, not at all important
- (Don't know)
- (Refused)

A65. Any other equipment or upgrades? **(OPEN-ENDED, PROBE FOR SPECIFICS)**
- A. Yes **(GO BACK TO F3)**
- B. No **(SKIP TO SECTION G)**
- (Don't know) **(SKIP TO SECTION G)**
- (Refused) **(SKIP TO SECTION G)**

[Survey transition language]: The following questions are provided to aid us in better understanding the characteristics of your household and will inform future program design and delivery.

Demographics
Household Characteristics

The last set of questions deal with household characteristics. These questions are optional and you do not need to give any information that you are uncomfortable with, but please keep in mind that any and all information you provide will remain confidential.

A66. Which of the following best describes your home/residence? READ LIST
- A. Single-family home, detached construction [NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK]
- B. Single family home, factory manufactured/modular
- C. Single family, mobile home
- D. Row House
- E. Two or Three family attached residence—traditional structure
- F. Apartment (4 + families)---traditional structure
- G. Condominium---traditional structure
- H. OTHER: (SPECIFY_________________________________)
- 98. (Don't Know)
- I. (Refused)

A67. Do you own or rent this residence?
- A. OWN
- B. RENT
- 98. (Don't Know)
- 99. (Refused)

A68. Approximately when was your home constructed? [DO NOT READ]
- A. Before 1960
- B. 1960-1969

C. 1970-1979
D. 1980-1989
E. 1990-1999
F. 2000-2005
G. 2006 OR LATER
98. (Don't Know)
99. (Refused)

A69. How many square feet is the above-ground living space (IF NECESSARY, THIS EXCLUDES WALK-OUT BASEMENTS)? NUMERICAL OPEN END [RANGE 0-99,999]
98. (Don't Know)
A. (Refused)

A70. **[IF G4=98,99]** Would you estimate the above-ground living space is about:
A. less than 1,000 sqft
B. 1,001-2,000 sqft
C. 2,001-3,000 sqft
D. 3,001-4,000 sqft
E. 4,001-5,000 sqft
F. Greater than 5,000 sqft
98. (Don't Know)
G. (Refused)

A71. How many square feet of conditioned living space is below- ground (IF NECESSARY, THIS INCLUDES WALK-OUT BASEMENTS) NUMERICAL OPEN END [RANGE 0-99,999]
98. (Don't Know)
A. (Refused)

A72. **[IF G6=98,99]** Would you estimate the below-ground living space is about:
A. less than 1,000 sqft
B. 1,000-2,000 sqft
C. 2,000-3,000 sqft
D. 3,000-4,000 sqft
E. 4,000-5,000 sqft
F. Greater than 5,000 sqft
98. (Don't Know)
99. (Refused)

A73. How old is your water heater?
A. (0-4 years)
B. (5-9 years)
C. (10-14 years)
D. (15-19 years)
E. (More than 19 years)
(Don't know)
(Refused)

A74. How many people live in this home?
A. (1)

B. (2)
C. (3)
D. (4)
E. (5)
F. (6)
G. (7)
H. (8 or more)
(Don't know)
(Refused)

A75. How many of them are teenagers age 13-19?
(IF THEY ASK WHY: EXPLAIN THAT TEENAGERS ARE GENERALLY ASSOCIATED WITH HIGHER ENERGY USE.)
A. (none)
B. (1)
C. (2)
D. (3)
E. (4)
F. (5)
G. (6)
H. (7)
I. (8 or more)
(Don't know)
(Refused)

The following questions are for classification purposes only and will not be used for any other purpose than to help Duke Energy continue to improve service.

A76. What is your age group? **(READ ALL ANSWERS UNTIL THEY REPLY)**
A. 18-34
B. 35-49
C. 50-59
D. 60-64
E. 65-74
F. Over 74
(Don't know)
(Refused)

A77. Please indicate your annual household income. **(READ ALL ANSWERS UNTIL THEY REPLY)**
A. Under $15,000
B. $15,000-$29,999
C. $30,000-$49,999
D. $50,000-$74,999
E. $75,000-$100,000
F. Over $100,000
(Don't know)
(Refused)

A78. May we share your individual responses with Duke Energy so they can better serve their customers? We will not share your name, but some of your individual responses could help shed light on questions this evaluation is trying to answer. **(OPEN-ENDED)**
4. Yes

CADMUS

5. No
98. (Don't know)
99. (Refused)

A79. Do you have any other comments or questions for Duke Energy at this time? **(OPEN-ENDED) (PROBE FOR SPECIFICS) (RECORD VERBATIM)**

A80. **(RECORD RESPONDENT'S GENDER – DO NOT ASK)**

A. (Male)
B. (Female)
(Don't know)
(Refused)

[Survey transition language]: This completes the survey. Your responses are very important to Duke Energy. We appreciate your participation and thank you for your time. Have a good evening/day!

We've reached the end of the survey.
Confirm Name & complete address from calling sheet. If needed, record any changes to Name or Address on calling sheet in "Changed Address" column.
Thanks again for your time and feedback today!

CADMUS

Appendix C. Participant Survey Frequency Tables

Energy Efficient Showerhead Installations

How many of the low-flow showerheads that you received from the Save Energy and Water Kit are currently installed in your home?

			NC	SC	Total
	(One showerhead)	Count	59	23	82
		% within State	56.2%	51.1%	54.7%
	(Two showerheads)	Count	25	13	38
		% within State	23.8%	28.9%	25.3%
	(Three showerheads)	Count	1	1	2
		% within State	1.0%	2.2%	1.3%
	(None have been installed)	Count	17	7	24
		% within State	16.2%	15.6%	16.0%
	[DO NOT READ] (Don't Know)	Count	3	1	4
		% within State	2.9%	2.2%	2.7%
Total		Count	105	45	150
		% within State	100.0%	100.0%	100.0%

One showerhead installed: Typically how many showers per week are taken using this showerhead?

			NC	SC	Total
	1.00	Count	0	1	1
		% within State	0.0%	4.5%	1.2%
	2.00	Count	2	0	2
		% within State	3.4%	0.0%	2.5%
	3.00	Count	2	1	3
		% within State	3.4%	4.5%	3.7%
	4.00	Count	3	2	5
		% within State	5.1%	9.1%	6.2%
	5.00	Count	3	0	3
		% within State	5.1%	0.0%	3.7%
	6.00	Count	2	2	4
		% within State	3.4%	9.1%	4.9%
	7.00	Count	17	6	23
		% within State	28.8%	27.3%	28.4%
	8.00	Count	3	2	5
		% within State	5.1%	9.1%	6.2%
	9.00	Count	1	0	1
		% within State	1.7%	0.0%	1.2%
	10.00	Count	3	1	4
		% within State	5.1%	4.5%	4.9%
	12.00	Count	2	0	2
		% within State	3.4%	0.0%	2.5%
	14.00	Count	10	5	15
		% within State	16.9%	22.7%	18.5%
	15.00	Count	1	0	1
		% within State	1.7%	0.0%	1.2%
	16.00	Count	1	0	1
		% within State	1.7%	0.0%	1.2%
	20.00	Count	4	0	4
		% within State	6.8%	0.0%	4.9%
	21.00	Count	1	2	3
		% within State	1.7%	9.1%	3.7%
	22.00	Count	1	0	1
		% within State	1.7%	0.0%	1.2%
	[DO NOT READ] (Don't Know)	Count	3	0	3
		% within State	5.1%	0.0%	3.7%

CADMUS

		NC	SC	Total
Total	Count	59	22	81
	% within State	100.0%	100.0%	100.0%

One showerhead installed: Can you give me your best guess on how long the average shower length is for this shower?

		NC	SC	Total
2.00	Count	2	0	2
	% within State	3.4%	0.0%	2.4%
3.00	Count	0	1	1
	% within State	0.0%	4.3%	1.2%
4.00	Count	1	0	1
	% within State	1.7%	0.0%	1.2%
5.00	Count	14	3	17
	% within State	23.7%	13.0%	20.7%
6.00	Count	1	2	3
	% within State	1.7%	8.7%	3.7%
7.00	Count	3	0	3
	% within State	5.1%	0.0%	3.7%
8.00	Count	3	0	3
	% within State	5.1%	0.0%	3.7%
10.00	Count	16	7	23
	% within State	27.1%	30.4%	28.0%
12.00	Count	2	1	3
	% within State	3.4%	4.3%	3.7%
13.00	Count	2	0	2
	% within State	3.4%	0.0%	2.4%
15.00	Count	5	4	9
	% within State	8.5%	17.4%	11.0%
20.00	Count	6	2	8
	% within State	10.2%	8.7%	9.8%
30.00	Count	0	1	1
	% within State	0.0%	4.3%	1.2%
90.00	Count	1	0	1
	% within State	1.7%	0.0%	1.2%
[DO NOT READ] (Don't Know)	Count	3	2	5
	% within State	5.1%	8.7%	6.1%
Total	Count	59	23	82
	% within State	100.0%	100.0%	100.0%

Two or three showerheads installed: Typically how many showers per week are taken using the showerhead that gets used most often in your household?

