Duke Energy Carolinas

Low Income Weatherization Program (2016–2018) Evaluation Report – Final

April 16, 2021

Table of Contents

1. Evaluation Summary 1
 1.1 Program Summary 1
 1.2 Evaluation Objectives 1
 1.3 High Level Findings 2
 1.4 Evaluation Recommendations 6
2. Program Description 8
 2.1 Program Design 8
 2.2 Program Implementation 8
 2.3 Program Performance 8
3. Overview of Evaluation Activities 10
 3.1 Program Staff Interviews 10
 3.2 Implementing Agency Staff Interviews 10
 3.3 Program Materials Review 11
 3.4 Participant Survey 11
 3.5 Consumption Analysis 12
 3.6 Engineering Analysis 12
4. Gross Impact Evaluation 13
 4.1 Methodology 13
 4.2 Results 19
 4.3 References 28
5. Process Evaluation—Weatherization Program 29
 5.1 Researchable Questions 29
 5.2 Methodology 29
 5.3 Key Findings 29
6. Process Evaluation—Durham Pilot 41
7. Key Findings and Recommendations 46

7.1 Key Impact Findings 46

7.2 Key Process Findings 46

7.3 Evaluation Recommendations 48

8. Summary Form 50

9. DSMore Table 51

Table of Tables

Table 1. Summary of Impact Results 3
Table 2. Measure Mix 3
Table 3. Annual Per Household Savings 9
Table 4. Agency Interview Sample 11
Table 5. Survey Disposition Category Key 11
Table 6. Accounts Included in the Consumption Analysis Model 14
Table 7. Results of Tier I and Tier II Consumption Analysis Models 19
Table 8. Annual Per-Participant Energy Savings from Consumption Analysis 20
Table 9. First Year Measure In-Service Rates 21
Table 10. Ex-Post Per-Unit Deemed Savings Estimates 23
Table 11. Engineering Analysis Total Gross Savings by Measure 24
Table 12. Engineering Analysis Gross Program Savings 25
Table 13. Measure Mix 26
Table 14. Engineering Demand-to-Energy Ratios 27
Table 15. Tier I Savings Comparison with Participants from Prior Evaluation 27
Table 16. 2016-2018 CAA Projects by Tier 30
Table 17. Agency Activity and Participation 33
Table 18. Impacts Reported by Participants 37
Table 19. Comparison of Participant Characteristics 44
Table 20. Comparison of Project Types 44
Table 21. Comparison of Tier II Measure Mix 45
Table 22. Summary of Impact Results 46

Table of Figures

Figure 1. Measure Contribution to Total Tier I and Tier II Energy Savings 4
Figure 2. In-Service Rate Components 16
Figure 3. Comparison of Tier II Savings to Prior Evaluation 20
Figure 4. Measure Contribution to Total Tier I and Tier II Energy Savings 26
Figure 5. DEC Weatherization Projects Per Year 2015-2018 31
Figure 6. How Participants First Heard About the DEC Weatherization Program (Multiple Response) 32
Figure 7. Participants' Main Motivation in Signing Up for Weatherization 32
Figure 8. Changes to Agency Participation 34
Figure 9. Participant Satisfaction with DEC Weatherization Program and Equipment 39

1. Evaluation Summary

This report presents findings from our impact and process evaluation of the Duke Energy Carolinas (DEC) Low Income Weatherization Program (hereafter referred to as the Weatherization Program or the program), covering the period of April 2016 to December 2018. The impact evaluation results are based on a combination of billing analysis and engineering analysis. Process evaluation results are based on a program materials review, interviews with program staff and participating agencies, and a telephone survey of program participants. In addition, this report includes a limited process evaluation of the new DEC Weatherization Pilot in Durham, North Carolina, based on an in-depth interview with pilot program staff and a program materials and tracking data review.

This report includes a high-level description of the evaluation methodologies as well as results, findings, and recommendations. The associated appendix includes additional detail on the impact methodology and results.

1.1 Program Summary

The Weatherization Program aims to improve the health, safety, and energy efficiency of income-qualified Duke Energy customer households by leveraging existing weatherization programs to provide a comprehensive package of electric conservation measures at no cost to DEC customers. Duke Energy's implementation partners are the program administrator (the North Carolina Community Action Association, or NCCAA); the database administrator (TRC; previously Lockheed Martin); and a network of local implementing agencies that include community action agencies (CAAs), local governments, and other nonprofit organizations that enroll customers and complete weatherization projects. DEC initially designed the program to leverage federally funded state weatherization assistance programs (State WAPs), in which implementing agencies already participate. DEC pays a fixed price per State WAP project completed at qualifying DEC customer's homes, with the requirement that agencies then use the funds to support future weatherization-related activities. In an effort to bypass strict DOE program funding rules and to encourage more participation in South Carolina, DEC introduced a new participation channel in 2018 in which agencies could submit qualifying weatherization projects originally funded from their operating budget or another source.

Weatherization Program participants must live in an individually metered single-family home with a household income less than or equal to 200% of the federal poverty guideline. The Weatherization Program offers two participation tiers for owner-occupied homes, as well as a refrigerator replacement offering to both owners and renters (with landlord approval). Tier I covers eligible projects at homes using less than 7 kWh per square foot annually and provides up to $600 for air sealing and low-cost energy efficiency upgrades like LEDs, domestic water heater tank insulation, low-flow shower heads, faucet aerators, and others. Tier II covers eligible projects at homes using at least 7 kWh per square foot annually and provides up to $4,000 for Tier I measures plus insulation improvements. Tier II projects can qualify for a higher funding cap of $6,000 if they include a qualifying heat pump upgrade or replacement. Refrigerator replacement is available even if the home did not receive any Tier I or Tier II measures. Refrigerator replacement eligibility and incentive levels are dependent on the old refrigerator's size and a two-hour metering test.

1.2 Evaluation Objectives

We established the following objectives for this evaluation:

- Review and update, as necessary, deemed savings estimates through a review of measure assumptions and calculations;

- Verify measure installation and persistence;
- Estimate program energy (kWh) and summer and winter peak demand (kW) savings;
- Determine participants' level of satisfaction with the program and measures received;
- Identify non-energy benefits realized by participants;
- Identify barriers to agency participation in the program and recommend strategies for addressing those barriers;
- Identify program strengths and potential ways that the program can increase average savings per household; and
- Compare the program design, participation levels, and savings potential of the Weatherization Program to early achievements of DEC's Durham Low Income Weatherization Pilot to assess Pilot performance and potential for savings.

To achieve these objectives, we completed a number of data collection and analytic activities:

- Impact evaluation activities included a review of program-tracking data, a deemed savings review, development of in-service rates (ISRs), an engineering analysis, and a consumption analysis.
- Process evaluation activities included a review of program materials; interviews with Duke Energy program staff, implementing agency staff, NCCAA and TRC staff, and Durham Pilot program managers; and a survey of participating customers.

1.3 High Level Findings

During the evaluation period, 1,706 households participated in the Weatherization Program, completing over 2,000 projects. The majority of participants (81%) completed a Tier II project; only 10% of participants completed a Tier I project. In addition, 24% received a replacement refrigerator, either as a stand-alone measure (8%) or in combination with Tier I or Tier II services (15%).

Impact Findings

Based on our impact analysis, we estimate that the projects completed during the evaluation period generate close to 3.2 million kWh of annual energy savings, 539 kW of annual summer coincident demand savings, and 935 kW of annual winter coincident demand savings. Tier II participants account for the largest share to program-level savings (89%) while Tier I participants and refrigerator replacements account for 1.3% and 9.6%, respectively, of total program energy savings.

Table 1 presents annual per-household and program-level net ex post savings for the evaluation period.

Table 1. Summary of Impact Results

Project Type	Number of Participants	Net Annual Savings Per Household			Net Annual Program Savings		
		Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Tier I	176	241	0.0724	0.0416	42,398	12.7	7.3
Tier II	1,387	2,042	0.3544	0.6438	2,832,531	491.5	892.9
Refrigerator Replacement	404	758	0.0864	0.0864	306,097	34.9	34.9
Total [a]	1,706				3,181,027	539.2	935.2

[a] The total number of unique participants is smaller than the sum of project types since some households complete more than one project.

Based on program-tracking data, almost all Tier I and Tier II participants (96% and 97%, respectively) received air sealing. The vast majority (91%) of Tier II participants also received insulation, and 74% received duct system sealing or insulation—measures not offered to Tier I participants. Larger shares of Tier II participants than Tier I participants received water heating measures, weatherstripping, lighting, and heating system tune-ups. Overall, 24% of participants received a new refrigerator and 19% an HVAC replacement or upgrade. Notably, 8% of participants only received a new refrigerator and 14% only received an HVAC replacement/upgrade.

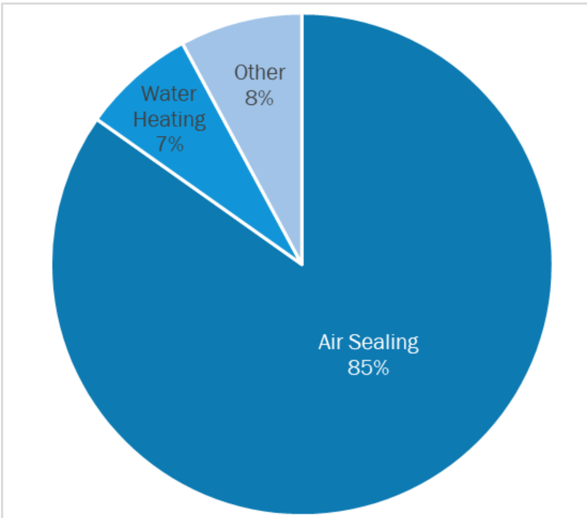
Table 2. Measure Mix

Measure Category	% of Participating Households Receiving Measure Category [a]		
	All Participants (N=1,706)	Tier I Participants (N=176)	Tier II Participants (N=1,146)
Air Sealing	75%	96%	97%
Insulation	61%	n/a	91%
Duct System	50%	n/a	74%
Water Heating	50%	31%	70%
Weatherstripping	43%	35%	59%
Lighting	26%	26%	35%
Heating System Tune-Up	19%	6%	27%
Refrigerator Replacement	24%	19%	17%
HVAC Replacement/Upgrade	19%	1%	7%

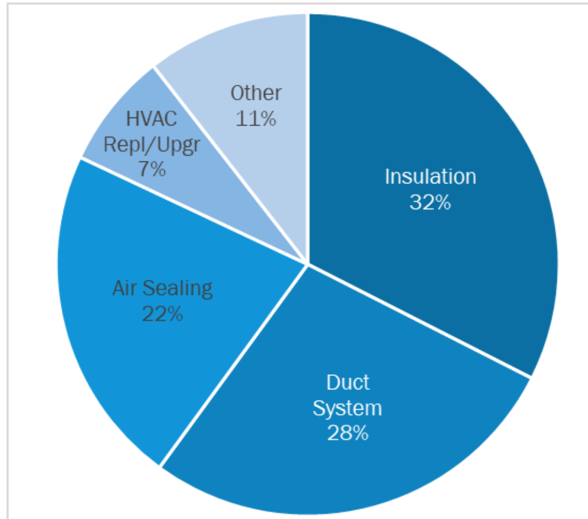
[a] Values are based on program-tracking data and do not incorporate ISRs.

Based on the engineering analysis, Tier I savings during the evaluation period came primarily from air sealing (85%). Another 7% came from water heating measures and 8% came from other Tier I measures (including heating system tune-ups, lighting measures, and weather-stripping). Tier II savings, on the other hand, were dominated by insulation (32%), duct sealing and insulation (28%), and air sealing (22%). HVAC replacements/upgrades accounted for 7% of engineering-based Tier II savings during the evaluation period, while other Tier II measures (including water heating measures, heating system tune-ups, lighting, and weather-stripping) contributed 11% (see Figure 1).