		NC	SC	Total
2.00	Count	1	1	2
	% within State	3.8%	7.1%	5.0%
5.00	Count	1	0	1
	% within State	3.8%	0.0%	2.5%
6.00	Count	1	1	2
	% within State	3.8%	7.1%	5.0%
7.00	Count	4	1	5
	% within State	15.4%	7.1%	12.5%
8.00	Count	0	2	2
	% within State	0.0%	14.3%	5.0%
12.00	Count	1	1	2
	% within State	3.8%	7.1%	5.0%
14.00	Count	6	4	10
	% within State	23.1%	28.6%	25.0%
15.00	Count	1	2	3

CADMUS

		% within State	3.8%	14.3%	7.5%
	18.00	Count	0	1	1
		% within State	0.0%	7.1%	2.5%
	20.00	Count	2	0	2
		% within State	7.7%	0.0%	5.0%
	21.00	Count	4	1	5
		% within State	15.4%	7.1%	12.5%
	25.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
	28.00	Count	2	0	2
		% within State	7.7%	0.0%	5.0%
	30.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
	35.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
Total		Count	26	14	40
		% within State	100.0%	100.0%	100.0%

Two or three showerheads installed: Can you give me your best guess on how long the average shower length is for this shower? (first shower)

			NC	SC	Total
	2.00	Count	0	1	1
		% within State	0.0%	7.1%	2.5%
	3.00	Count	0	1	1
		% within State	0.0%	7.1%	2.5%
	5.00	Count	3	2	5
		% within State	11.5%	14.3%	12.5%
	6.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
	7.00	Count	2	1	3
		% within State	7.7%	7.1%	7.5%
	8.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
	10.00	Count	8	2	10
		% within State	30.8%	14.3%	25.0%
	12.00	Count	2	2	4
		% within State	7.7%	14.3%	10.0%
	15.00	Count	4	3	7
		% within State	15.4%	21.4%	17.5%
	30.00	Count	1	1	2
		% within State	3.8%	7.1%	5.0%
	35.00	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
	60.00	Count	0	1	1
		% within State	0.0%	7.1%	2.5%
	70.00	Count	2	0	2
		% within State	7.7%	0.0%	5.0%
	[DO NOT READ] (Don't Know)	Count	1	0	1
		% within State	3.8%	0.0%	2.5%
Total		Count	26	14	40
		% within State	100.0%	100.0%	100.0%

CADMUS

Two or three showerheads installed: How many showers per week are typically taken using the second showerhead?

		NC	SC	Total
1.00	Count	2	0	2
	% within State	9.1%	0.0%	5.7%
2.00	Count	2	0	2
	% within State	9.1%	0.0%	5.7%
4.00	Count	1	1	2
	% within State	4.5%	7.7%	5.7%
5.00	Count	2	2	4
	% within State	9.1%	15.4%	11.4%
7.00	Count	4	4	8
	% within State	18.2%	30.8%	22.9%
14.00	Count	1	3	4
	% within State	4.5%	23.1%	11.4%
15.00	Count	1	0	1
	% within State	4.5%	0.0%	2.9%
20.00	Count	2	0	2
	% within State	9.1%	0.0%	5.7%
21.00	Count	2	1	3
	% within State	9.1%	7.7%	8.6%
30.00	Count	1	0	1
	% within State	4.5%	0.0%	2.9%
[DO NOT READ] (Don't Know)	Count	4	2	6
	% within State	18.2%	15.4%	17.1%
Total	Count	22	13	35
	% within State	100.0%	100.0%	100.0%

Two or three showerheads installed: And again for this shower, can you give me your best guess on how long the average shower length is, in minutes? (second shower)

		NC	SC	Total
2.00	Count	1	0	1
	% within State	4.5%	0.0%	2.9%
5.00	Count	5	3	8
	% within State	22.7%	23.1%	22.9%
7.00	Count	2	1	3
	% within State	9.1%	7.7%	8.6%
9.00	Count	0	1	1
	% within State	0.0%	7.7%	2.9%
10.00	Count	7	3	10
	% within State	31.8%	23.1%	28.6%
12.00	Count	1	0	1
	% within State	4.5%	0.0%	2.9%
15.00	Count	1	2	3
	% within State	4.5%	15.4%	8.6%
30.00	Count	2	0	2
	% within State	9.1%	0.0%	5.7%
48.00	Count	1	0	1
	% within State	4.5%	0.0%	2.9%
49.00	Count	0	1	1
	% within State	0.0%	7.7%	2.9%
60.00	Count	0	1	1
	% within State	0.0%	7.7%	2.9%
[DO NOT READ] (Don't Know)	Count	2	1	3
	% within State	9.1%	7.7%	8.6%
Total	Count	22	13	35
	% within State	100.0%	100.0%	100.0%

CADMUS

Two or three showerheads installed: And how many showers per week are typically taken using the third showerhead?

		NC	SC	Total
2.00	Count	0	1	1
	% within State		100.0%	100.0%
Total	Count	0	1	1
	% within State		100.0%	100.0%

Two or three showerheads installed: And finally for this third shower, can you give me your best guess on how long the average shower length is in minutes?

		NC	SC	Total
10.00	Count	0	1	1
	% within State		100.0%	100.0%
Total	Count	0	1	1
	% within State		100.0%	100.0%

Did the showerhead(s) you installed from the kit replace (an) other low-flow showerhead(s) or (a) regular showerhead(s)?

			NC	SC	Total
	(YES - At least one kit item replaced another low-flow showerhead)	Count	42	22	64
		% within State	49.4%	59.5%	52.5%
	(No kit items replaced low-flow showerhead(s) / all replaced regular-flow)	Count	39	11	50
		% within State	45.9%	29.7%	41.0%
	[DO NOT READ] (Don't Know)	Count	4	4	8
		% within State	4.7%	10.8%	6.6%
Total		Count	85	37	122
		% within State	100.0%	100.0%	100.0%

How many previously-installed low-flow showerheads were replaced by showerheads from the kit?

			NC	SC	Total
	(One showerhead)	Count	4	0	4
		% within State	26.7%	0.0%	18.2%
	(Two showerheads)	Count	11	6	17
		% within State	73.3%	85.7%	77.3%
	[DO NOT READ] (Don't Know)	Count	0	1	1
		% within State	0.0%	14.3%	4.5%
Total		Count	15	7	22
		% within State	100.0%	100.0%	100.0%

For the showerheads that you received with the kit and which are not currently installed, did you try to install them?

		NC	SC	Total
Yes	Count	12	11	23
	% within State	25.5%	47.8%	32.9%
No	Count	32	11	43
	% within State	68.1%	47.8%	61.4%
[DO NOT READ] (Don't Know)	Count	2	1	3
	% within State	4.3%	4.3%	4.3%
[DO NOT READ] (Refused)	Count	1	0	1
	% within State	2.1%	0.0%	1.4%
Total	Count	47	23	70
	% within State	100.0%	100.0%	100.0%

Why (is/are) the showerhead(s) not currently installed?*

Category of Action	Count Mentioning: NC	Count Mentioning: SC	Count Mentioning: Total
Does not fit / would have to change pipes	1	2	3
Does not work with handheld shower fixture	1	1	2
Aesthetics / does not match existing fixture		1	1
Low flow / not enough water pressure	1		1
Gave the item away to another household	1		1

* Although 23 participants reported trying to install showerheads that are not currently installed, when asked to explain why these items are not installed most indicated that they had not tried or did not intend to try installing them. This table only includes responses that indicate that the participant did try to install the showerhead.

Faucet Aerator Installations

Is the kitchen faucet aerator that you received from the kit currently installed in your home?

		NC	SC	Total
Yes	Count	52	22	74
	% within State	49.5%	48.9%	49.3%
No	Count	51	20	71
	% within State	48.6%	44.4%	47.3%
[DO NOT READ] (Don't Know)	Count	2	3	5
	% within State	1.9%	6.7%	3.3%
Total	Count	105	45	150
	% within State	100.0%	100.0%	100.0%

Did the faucet in your kitchen already have an aerator that had to be removed before installing the aerator provided by the kit?

		NC	SC	Total
Yes	Count	24	14	38
	% within State	46.2%	63.6%	51.4%
No	Count	23	7	30
	% within State	44.2%	31.8%	40.5%
[DO NOT READ] (Don't Know)	Count	5	1	6
	% within State	9.6%	4.5%	8.1%
Total	Count	52	22	74

CADMUS

	% within State	100.0%	100.0%	100.0%

Did you try to install the kitchen aerator that you received with the kit?

			NC	SC	Total
	Yes	Count	8	4	12
		% within State	15.7%	20.0%	16.9%
	No	Count	41	16	57
		% within State	80.4%	80.0%	80.3%
	[DO NOT READ] (Don't Know)	Count	1	0	1
		% within State	2.0%	0.0%	1.4%
	[DO NOT READ] (Refused)	Count	1	0	1
		% within State	2.0%	0.0%	1.4%
Total		Count	51	20	71
		% within State	100.0%	100.0%	100.0%

Why is the kitchen aerator not currently installed?*

Category of Action	Count Mentioning: NC	Count Mentioning: SC	Count Mentioning: Total
Does not fit on faucet	4	2	6
Does not work with water filter	2		2
Low flow / not enough water pressure	1	1	2
Aerator is not adjustable	1		1
Too complicated to install on my faucet		1	1
Aerator made a loud noise when I used it	1		1

* Although 12 participants reported trying to install kitchen aerators that are not currently installed, 13 responses are shown in this table because one participant gave two reasons why the item is not currently installed (low flow and not adjustable).