Figure 1. Measure Contribution to Total Tier I and Tier II Energy Savings



Tier I kWh Savings



Tier II kWh Savings

Process Findings

The process evaluation found that the DEC Weatherization Program continues to benefit from previously established relationships, implementation processes, and program-tracking systems. Program and implementation staff reported no major changes to the program since the previous evaluation aside from the new participation channel established in 2018. Participating agencies also reported minimal changes to how they implement and participate in the Weatherization Program, and many reported the DEC funds allow them to complete more weatherization jobs than they would have otherwise.

Key process findings include:

- **Program Participation.** Participation in the Weatherization Program has been increasing steadily since the program began in 2015. Agencies work hard to inform clients about the program through multiple advertising channels (newspaper ads, in-person events, agency websites, etc.) and half of interviewed agencies indicated the number of projects they complete each year is increasing.

- **New Participation Channel.** Prior to 2018, agencies could only submit projects originally funded by the State WAP for reimbursement from Duke Energy. Now, agencies may submit for reimbursement projects they originally funded through their operating budget or another source. This opened the possibility of non-CAA organizations, such as non-profit organizations, to participate in the program and bring Weatherization Program services to their clients. Half of the agencies we interviewed indicated they had used this new participation channel. One agency, a non-profit organization, indicated they used this participation channel exclusively and only performed refrigerator replacements since their organization was not equipped to perform more extensive weatherization on clients' homes.

- **Satisfaction.** The process evaluation showed high satisfaction with the Weatherization Program. Interviewed agency staff often provided unprompted praise for the program implementation team and underscored the importance of the program to their clients. Agencies found the logistical elements of the program—including program organization, communication, and reporting—to be key program strengths. Participants were also highly satisfied with the program overall. A key concern for participants is high energy bills, and survey results suggest the program is helping participants in this respect, with 73% and 58% of respondents reporting lower summer and winter electricity bills, respectively, following participation in the program.

- **Non-Energy Impacts.** In addition to lowering energy bills, the Weatherization Program provides substantial non-energy benefits to participants including improved home comfort in the summer and winter, reduced draftiness, and better lighting. To a lesser extent, survey respondents also reported lower outdoor noise levels and home maintenance costs, improved quality of life, safer homes, and increased water efficiency.

- **South Carolina Policy Barriers.** Despite the new participation channel—introduced in 2018 to encourage participation by South Carolina agencies—barriers to program participation remain high in South Carolina, and no projects were completed in the state during this evaluation period. While the new participation channel has not yet resulted in program participation in the state, program staff continue to conduct outreach and provide additional support to South Carolina agencies and to encourage future program participation.

- **Durham Pilot.** Between October 2018 and December 2019, Duke Energy offered a weatherization pilot in Durham, North Carolina, which served a total of 206 customers. One goal of this pilot was to determine if the current DEC Weatherization Program design and funding model could be improved to expand program services to South Carolina and into the Duke Energy Progress (DEP) service territory. The limited process evaluation of the Durham Pilot found key differences between the pilot and the Weatherization Program in program eligibility, implementation, and measure mix:

  - Not relying on agencies to implement the program made the Durham Pilot implementation smoother and more flexible, and access to customer data allowed Pilot staff to target the program to the customers who needed it most. Since the Durham Pilot was entirely funded by DEC, participants did not need to spend time completing federal or state assistance program applications, which greatly reduced administrative burden on participants.

  - Compared to DEC Weatherization projects in the evaluation period, Durham Pilot projects were more likely to include both weatherization measures and an HVAC upgrade. Additionally, Durham Pilot participants were more likely to receive a refrigerator replacement. Based on the measure mix, we believe that the Durham Pilot has the potential to provide per household savings on par with, or possibly greater than, the savings estimated for the DEC Weatherization Program. Since this evaluation did not include a formal impact assessment, however, more rigorous impact analysis would be required to quantify the savings of the Durham Pilot.

  Overall, pilot staff were highly satisfied with the performance of the pilot and indicated that participants were particularly grateful for program services they may have otherwise waited years to receive. Given the continuing policy barriers in South Carolina, despite the new participation channel, a program design similar to the Durham Pilot could be a good option for bringing weatherization services to customers in South Carolina and/or the DEP service territory.

1.4 Evaluation Recommendations

We have developed the following recommendations based on the results of our evaluation:

- **Consider tracking several additional parameters within the program-tracking system, if feasible. to enhance the accuracy of future deemed savings estimates.** Our deemed savings review (see Appendix B) identified a few parameters that are currently not tracked in program data: (1) pre- and post- blower door results in units of reduced cubic feet per minute (CFM); (2) presence or type of cooling at participating homes; (3) water heating fuel of participating homes; and (4) the installed location (e.g., bathroom, kitchen) for each low-flow faucet aerator. Some of this information is currently collected in the participant survey but having it in the program-tracking data for the population of participants would enhance the accuracy of future deemed savings estimates. We therefore recommend asking weatherization agencies to enter this information into the program's tracking system, if available.

- **Consider changing the reimbursement structure or increase reimbursement amounts.** The current Tier II incentive structure provides up to $6,000 for Tier II projects. TRC and NCCAA indicated that agencies may struggle covering the cost of HVAC replacements with the current reimbursement amount, which has not increased since the program began in 2015. In addition, this reimbursement cap may also prevent participants from receiving weatherization services in addition to HVAC replacements/upgrades: Based on program-tracking data, only 6% of Tier II projects include both HVAC replacements/upgrades and other Tier II measures, compared to 34% in the Durham Pilot, which provided higher incentives. Agencies may be able to provide additional energy saving measures in Tier II homes, leading to deeper savings, if the overall Tier II incentive amount was increased.

- **Increase support to agencies in program marketing and outreach.** Agencies noted that communication and organization of the program were key strengths and frequently provided unprompted praise for staff at Duke Energy and NCCAA. One area agency identified for potential additional Duke assistance was marketing and outreach to help increase customer awareness of the program. This could be through information about the program on customer bills or on Duke Energy's website, or by developing testimonials from past program participants with examples of bill savings and other benefits—such as non-energy impacts (NEIs) reported by many surveyed participants—derived from their weatherization projects.

- **Explore options to increase the uptake of comprehensive weatherization projects though the new participation channel.** The new participation channel allows non-profit and other organizations to provide program services to customers who may not have been able to receive them otherwise. One objective of this channel was to overcome barriers to participation in South Carolina, as State policies prevent CAAs from participating in the program. Based on program-tracking data through April 2020, however, the new channel has not been successful in encouraging South Carolina organizations to participate in the program. In addition, information from our agency interviews suggest that some non-CAAs may not be equipped to facilitate the implementation of weatherization projects and thus limit their activity to equipment replacement. The program should continue to explore ways to promote participation in South Carolina, by identifying suitable partner organizations (with prior weatherization expertise) and/or providing non-CAA organization with additional support in implementing weatherization services.

- **Consider expanding the Durham Pilot to include the South Carolina service territory.** Given the substantial policy barriers that continue to block participation in South Carolina, one way to provide weatherization upgrades to South Carolina customers is to introduce a program design similar to the Durham Pilot. Based on our review of project types and measures installed through the pilot, the savings potential for a program design similar to the pilot appears to be on par with, or even greater than, savings observed for the Weatherization Program. In addition, pilot participants and staff were very satisfied with the experience, and there were very few implementation challenges. If policy barriers persist, or the new participation channel fails to increase participation in South Carolina, this may be an option to expand services in the state.

2. Program Description

This section describes key elements of program design, implementation, and performance. The evaluation period addressed in this report is April 1, 2016 through December 31, 2018. This is the second evaluation of the DEC Weatherization Program; the first evaluation covered the period of February 1, 2015 through March 31, 2016.

2.1 Program Design

The Weatherization Program aims to improve the health, safety, and energy efficiency of income-qualified Duke Energy customer households. The program does so by providing customers with comprehensive home weatherization services and repairs that reduce electric energy consumption. The program distributes funding through a network of CAAs and other similar organizations (collectively referred to as “agencies”), which serve Duke Energy’s residential electric customers. The program reimburses agencies for work completed at eligible homes.

The DEC Weatherization Program offers two tiers of funding for weatherization upgrades to owner-occupied homes, as well as refrigerator replacements to both homeowners and renters (with landlord approval). Tier I covers eligible projects at homes using less than 7 kWh per square foot annually and provides up to $600 for air sealing and low-cost energy efficiency upgrades like LEDs, domestic water heater tank insulation, low-flow shower heads, faucet aerators, and others. Tier II covers eligible projects at homes using at least 7 kWh per square foot annually and provides up to $4,000 for Tier I measures plus insulation improvements. Tier II projects can qualify for a higher funding cap of $6,000 if they include a qualifying heat pump upgrade or a heat pump system replacement. Refrigerator replacement is available even if the home did not receive any Tier I or Tier II measures. Refrigerator replacement eligibility and incentive levels are dependent on the old refrigerator’s size and a two-hour metering test.

In 2018, the program introduced a new participation channel, which broadened the type of organizations that can participate in the program and the funding sources for projects. Prior to this change, only CAAs were eligible to participate, and they could only submit qualifying DOE/State WAP projects for reimbursement. Now, other organizations, such as non-profits, are also eligible to submit projects, and the projects do not have to be DOE/State WAP projects but could be funded from the organization’s operating budget or another funding source. DEC made this change to offer an alternative participation channel that can work within the strict DOE guidelines in South Carolina.

2.2 Program Implementation

During the evaluation period, DEC contracted with NCCAA and their subcontractor TRC to implement the Weatherization Program. In total, 15 local agencies participated in the program—including CAAs, local and regional government offices, and other non-profit organizations. These agencies also implement a variety of poverty relief activities, including the State WAP. NCCAA and TRC oversee agency submittals, invoicing, and program-tracking; train agencies on the program and requirements; support participating agencies in making the most of program funding; and conduct outreach to potential new agencies.

2.3 Program Performance

During the evaluation period the program served 1,706 unique households. The majority of participants (81%) completed a Tier II project. Only 10% of participants completed a Tier I project and 24% received a replacement refrigerator. Based on the impact analysis, the program achieved average annual savings of 241 kWh per Tier I participant and 2,042 kWh per Tier II participant. Refrigerator recipients saved an additional 758 kWh per year. Table 3 summarizes program participation as well as per household energy and demand savings, by project type.

Table 3. Annual Per Household Savings

Project Type	Number of Participants	Net Annual Savings Per Household		
		Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Tier I	176	241	0.0724	0.0416
Tier II	1,387	2,042	0.3544	0.6438
Refrigerator Replacement	404	758	0.0864	0.0864
Total [a]	1,706			

[a] The total number of participants is greater than the sum of project types since some households complete more than one project.

3. Overview of Evaluation Activities

3.1 Program Staff Interviews

We conducted in-depth interviews with Duke Energy program staff (supporting both the DEC Weatherization program and Duke's Durham Weatherization Pilot) and the DEC Weatherization Program administrator. The main purpose of each interview was to gain insight into program implementation processes and to develop research objectives for the evaluation. In particular, the interviews allowed us to identify consistencies and inconsistencies across the program, processes that are working well, and processes that could be improved moving forward.

3.1.1 Duke Energy Program Staff Interview

Opinion Dynamics conducted an in-depth interview with the DEC Weatherization Program manager in November 2019. The purpose of the interview was to gauge changes in program design and implementation since the last evaluation, and DEC's current expectations for the Weatherization Program, including the program's goals, successes, and challenges over the evaluation period. The interview also covered changes to the program's measure mix, agency participation, and barriers to program participation.