How many of the bathroom faucet aerators that you received from the kit are currently installed in your home?

			NC	SC	Total
	(One aerator)	Count	29	9	38
		% within State	27.6%	20.0%	25.3%
	(Two aerators)	Count	20	11	31
		% within State	19.0%	24.4%	20.7%
	(Three aerators)	Count	7	6	13
		% within State	6.7%	13.3%	8.7%
	(Four aerators)	Count	2	1	3
		% within State	1.9%	2.2%	2.0%
	(Five aerators)	Count	0	1	1
		% within State	0.0%	2.2%	.7%
	None have been installed	Count	41	16	57
		% within State	39.0%	35.6%	38.0%
	[DO NOT READ] (Don't Know)	Count	5	1	6
		% within State	4.8%	2.2%	4.0%
	[DO NOT READ] (Refused)	Count	1	0	1
		% within State	1.0%	0.0%	.7%
Total		Count	105	45	150
		% within State	100.0%	100.0%	100.0%

CADMUS

Did you have to remove any aerators from your bathroom faucets before installing the aerator(s) provided by the kit?

			NC	SC	Total
	Yes	Count	33	20	53
		% within State	56.9%	71.4%	61.6%
	No	Count	24	8	32
		% within State	41.4%	28.6%	37.2%
	[DO NOT READ] (Don't Know)	Count	1	0	1
		% within State	1.7%	0.0%	1.2%
Total		Count	58	28	86
		% within State	100.0%	100.0%	100.0%

How many previously-installed bathroom aerators were replaced by aerators from the kit?

			NC	SC	Total
	(One aerator)	Count	3	2	5
		% within State	14.3%	12.5%	13.5%
	(Two aerators)	Count	11	6	17
		% within State	52.4%	37.5%	45.9%
	(Three aerators)	Count	7	6	13
		% within State	33.3%	37.5%	35.1%
	(Four aerators)	Count	0	1	1
		% within State	0.0%	6.3%	2.7%
	None have been installed	Count	0	1	1
		% within State	0.0%	6.3%	2.7%
Total		Count	21	16	37
		% within State	100.0%	100.0%	100.0%

For the bathroom aerators that you received with the kit and which are not currently installed, did you try to install them?

			NC	SC	Total
	Yes	Count	25	10	35
		% within State	27.5%	25.0%	26.7%
	No	Count	55	29	84
		% within State	60.4%	72.5%	64.1%
	[DO NOT READ] (Don't Know)	Count	11	1	12
		% within State	12.1%	2.5%	9.2%
Total		Count	91	40	131
		% within State	100.0%	100.0%	100.0%

CADMUS

Why (is/are) the bathroom aerator(s) not currently installed?*

Category of Action	Count Mentioning: NC	Count Mentioning: SC	Count Mentioning: Total
Does not fit on faucet	4	3	7
Low flow / not enough water pressure	2	1	3
Aerator does not work	2		2

* Although 35 participants reported trying to install bathroom aerators that are not currently installed, when asked to explain why these items are not installed most indicated that they had not tried or did not intend to try installing them. This table only includes responses that indicate that the participant did try to install a bathroom aerator.

Pipe Insulation

Is any of the pipe insulation from the kit currently installed on your hot water pipes?

			NC	SC	Total
	Yes	Count	30	20	50
		% within State	28.6%	44.4%	33.3%
	No	Count	68	20	88
		% within State	64.8%	44.4%	58.7%
	[DO NOT READ] (Don't Know)	Count	7	5	12
		% within State	6.7%	11.1%	8.0%
Total		Count	105	45	150
		% within State	100.0%	100.0%	100.0%

How much of the pipe insulation that you received from the kit is currently installed? Would you say...

			NC	SC	Total
	All, or almost all, of it;	Count	18	9	27
		% within State	60.0%	45.0%	54.0%
	About 75% of it;	Count	5	2	7
		% within State	16.7%	10.0%	14.0%
	About half of it;	Count	4	5	9
		% within State	13.3%	25.0%	18.0%
	or about 25% of it?	Count	1	2	3
		% within State	3.3%	10.0%	6.0%
	[DO NOT READ] (Don't Know)	Count	2	2	4
		% within State	6.7%	10.0%	8.0%
Total		Count	30	20	50
		% within State	100.0%	100.0%	100.0%

When you installed the pipe insulation that you received with the kit, did you replace old insulation that was already there, or add insulation where there previously wasn't any, or both?

		NC	SC	Total
(Just replaced old insulation)	Count	8	6	14
	% within State	26.7%	30.0%	28.0%
(Just installed new insulation)	Count	15	8	23
	% within State	50.0%	40.0%	46.0%

CADMUS

	(Both - some kit insulation replaced old insulation AND some was installed where there wasn't previously insulation)	Count	5	5	10
		% within State	16.7%	25.0%	20.0%
	[DO NOT READ] (Don't Know)	Count	2	1	3
		% within State	6.7%	5.0%	6.0%
Total		Count	30	20	50
		% within State	100.0%	100.0%	100.0%

What is the diameter of the pipe that you insulated?

			NC	SC	Total
	1.00	Count	8	4	12
		% within State	26.7%	20.0%	24.0%
	2.00	Count	4	1	5
		% within State	13.3%	5.0%	10.0%
	3.00	Count	4	2	6
		% within State	13.3%	10.0%	12.0%
	5.00	Count	0	3	3
		% within State	0.0%	15.0%	6.0%
	[DO NOT READ] (Don't Know)	Count	14	8	22
		% within State	46.7%	40.0%	44.0%
	[DO NOT READ] (Refused)	Count	0	2	2
		% within State	0.0%	10.0%	4.0%
Total		Count	30	20	50
		% within State	100.0%	100.0%	100.0%

Did you try to install any of the pipe insulation that you received with the kit?

			NC	SC	Total
	Yes	Count	4	4	8
		% within State	5.8%	20.0%	9.0%
	No	Count	62	16	78
		% within State	89.9%	80.0%	87.6%
	[DO NOT READ] (Don't Know)	Count	3	0	3
		% within State	4.3%	0.0%	3.4%
Total		Count	69	20	89
		% within State	100.0%	100.0%	100.0%

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

September 27, 2016

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 and offers a performance-based incentive up to 80 percent of the total project cost, inclusive of both materials and installation, on high-efficiency lighting and refrigeration equipment.

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

1.2 Evaluation Objectives and High Level Findings

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

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

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

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

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

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

The evaluation team verified gross energy savings at 111 percent of deemed reported energy savings for DEP and 112 percent for DEC, and gross peak demand reductions at 96 percent for DEP and DEC. A net-to-gross (NTG) ratio was estimated at 1.04, yielding total verified net energy savings of 56,491 megawatt-hours (MWh) for DEP and 90,375 MWh for DEC, and net peak demand reductions of 11.6 megawatts (MW) for DEP and 20.6 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	48,772	54,318	1.11
Gross Energy Impacts (MWh)	DEC	77,269	86,899	1.12

Source: Navigant analysis and Duke Energy tracking data.

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

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

Source: Navigant analysis and Duke Energy tracking data.

Table 1-3. Program Net Energy Impacts

	Jurisdiction	MWh
Net Energy Impacts (MWh)	DEP	56,491
Net Energy Impacts (MWh)	DEC	90,375

Source: Navigant analysis.

Table 1-4. Program Net Peak Demand Impacts

	Jurisdiction	MW
Net Summer Peak Demand Impacts (MW)	DEP	11.6
Net Winter Peak Demand Impacts (MW)	DEP	6.4
Net Summer Peak Demand Impacts (MW)	DEC	20.6
Net Winter Peak Demand Impacts (MW)	DEC	11.3

Source: Navigant analysis.

1.3 Evaluation Parameters and Sample Period

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

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

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

Table 1-5. Evaluated Parameters

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

Source: Navigant analysis

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

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

Table 1-6. Sample Period Start and End Dates

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

Source: Navigant analysis

1.4 Recommendations

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

Table 1-7. Summary of PY2015 SBES Recommendations

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

Source: Navigant analysis

2. PROGRAM DESCRIPTION

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

2.1 Program Design

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

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

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

2.2 Reported Program Participation and Savings

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

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

Table 2-1. Reported Participation and Gross Savings Summary

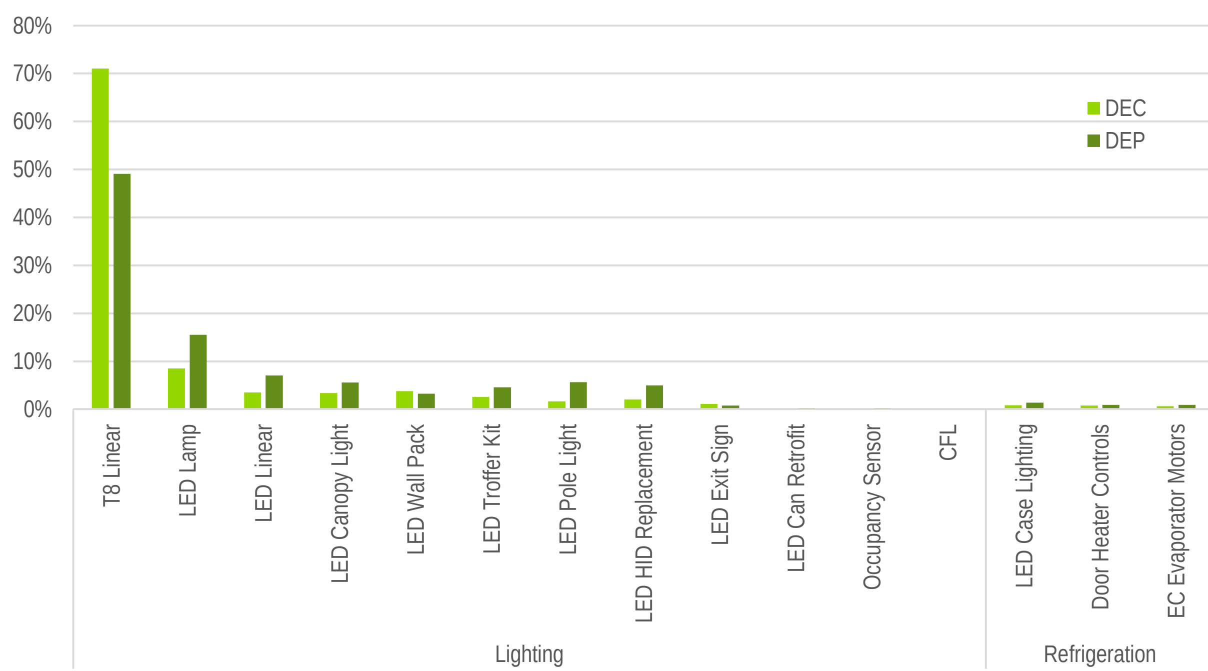
Reported Metrics	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP)	PY2015 (DEC)
Participants	675	1,759	1,790	3,080
Measures Installed	42,537	108,816	132,977	234,788
Gross Annual Energy Savings (MWh)	14,242	38,665	48,772	77,269
Average Quantity of Measures per Project	63	62	74	76
Average Gross Savings Per Project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

Source: SBES Tracking Database

2.2.1 Program Summary by Measure

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

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

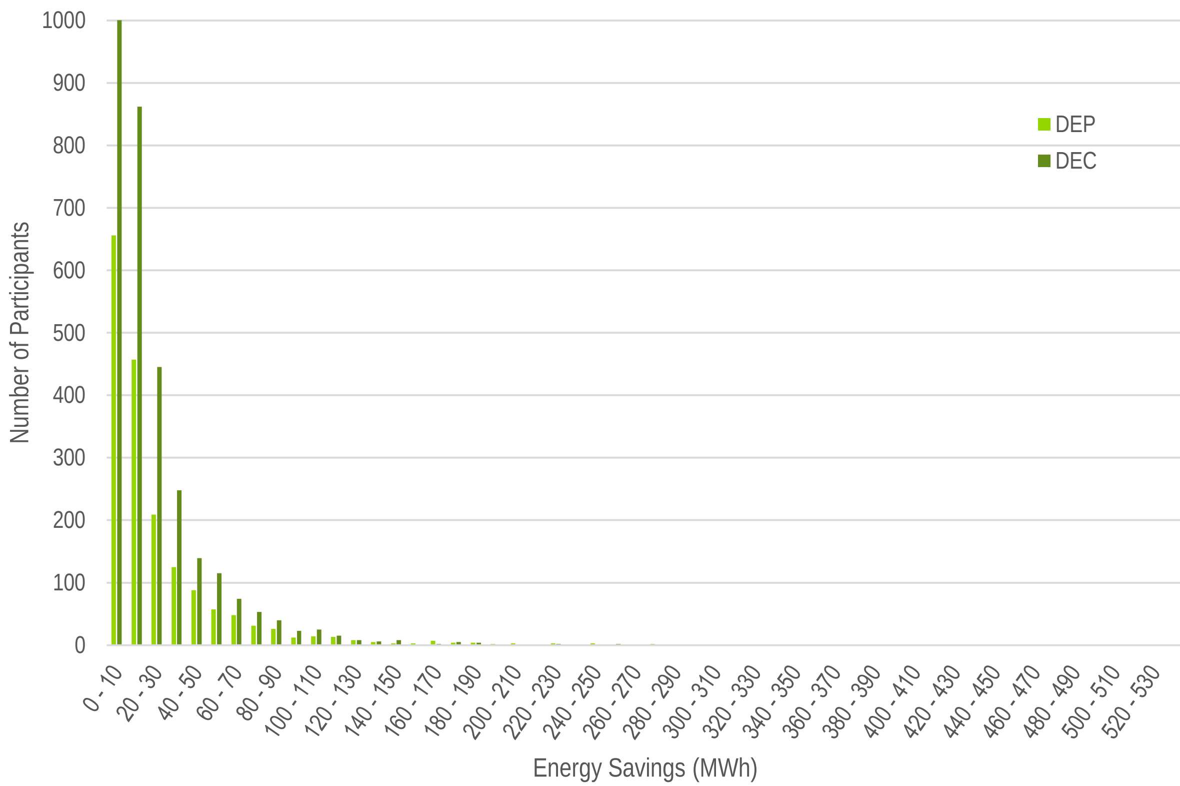


Source: SBES Tracking Database

2.2.2 Savings by Project

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

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



Source: SBES Tracking Database

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

3. KEY RESEARCH OBJECTIVES

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

3.1 Impact Evaluation

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

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

3.2 Net-to-Gross Analysis

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

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

3.3 Process Evaluation

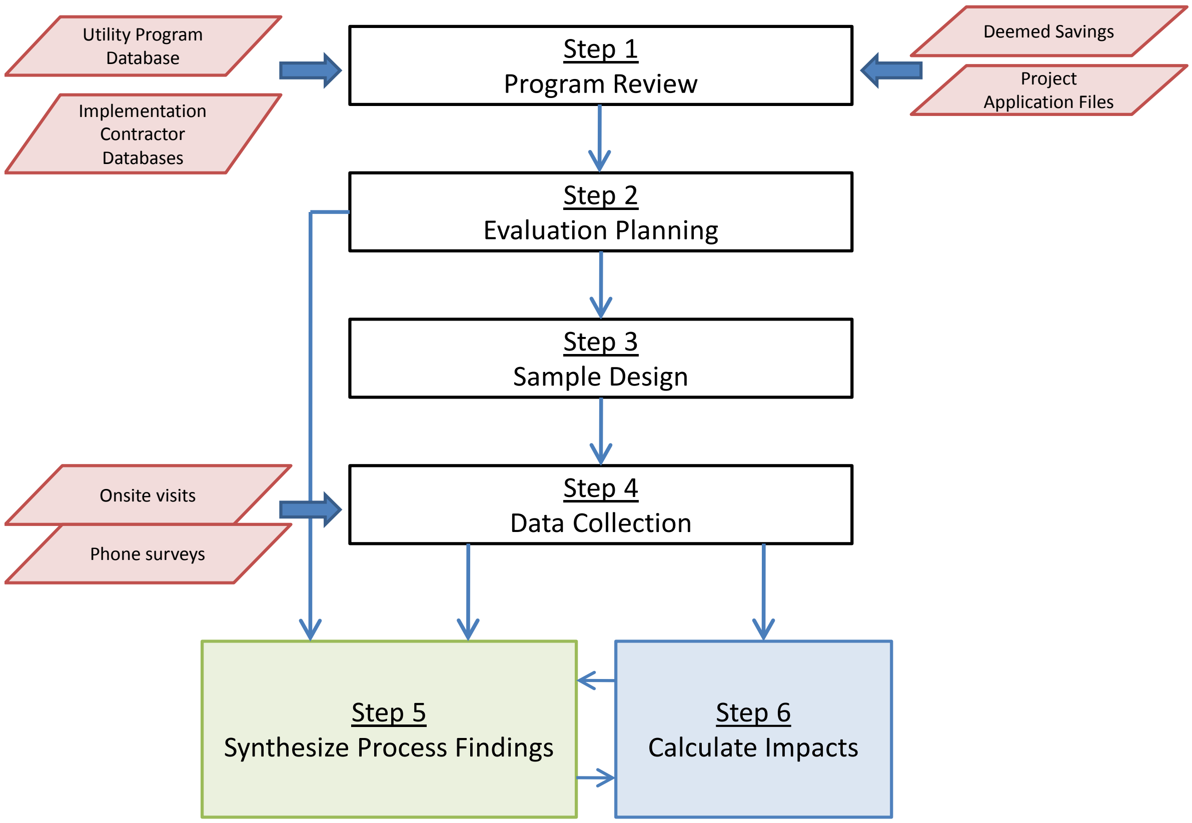
The process evaluation focuses on the program implementation and the customer experience. Objectives include:

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

3.4 Evaluation Overview

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

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 as an input to system planning.