3.1.2 Program Administrator Staff Interview

We conducted one in-depth interview with NCCAA (the program administrator) and its subcontractor TRC. TRC maintains the program-tracking database and serves as the day-to-day contact for agencies, providing them with training and implementation support. This interview explored program-wide coordination, delivery, and enrollment processes. It provided insight into the program's reimbursement process and gauged the administrators' satisfaction with program elements. The interview also helped identify key similarities and differences across implementing agencies and any barriers to agency participation.

3.1.3 Duke Energy Durham Weatherization Pilot Staff Interview

As part of our limited process evaluation of the DEC Weatherization Pilot program in Durham, NC, we conducted one interview with the DEC Weatherization Pilot program manager and community outreach manager. The objective of the interview was to document the program design of the pilot, identify early implementation successes and challenges, and enable comparisons to the Weatherization Program.

3.2 Implementing Agency Staff Interviews

Fifteen agencies, all located in North Carolina, submitted projects to the DEC Weatherization Program during the evaluation period. These agencies each received funding for an average of 136 projects (range: 1 to 746 projects per agency). We conducted semi-structured in-depth interviews with a sample of six of the 15 participating agencies selected to represent varied types of organizations and levels of program participation. We explored changes to the program since the last evaluation, feedback on implementation processes and funding structure, as well as agencies' satisfaction with the program and views about successes and barriers to participation.

We completed these interviews in June and July 2020. Responding agencies completed 82% of the 2016–2018 projects. Table 4 summarizes the sample and outcome.

Table 4. Agency Interview Sample

Participating Agencies	Agencies in Sample	Completed Interviews	Cooperation Rate
15	6	6	100%

3.3 Program Materials Review

Opinion Dynamics reviewed the program's procedures manual and the program-tracking database. We reviewed changes made to the manual in October 2017 and October 2018, relative to the program's original 2015 manual. We found the manual sections relating to program operations, customer eligibility guidelines, and measure installation guidelines to be complete and of high quality.

3.4 Participant Survey

Opinion Dynamics implemented a computer-assisted telephone interviewing (CATI) survey in June and July 2020. The survey gathered data to verify participation in the program; develop measure-level estimates of installation, persistence, and in-service rates (ISRs); and support our process evaluation.

The survey sample design and sample size were based on customers who participated during the evaluation period. Of the 1,706 participants in the database, we drew a random sample of 620 valid telephone numbers. We used this sample to complete 102 participant telephone interviews. The average length of the interviews was approximately 15 minutes; the response rate was 18%.

We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR). We chose to use AAPOR Response Rate 3 (RR3), which includes an estimate of eligibility for sample units that we were unable to reach. We present the formulas used to calculate RR3 and the definition of each variable used in the formulas below.

$$RR3 = I / ((I + R + NC + O) + (e * U))$$

$$e = (I + R + NC) / (I + R + NC + E)$$

Table 5. Survey Disposition Category Key

Disposition Code	Disposition Category	Number of Customers
Complete interview	I	102
Eligible incomplete interview	N	7
Survey-ineligible household	X1	1
Not a household	X2	41
Household with undetermined survey eligibility	U1	331
Undetermined if household	U2	138
Estimated proportion of cases of unknown survey eligibility that are eligible	Incidence/e1	99%
Estimated proportion of cases of unknown household eligibility that are eligible	e2	91%

3.5 Consumption Analysis

Opinion Dynamics conducted a consumption analysis to determine the net energy savings attributable to the DEC Weatherization program during the evaluation period. We used separate linear fixed effects regression (LFER) models to estimate the overall net ex post program savings for Tier I and Tier II participants. The fixed effect in our models is the customer, which allows us to control for all household factors that do not vary over time. The consumption analysis used customers who participated from April 2016 through December 2018 as the treatment group and those who participated from January 2019 through March 2020 as the comparison group.

While we conducted consumption analysis for both Tier I and Tier II participants, this evaluation only relies on consumption analysis results for Tier II participants. For Tier I participants, we used a combination of engineering analysis results and impact results from the prior evaluation to assess program savings. We were not able to use Tier I consumption analysis results because they were not statistically significant.[1]

Section 4.1.1 provides a summary of the consumption analysis approach; Appendix A contains the detailed methodology description.

3.6 Engineering Analysis

The engineering analysis served several purposes: (1) to develop demand-to-energy savings ratios for Tier I and Tier II projects; (2) to develop ex post energy and demand savings for refrigerator replacements; (3) to understand the relative contribution of different measures to Tier I and Tier II savings; and (4) to develop inputs into Tier I energy savings.

The engineering analysis consisted of two components:

- Measure verification and development of measure-specific ISRs, and
- A deemed savings review of all program measures.

We verified measures and developed measure-specific ISRs based on responses to the participant survey. As part of the deemed savings review, we reviewed measure-level savings and revised input assumptions, as needed, to be consistent with standard industry practice and other Duke Energy Carolinas program assumptions and to align with applicable versions of reviewed TRMs (e.g., Illinois, Indiana, Mid-Atlantic). We also integrated data gathered through the participant survey, for example, the share of participating households with electric domestic water heating.

Appendix B provides more detail on the methods and input assumptions used in the deemed savings review and engineering analysis.

[1] Two factors likely contributed to the inability of the model to detect statistically significant savings: (1) the small number of Tier I participants and (2) the small expected savings of Tier I measures, relative to baseline household electricity usage.

4. Gross Impact Evaluation

4.1 Methodology

The gross impact analysis for the 2016–2018 DEC Weatherization Program included a consumption analysis as well as an engineering analysis. The consumption analysis determined the net evaluated energy (kWh) impacts for Tier II. The engineering analysis supplemented the consumption analysis by:

- Providing a ratio of demand savings (kW) to energy savings (kWh), which is then applied to the consumption analysis net energy savings to calculate net evaluated demand savings;
- Developing ex post energy and demand savings for refrigerator replacements;
- Providing insight into the relative contribution of different measures to Tier I and Tier II savings; and
- Developing inputs into Tier I energy savings.