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

DEP	Energy Savings (MWh)	Summer Peak Demand Reductions (MW)	Winter Peak Demand Reductions (MW)
Reported Gross Savings	48,772	11.7	11.7
Realization Rate	1.11	0.96	0.53
Verified Gross Savings	54,318	11.2	6.2
NTGR	1.04	1.04	1.04
Verified Net Savings	56,491	11.6	6.4

Source: Navigant analysis

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

DEC	Annual Energy Savings (MWh)	Summer Peak Demand Reductions (kW)	Winter Peak Demand Reductions (kW)
Reported Gross Savings	77,269	20.5	20.5
Realization Rate	1.12	0.96	0.53
Verified Gross Savings	86,899	19.8	10.9
NTGR	1.04	1.04	1.04
Verified Net Savings	90,375	20.6	11.3

Source: Navigant analysis

4.1 Impact Methodology

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

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

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

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

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

[2] PY2013 DEP EEB EM&V Report

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

4.2 Sample Design

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

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

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

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

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

Table 4-3. Onsite Sample Summary

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

Source: Navigant analysis

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.

4.3.4 Annual Operating Hours

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

4.3.5 Coincidence Factor (CF)

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

4.3.6 Unit Savings

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

4.4 Key Impact Findings

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

Table 4-5. Energy Impacts by Strata

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

Source: Navigant analysis

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

Table 4-6. Summer Peak Demand Impacts by Strata

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

Source: Navigant analysis

Table 4-7. Winter Peak Demand Impacts by Strata

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

Source: Navigant analysis

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

4.5 Detailed Impact Findings

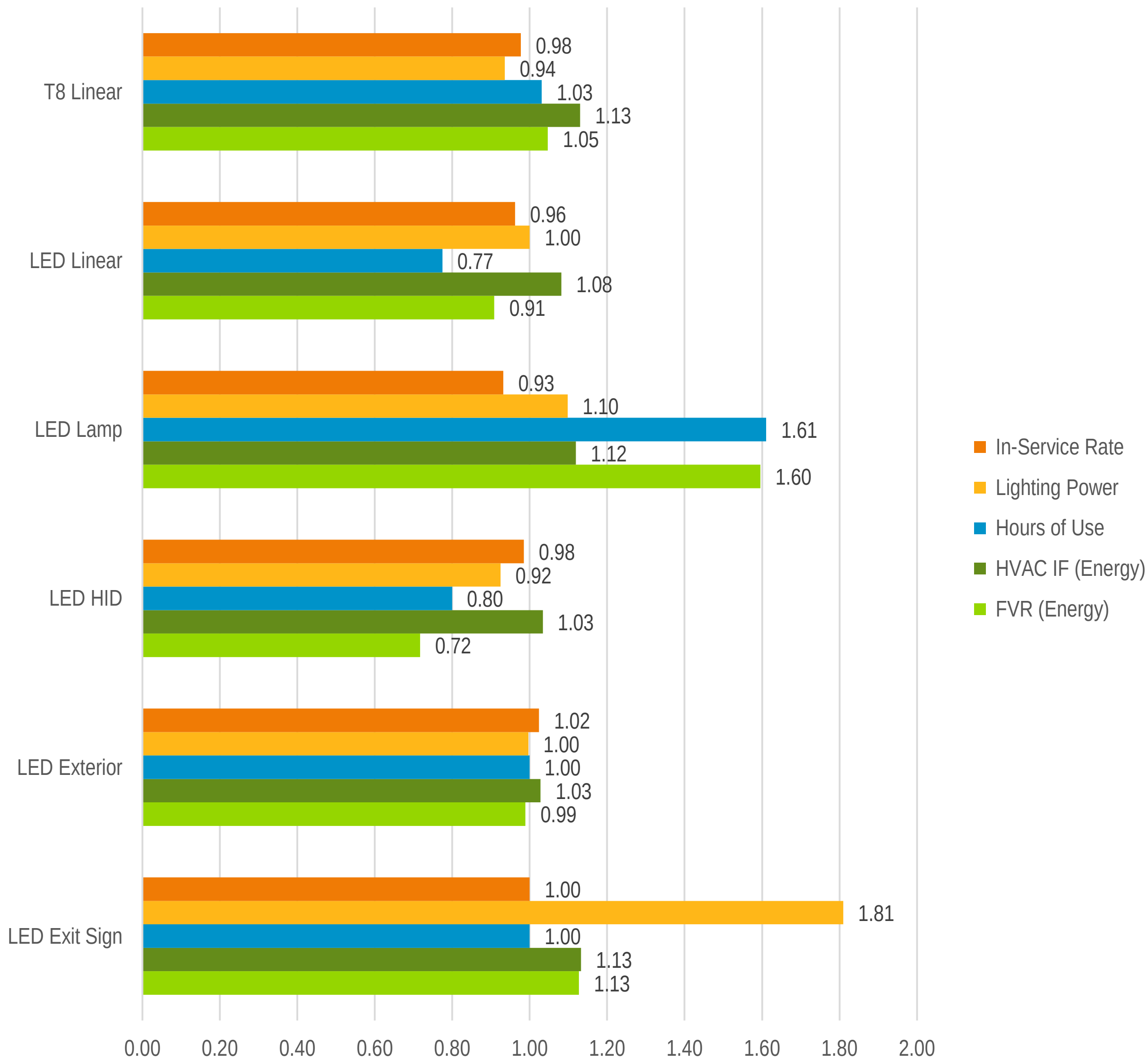
This section examines findings from the evaluation of lighting measures in order to identify the main drivers of the verified savings values. The evaluation team uses the Field Verification Rate (FVR) to describe the overall verified savings relative to the reported savings for each measure. FVRs reflect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

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

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

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

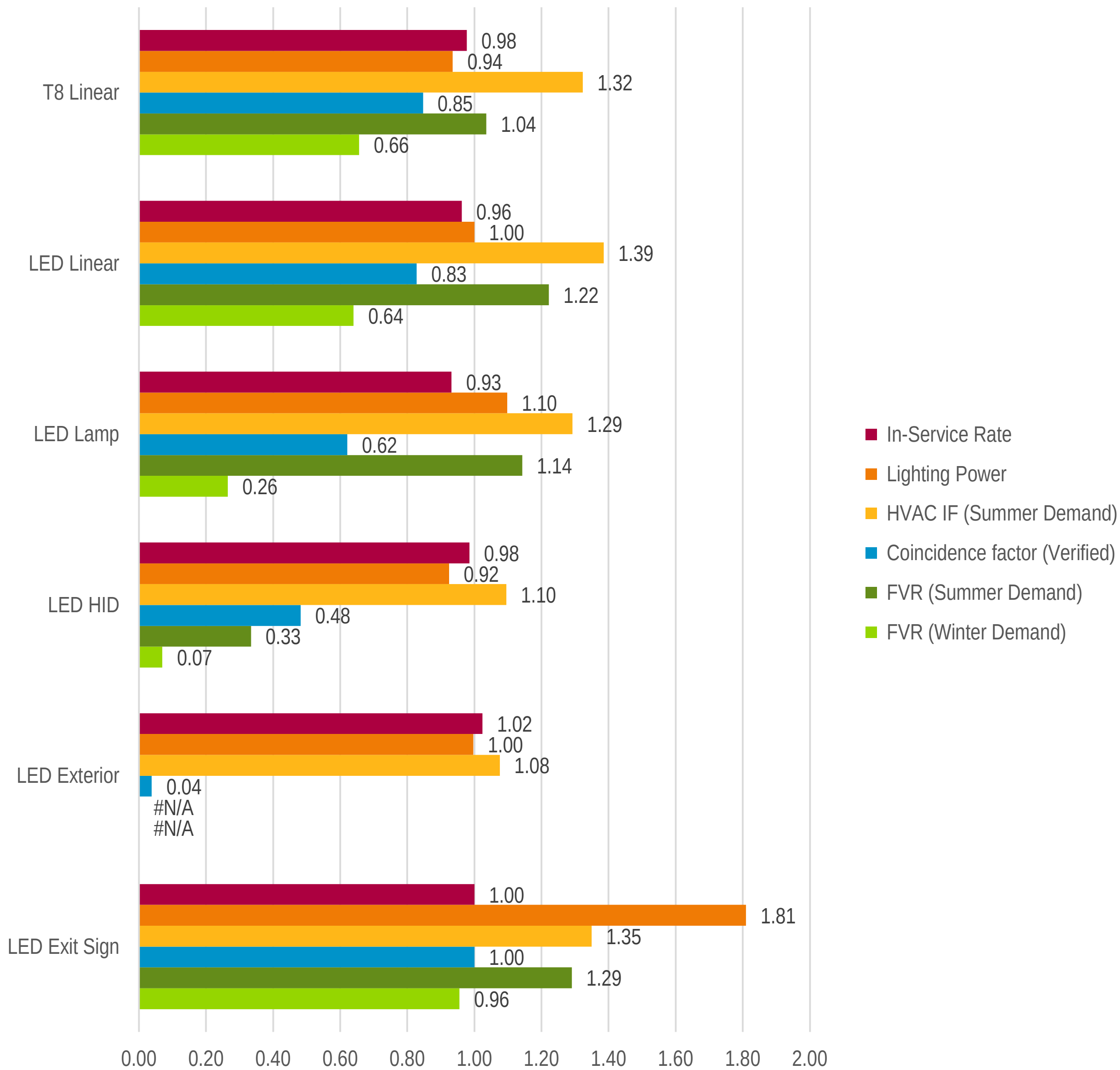
Figure 4-1. Gross Energy Savings Field Verification Rates



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.

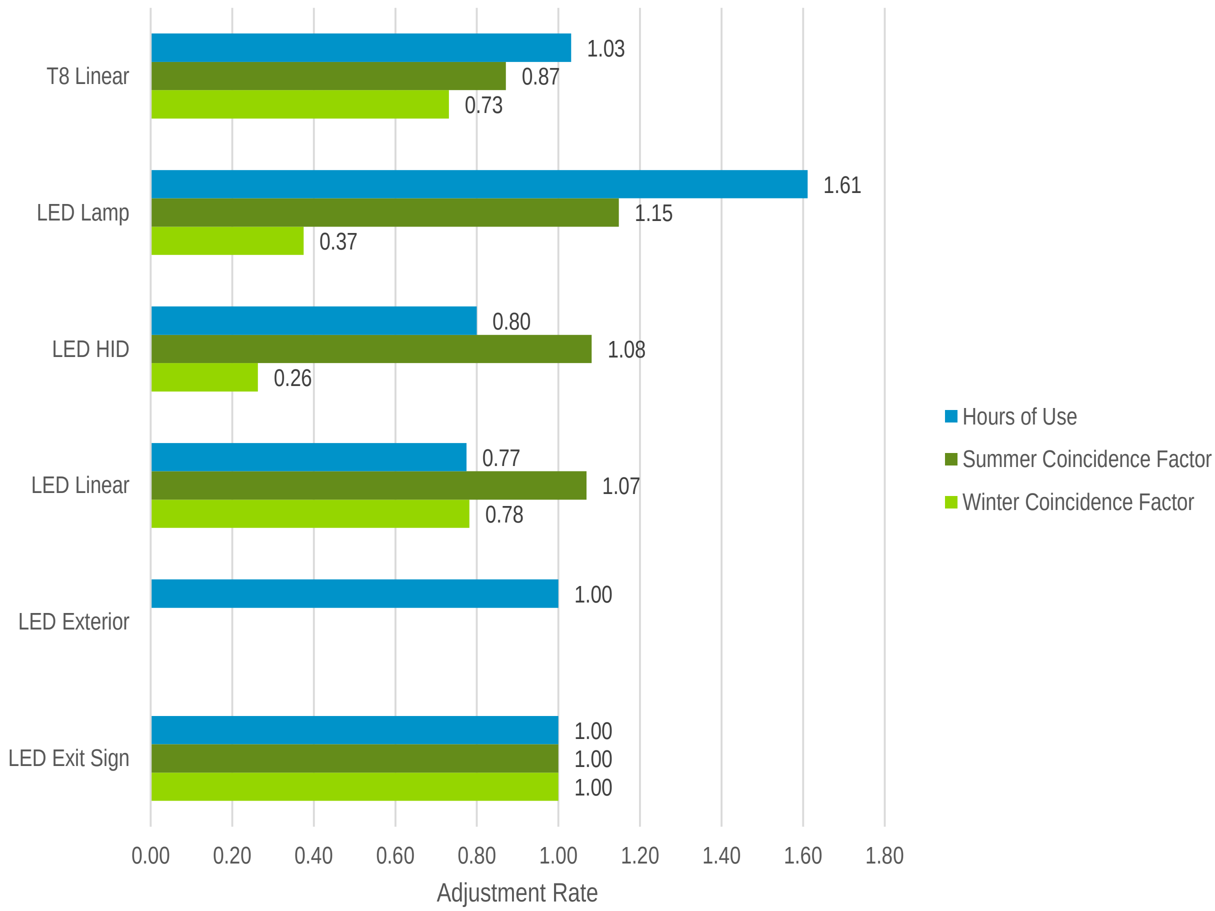
Figure 4-2. Gross Peak Demand Reductions Field Verification Rates



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 0.93 for LED screw-in lamps and 1.02 for LED exterior fixtures.

4.5.2 Hours-of-Use Adjustments

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

4.5.3 Lighting Power

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

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

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

4.5.4 HVAC Interactive Effects

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

4.5.5 Coincidence Factors

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

5. NET-TO-GROSS ANALYSIS

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

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

Table 5-1. Net-to-Gross Results

	PY2013 (DEP)	PY2014 (DEP)	PY2015 (DEP & DEC)
Estimated Free Ridership	0.04	0.04	0.05
Estimated Spillover	0.02	0.07	0.09
Estimated NTG	0.98	1.03	1.04

Source: Navigant analysis

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

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

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

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

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

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

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

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

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

The basic equation is shown in Equation 1.

Equation 1. Net-to-Gross Ratio

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

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

5.2 Methods for Estimating Free Ridership and Spillover

5.2.1 Estimating Free Ridership

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

Respondents were asked three categories of program-influence questions:

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

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

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

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

5.2.2 Estimating Spillover

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

- **Whether spillover exists at all.** These were yes/no questions that asked, for example, whether the respondent incorporated energy efficiency measures or designs that were not recorded in program records. Questions related to extra measures installed at the project site (within-facility spillover) and to measures installed in non-program projects (outside-facility spillover) within the service territory.

- **The share of those savings that could be attributed to the influence of the program.** Participants were asked if they could estimate the energy savings from these additional extra

[5] Scores were calculated by the following formulas:

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

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

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

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

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

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

5.2.3 Combining Results across Respondents

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

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

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

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

5.3.1 Review of Data Collection Efforts for Attribution Analysis

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

Table 5-2. Attribution Survey Completes by Project Type

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

Source: Navigant analysis

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 5 percent of program-reported savings.

5.3.3 Spillover Results

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

5.3.4 Net-to-Gross Ratio

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

Equation 2. Net-to-Gross Ratio

NTG = 1 – free ridership + spillover

Using the overall free ridership value of 4 percent and the overall spillover value of 9 percent, the NTG ratio is 1 – 0.05 + 0.09 = 1.04. The estimated NTG ratio of 1.04 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 104 MWh is attributable to the program.

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

	Free Ridership	Spillover	NTG Ratio
SBES Program Total	0.05	0.09	1.04

Source: Navigant analysis

6. SUMMARY FORM

Program Name

Completed EMV Fact Sheet

Description of program

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

The program consists of lighting and refrigeration measures.

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

Date	July 15, 2016
Region(s)	Duke Energy Progress; Duke Energy Carolinas
Evaluation Period	DEP 1/1/15 – 2/29/16 DEC 8/1/14 – 2/29/16
Annual kWh Savings	DEP 56,490,635 kWh DEC 90,374,674 kWh
Per Participant kWh Savings	DEP 27,247 DEC 25,087
Coincident kW Impact	DEP 11,650 DEC 20,603
Net-to-Gross Ratio	1.04
Process Evaluation	Annual
Previous Evaluation(s)	2013 and 2014 (DEP)

Evaluation Methodology

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

Impact Evaluation Details

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

7. PROCESS EVALUATION

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

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

7.1 Process Methodology

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

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

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

7.2 Sampling Plan and Achievements

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

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

7.3 Program Review

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

- **Program Design** – The SBES program is designed to offer high incentives (up to 80 percent of the total cost of the project) on efficient equipment to reduce energy use and peak demand. It specifically targets small business customers that are difficult to reach and often do not pursue energy efficiency on their own. In PY2015 the program rolled out new marketing materials centered around case studies for various types of small business customers.