While we conducted consumption analysis for both Tier I and Tier II participants, this evaluation only relies on consumption analysis results for Tier II participants. For Tier I participants, we used a combination of engineering analysis results and impact results from the prior evaluation to assess program savings. We were not able to use Tier I consumption analysis results because they were not statistically significant.

4.1.1 Consumption Analysis

Opinion Dynamics conducted a consumption analysis to determine the overall evaluated program savings from Tier I and Tier II projects. Consumption analysis is a statistical analysis of energy consumption recorded in utility billing records. Because billing records reflect whole-building energy use, the method is well suited for studying the combined impact of the Weatherization Program's mix of energy-efficiency measures per home. Total program savings from Tier I and Tier II projects are estimated by examining variation among participants' monthly electricity consumption pre- and post-program period, relative to the variation in a comparison group's electricity consumption during those times.

Data Cleaning and Preparation

Prior to specifying the models, we performed thorough cleaning of the consumption and participation data. We checked data for gaps and inconsistencies as well as for sufficiency. Among other checks, we ensured that the participants retained in the analysis had sufficient pre- and post-participation consumption data, participation dates were accurate, and the consumption data was free of outliers, such as bill periods with unreasonably small or unreasonably large consumption.

Comparison Group Selection

Incorporating a comparison group into the consumption analysis allows evaluators to control for changes in economic conditions and other non-program factors that might affect energy use during the study period. Like many other energy efficiency programs, the Weatherization Program was not designed as an experiment. As such, we leveraged a quasi-experimental approach to the evaluation by developing a comparison group of participants. There are multiple approaches to selecting a comparison group, including the use of future participants, past participants, or similar non-participants. When possible, using future program participants as a comparison group is a preferred method. The use of future participants—who are similar to the evaluated participants—as the comparison group allows to effectively control for self-selection biases. We relied on a comparison group of customers who participated in the Weatherization Program between January 1, 2019 and March 31, 2020.

We performed equivalency checks to assess the similarity of treatment and comparison groups in terms of energy consumption, weather, and housing characteristics in order to validate that the comparison group can serve as a valid baseline. We performed equivalency analysis by tier as well as among Tier II HVAC and weatherization customers separately to ensure balanced consumption among key Tier II subpopulations. Analysis of weather patterns indicates nearly perfect equivalency between the treatment and comparison group customers. Treatment and comparison group participants are also similar across key housing characteristics, such as home vintage, size, and type. As for the consumption data, Tier I treatment participants are a little more likely to have higher heating load than comparison group participants, while Tier II treatment participants are more likely to have a slightly higher cooling load. Both factors are controlled for in the model and are therefore not concerning from a potential bias perspective.

Controlling for Participation in Other Programs

Some customers participated in other Duke Energy programs after participating in the Weatherization Program. Including those customers in the consumption analysis would result in double counting of savings from other programs and artificially inflating the estimate of savings from the Weatherization Program. We dropped those customers from the analysis so that we can get the most accurate estimate of the effects of the Weatherization Program. As part of the analysis, we identified and dropped Weatherization Program participants who cross-participated in the Appliance Recycling Program,[2] the Residential Energy Efficient Products & Services Program, the Smart $avers Residential Program, and the Residential Energy Assessments Program.[3] Overall, we dropped 51% of Tier I and 53% of Tier II participants.

Table 6 below summarizes final participant counts used to develop consumption analysis models.

Table 6. Accounts Included in the Consumption Analysis Model

Program Component	Treatment Group	Comparison Group	Total
Tier I	55	65	120
Tier II	469	469	938
Tier II Weatherization Measures	*438*	*267*	*705*
HVAC Replacement/Upgrade	*40*	*228*	*268*

[2] The Appliance Recycling Program was discontinued at the end of 2015 but residual participation continued through June 2016.

[3] Notably, we only dropped cross-participants who participated in other programs during the 12-month post-period. We retained participants who participated more than a year after participating in the Weatherization Program.

Modeling

We used a Linear Fixed Effects Regression (LFER) model for this analysis. Each tier was analyzed in a separate regression model because the tiers are expected to provide different levels of per-home savings due to differing measures, features, and customer eligibility criteria.[4]

LFER models for each tier included a series of explanatory variables designed to improve our estimate of savings relative to the baseline (i.e., what participants' consumption might have been during the post-program period, had they not received program services). The relationship of interest is between the dependent variable (monthly energy use) and a "dummy" variable that indicates whether an individual participated in the Weatherization Program. Based upon Duke Energy's requests to isolate savings from refrigerator replacements separately from the package of measures provided for each tier, we included an indicator variable to capture the effect of a refrigerator replacement in addition to the tier-related measures, which removes the effect of the refrigerator from the effects of the rest of the measures installed. In addition to excluding savings from the refrigerator measure, Duke Energy was interested in understanding savings from the new HVAC replacement/upgrade measure within the Tier II program component. To accommodate that request, we estimated a Tier II model that included an indicator variable for HVAC replacement/upgrade so that we could separate the impact of this measure from the impact of other Tier II measures.

Consumption analyses typically include a series of additional variables to explain non-program variation in monthly energy use pre- and post-participation. Following best practice, we used a fixed-effects model, which captures the effect of household-specific characteristics that do not vary over time (as customer-specific intercepts).[5] We also included weather (heating degree days and cooling degree days) in the model. Additionally, we included monthly dummies to further control for seasonal differences in energy consumption overall. After controlling for all of these outside influences, the final model results for the DEC Weatherization Program reflect savings associated with installed measures and any behavioral changes from energy efficiency knowledge gained during their participation process.

Appendix A contains a detailed discussion of the consumption analysis methodology, including data cleaning steps, the equivalency assessment for the comparison group (including cross-participation), and the final model specification and outputs.

4.1.2 Engineering Analysis

As part of the impact evaluation, Opinion Dynamics conducted an engineering analysis for each Weatherization Program measure installed during the evaluation period. The engineering analysis consisted of two distinct steps: (1) measure verification and development of measure specific ISRs; and (2) a deemed savings review of all program measures. Both are described below.

[4] Note that participants who only received a refrigerator replacement were excluded from the consumption analysis.

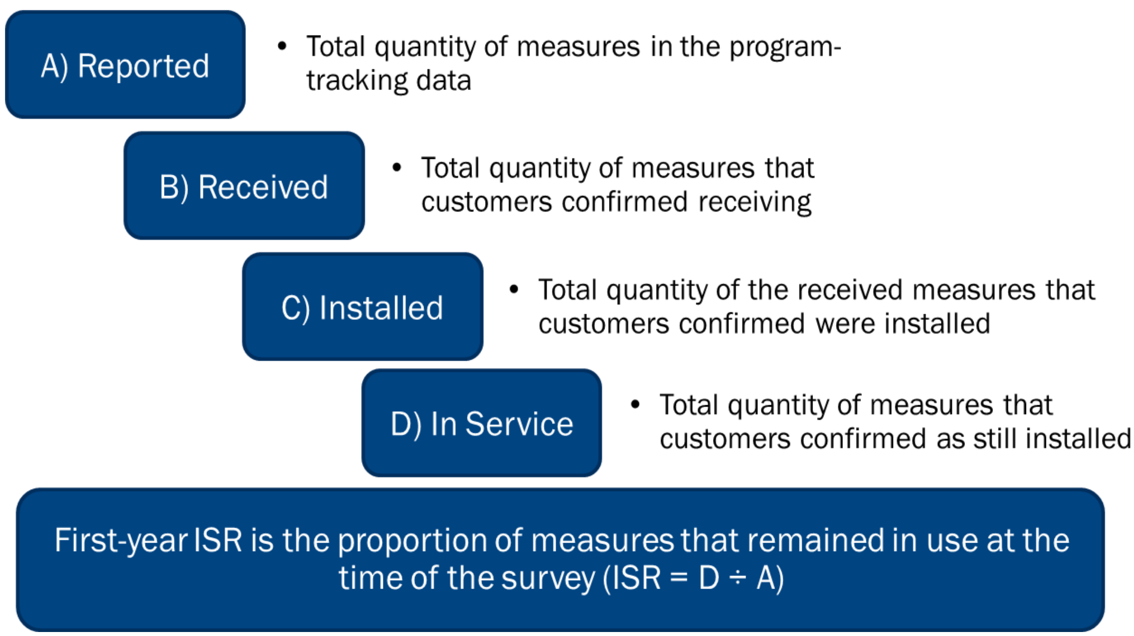
[5] This includes factors such as building square footage, appliance stock, habitual behaviors and preferences, household size, and others.

Measure Verification

The participant survey included questions designed to verify that participants received and installed program measures and that those measures remained in place and operational. The measure-level ISRs represent the share of measures in the program tracking data that was still in service at the time of the survey, based on 102 completed telephone interviews. Our engineering analysis applied the ISRs to ex post deemed savings to develop total engineering savings.

Figure 2 outlines the method for deriving the ISR for each measure. During the survey, we asked participants to confirm that they received the quantity of measures recorded in Duke Energy's program tracking data and, when necessary, to provide the correct quantity. We also asked participants to confirm the quantity of measures that were installed and remained in service at the time of the survey.

Figure 2. In-Service Rate Components



Based on the survey responses, we calculated the verification, installation, and persistence rates, as well as the resulting ISR–using the equations shown below–for each participant and each measure they received. We then developed averages of all four rates for each measure group.

1) $$Verification\ Rate = \frac{(B)Received\ Quantity}{(A)Reported\ Quantity}$$

2) $$Installation\ Rate = \frac{(C)Installed\ Quantity}{(B)Received\ Quantity}$$

3) $$Persistence\ Rate = \frac{(D)In\ Service\ Quantity}{(C)Installed\ Quantity}$$

4) $$First\ Year\ InService\ Rate = \frac{(D)In\ Service\ Measures}{(A)Reported\ Measures}$$

In previous evaluations of the DEC Weatherization Program and other DEC direct-install programs, Opinion Dynamics found that participants had difficulty verifying certain measures, and that the nature of certain measures made verification of installation and persistence unnecessary. As such, we made the following assumptions:

- **Water heater tank wrap, pipe wrap, and duct sealing/insulation:** For these measures, we assumed 100% for all four rates as participants are often not aware of the installation of these measures, but once installed, they are unlikely to be removed.
- **Door weather-stripping, refrigerator replacement, heating system upgrade, air sealing, and insulation:** We asked participants to verify receipt of these measures but assumed that agency staff installed 100% of the verified items. We also assume that 100% of installed air sealing and insulation remained installed as they are difficult to remove.

Ex Post Deemed Savings

We used several resources and assumptions to conduct our deemed savings review, including previous DEC low income program evaluations, relevant TRMs (specifically IL, IN, and Mid-Atlantic) and other secondary sources (such as ASHRAE Fundamentals and the US EPA air source heat pump calculator) to examine algorithms and assumptions. Where possible, we used DEC-specific assumptions to estimate measure-specific deemed savings including participant survey data, program-tracking data, and supplemental refrigerator test data. For more information on the algorithms and inputs that our engineering team used to develop deemed savings estimates for each measure, see Appendix B.

Total Program Gross Savings

We developed total program gross savings, by tier, by applying the measure-specific ISRs to the ex post deemed values. We then multiplied the adjusted deemed savings by the measure quantity provided in the program tracking database to arrive at total program savings. Where savings for certain measures rely on electric heating equipment or the presence of cooling equipment, our engineering team developed fuel-specific deemed values and applied them based on the HVAC equipment specified within the program tracking database. Since the database does not provide water heating fuel type, however, we developed weighted savings for water conservation measures based on participant survey responses, which indicated that 78% of participating homes have electric water heating.