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

7.4 Key Process Findings

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

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

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

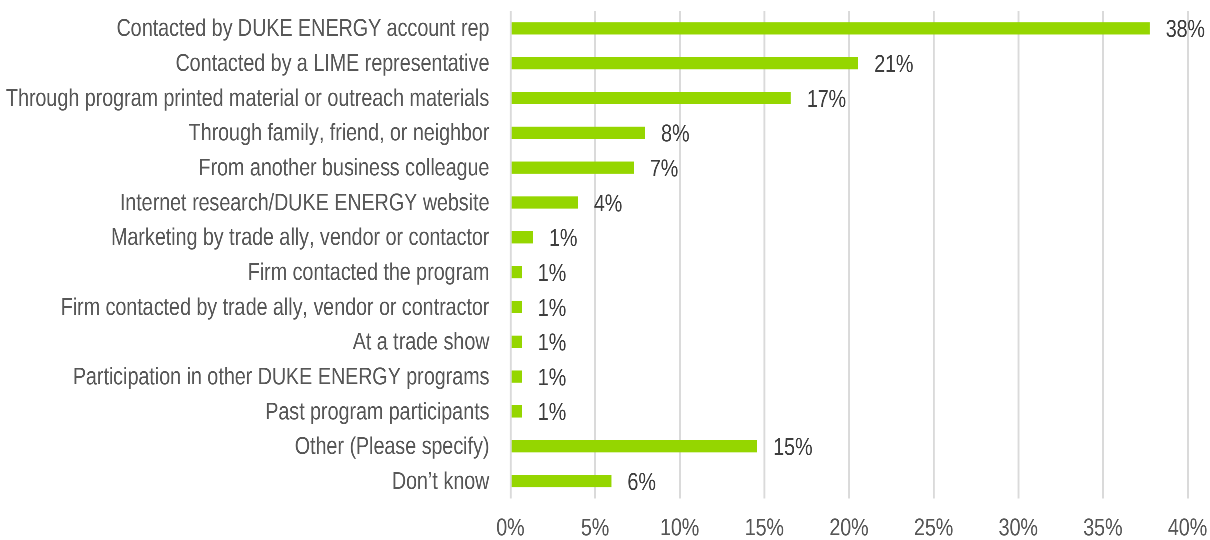
The following sections detail the process findings and addresses the following topics:

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

7.4.1 Marketing and Outreach

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

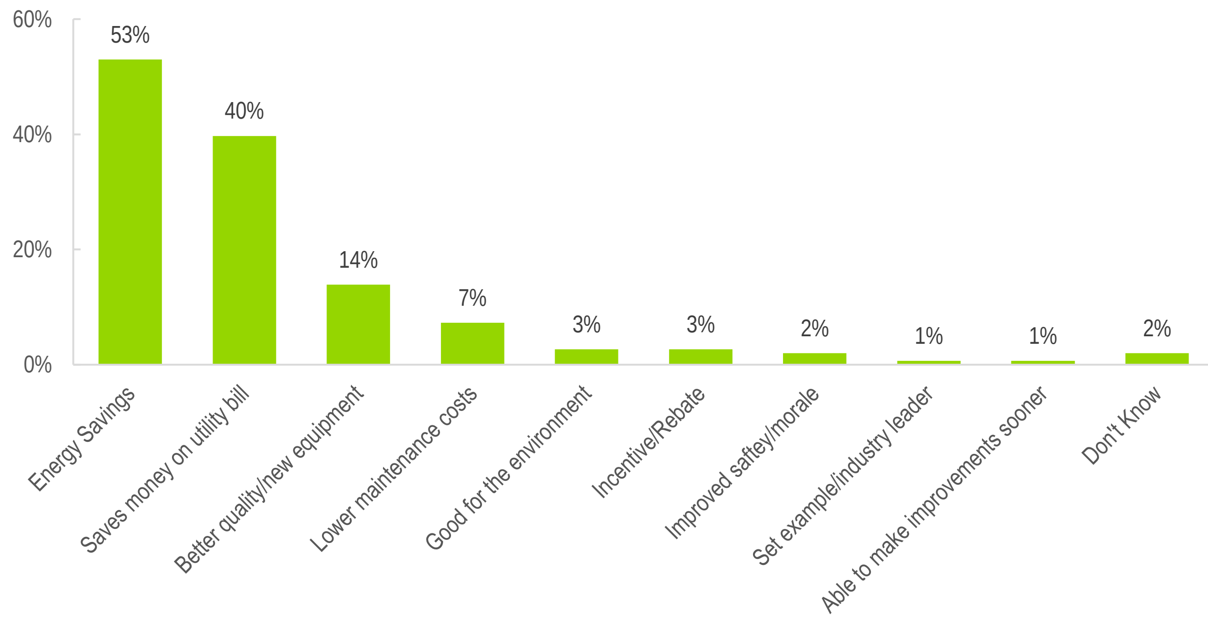
Figure 7-1. How Program Participants First Learned About the SBES Program (n = 151)



Source: Navigant analysis

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

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



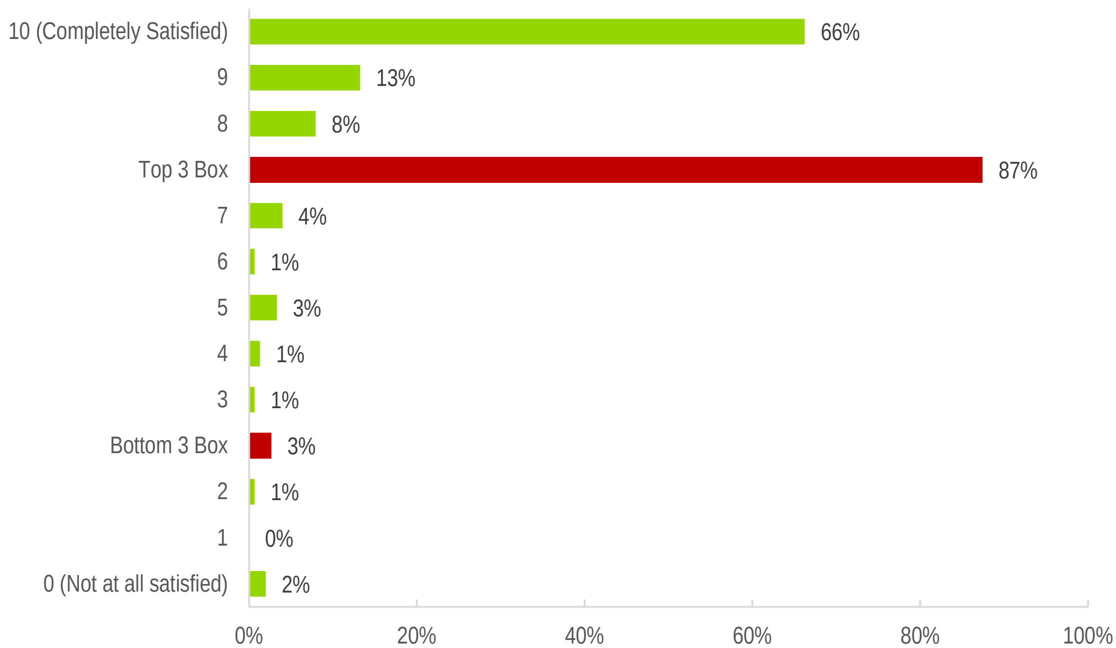
Source: Navigant analysis

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

7.4.2 Customer Experience

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

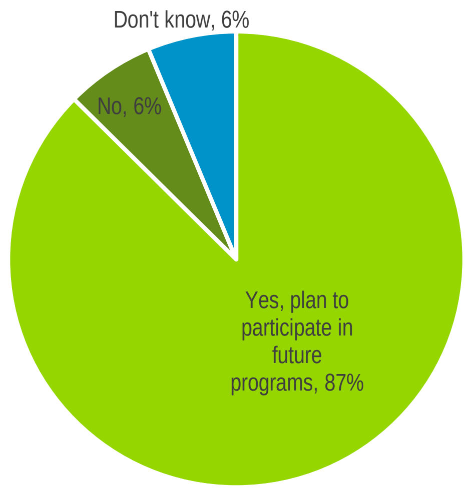
Figure 7-3: Customer Satisfaction with Overall Program (n=151)



Source: Navigant analysis

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

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



Source: Navigant analysis

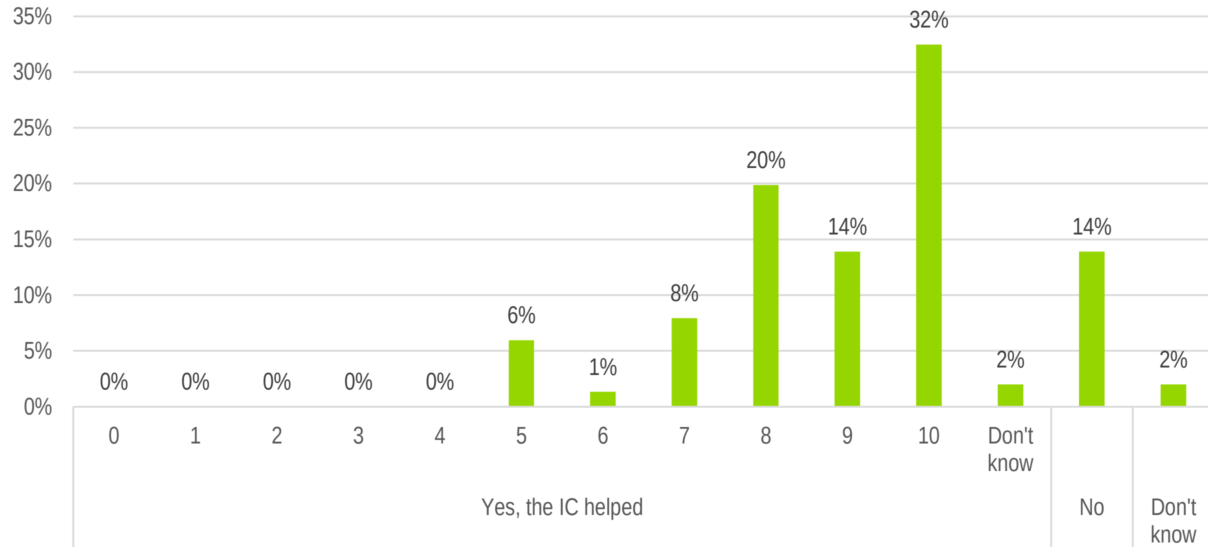
7.4.3 Implementation Contractor

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

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

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

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

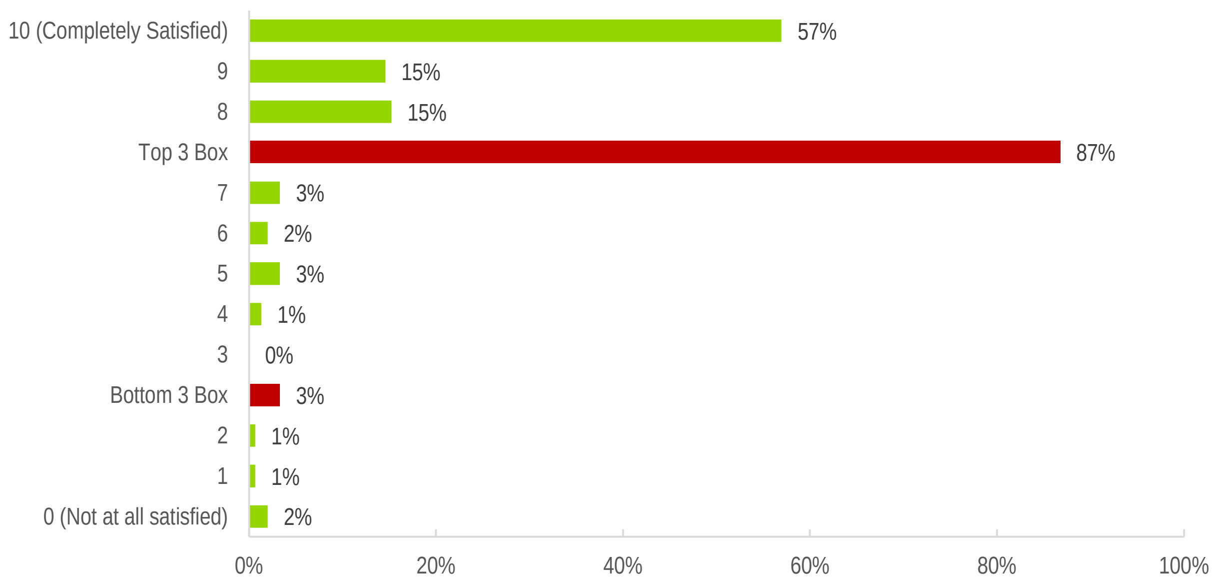


Source: Navigant analysis

7.4.4 Installation Contractors

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

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



Source: Navigant analysis

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

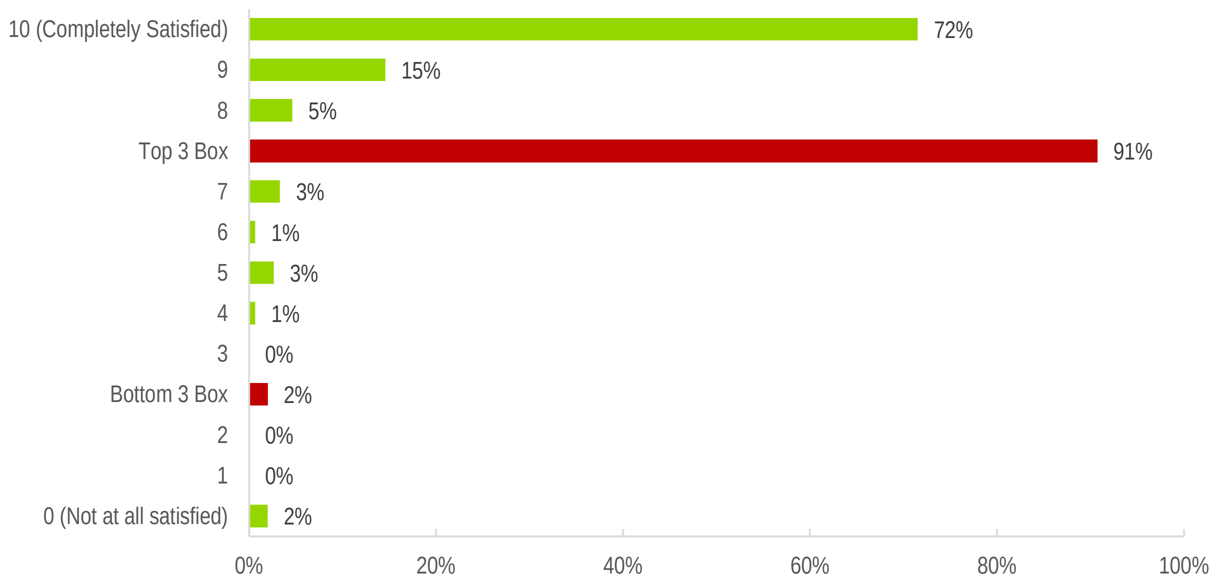
7.4.5 Measure Incentives

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

7.4.6 Upgraded Equipment

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

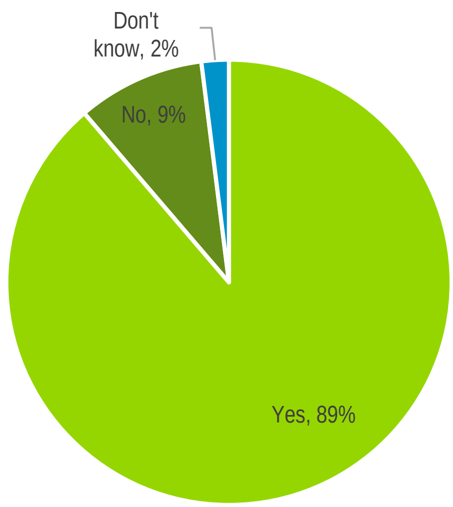
Figure 7-7: Participant Satisfaction with New Equipment (n=151)



Source: Navigant analysis

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

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



Source: Navigant analysis

7.4.7 Suggested Improvements

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

Summary of Improvements Mentioned by Customers

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

8. CONCLUSIONS AND RECOMMENDATIONS

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

8.1 Conclusions

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

- **Participants continue to be overwhelmingly satisfied with the SBES Program and Duke Energy**, including overall service, pricing, installation, and efficient equipment quality.
- **Duke Energy has successfully expanded into the DEC jurisdiction** in PY2015. The program had no apparent issues scaling up operations in the DEC service territory, and there are no meaningful differences in the EM&V team's findings between the two jurisdictions.
- **The program has increased average project savings substantially** compared to PY2014. This is driven by new LED measures that have higher per-unit savings, and targeting of larger customers that are able to generate more savings per site.
- The Duke Energy program management team and the IC have **demonstrated a commitment to quality** by quickly implementing program changes based on evaluation feedback provided in the PY2014 evaluation. Additionally, the IC team has created new branded marketing materials with case studies for a variety of small business facilities.
- The **installation of high–efficiency equipment continues to be the key selling point**. The SBES Program successfully added linear LED retrofit measures to the suite of program offerings for PY2015, replacing T8 fluorescent fixtures. LED measures have grown considerably as a share of total program savings, while refrigeration has remained stable from PY2014 at under 10 percent.
- The **energy savings realization rate is 1.11 for DEP and 1.12 for DEC,** and is driven by several EM&V adjustments that roughly balanced out. The key adjustments the EM&V team made were the in-service rates and HVAC interactive effects. The **peak demand realization rate is lower at 0.96 for DEP and DEC** and is driven by HVAC interactive effects and coincidence factors.
- The evaluation effort estimated **free ridership for the SBES Program at 5 percent and spillover at 9 percent**, which drives an **NTG ratio of 1.04**. This indicates that the SBES Program is successfully reaching customers that would have not completed energy efficiency upgrades in the absence of the program. Spillover has increased from PY2014 and indicates that the program is showcasing the benefits of energy efficiency.

8.2 Recommendations

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

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

Increasing Program Participation

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

Increasing Customer Satisfaction

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

Improving Accuracy of Reported Savings

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

9. MEASURE-LEVEL INPUTS FOR DUKE ENERGY ANALYTICS

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

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

Table 9-1. HVAC Interactive Effects[7]

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

[7] PY2013 DEP EEB EM&V Report

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

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

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

10. APPENDICES

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

- PY2014 DEP SBES Impact Summary.xlsx

PY2015 DEP_DEC
SBES Impact Summa

CERTIFICATE OF SERVICE

I certify that a copy of Duke Energy Carolinas, LLC's Application for Approval of Demand-Side Management and Energy Efficiency Cost Recovery Rider and Supporting Testimony and Exhibits, in Docket No. E-7, Sub 1130, has been served by electronic mail, hand delivery or by depositing a copy in the United States mail, postage prepaid properly addressed to parties of record.

This the 8th day of March, 2017.

____

Brian L. Franklin
Associate General Counsel
Duke Energy Corporation
550 S. Tryon St.
DEC 45A/P.O. Box 1321
Charlotte, North Carolina 28201
Tel: 980.373.4465
brian.franklin@duke-energy.com
North Carolina State Bar No. 35075

ATTORNEY FOR DUKE ENERGY CAROLINAS, LLC