We then estimated per household savings for each tier by dividing total tier savings by the number of households participating in that tier.

4.1.3 Tier I Savings

Because the consumption analysis did not generate statistically significant results for Tier I participants, we developed per household Tier I savings using a combination of engineering analysis results and results from the prior evaluation. Specifically, the analysis consisted of the following steps:

- **Step 1:** Develop a ratio of per household Tier I savings based on (1) engineering estimates from this evaluation and (2) normalized engineering estimates from the prior evaluation; and
- **Step 2:** Apply the Tier I savings ratio from Step 1 to Tier I consumption analysis results from the prior evaluation.

The goal of this analysis was to develop a measure of Tier I activity during this evaluation period relative to Tier I activity during the last evaluation period that can then be applied to Tier I consumption analysis results from the prior evaluation.[6] The following subsections provide more detail on the two steps.

Ratio of Tier I Engineering-based Savings

We developed the Tier I savings ratio using the following equation:

$$\textit{Tier I Savings Ratio} = \textit{Per HH Tier I Savings}_{2016\text{-}18} \,/\, \textit{Normalized per HH Tier I Savings}_{2015\text{-}16}$$

$$= 1{,}014 \text{ kWh} \,/\, 1{,}103 \text{ kWh}$$

$$= 0.92$$

The numerator in this equation (1,014 kWh) is the per household Tier I savings as estimated in the engineering analysis for this evaluation (see Section 4.1.2).

The denominator (1,103 kWh) is estimated by multiplying, for each Tier I measure, the 2015–16 ISR-adjusted quantity by the 2016–18 average Tier I savings value. We "normalized" the 2015–16 Tier I engineering analysis results with deemed savings values from this evaluation to isolate changes in program activity (i.e., changes in the measure mix and the average quantity of measures received by each Tier I participant) between the two evaluation periods. This normalization step was important because updates to deemed savings assumptions resulted in changes to deemed savings values between the two evaluations, in particular for air sealing, the dominant Tier I measure. These changes were made, in part, to develop more consistent assumptions between various Duke program evaluations (as requested by regulatory staff) and are not necessarily reflective of changes in the operation or outcomes of the Weatherization Program.

Final Tier I Savings

We estimated the final per household Tier I savings for the 2016–18 evaluation period as follows:

$$\textit{Final Per HH 2016–18 Tier I Savings} = \textit{Tier I Savings Ratio} * \textit{2015–16 Tier I Savings}_{\textit{Consumption Analysis}}$$

$$= 0.92 * 262 \text{ kWh}$$

$$= 241 \text{ kWh}$$

The final Tier I per household savings thus leverage the Tier I consumption analysis results from the prior evaluation (262 kWh) but adjust those results by the change in Tier I activity (on a per household basis) between the two evaluation periods (92%).

[6] We selected this approach since the previous evaluation of this program found that engineering analysis results alone do not provide a good proxy for the consumption analysis. However, engineering analysis results from this evaluation, relative to those from the prior evaluation, provide a good indication of changes in program activity that can be used to adjust the consumption analysis results from the prior evaluation.

4.2 Results

4.2.1 Consumption Analysis

This section provides per-participant consumption analysis results. Appendix A contains the complete results of the models. Table 7 summarizes the results of the consumption analysis models for Tier I and Tier II. The variable "Post" represents the main effect of the treatment, i.e., the change in average daily consumption (ADC) attributable to participation in the DEC Weatherization Program, controlling for whether or not the participant had also received a refrigerator replacement and/or an HVAC replacement/upgrade (applicable to Tier II only). Local weather (expressed as Cooling Degree Days, CDD, and Heating Degree Days, HDD) also significantly impacted consumption.[7]

As can be seen in the table, the participation coefficient for Tier I is not statistically significant, indicating that the model did not establish a statistically significant relationship between participation in the program and energy consumption. For Tier II, all program-related coefficients are statistically significant and negative, indicating a negative relationship between participation and energy consumption, i.e., the presence of savings.

Table 7. Results of Tier I and Tier II Consumption Analysis Models

Variable	Tier 1 Coefficients	Tier 2 Coefficients
Post (Participation Date)	1.071	-5.685***
Refrigerator Replacement Indicator	1.592	-7.262***
HVAC Improvements	--	-4.682**
CDD (Cooling Degree Days)	0.024	0.031***
HDD (Heating Degree Days)	0.008**	0.017***
Constant (Average Intercept)	16.784***	31.924***
Observations (Number of customer bills)	4,816	38,325
Adjusted R-squared	0.527	0.677

* p<0.1, ** p<0.05, *** p<0.01.

Table 8 shows the estimated annual per-home savings for the program. As noted above, the results in the Tier I and Tier II rows reflect the effect of the Weatherization Program alone (any changes in energy use due to other programs are not included) and exclude impacts of the program refrigerator installations. For Tier II, the table isolates estimated savings for Tier II weatherization measures and HVAC replacement/upgrades, respectively.[8] It should be noted that the estimates of percent savings per home are based on the *modeled*

[7] The coefficients for the monthly dummies are presented in Appendix A.

[8] The category "Tier II weatherization measures" includes all Tier II measures other than HVAC Replacement/Upgrade, i.e., it includes measures such as lighting and water heating measures.

baseline usage, including the pre-period usage of both treatment and control group participants, controlling for weather. As such, Table 8 presents a single baseline usage estimate for overall Tier II savings as well as savings for Tier II weatherization measures and the HVAC replacement/upgrade measure.

The savings estimate for Tier I participants is not statistically significant at 90% confidence, indicating that the model could not detect a savings signal. The small sample size relative to the variability in the consumption data as well as the nature and depth of Tier I improvements (smaller expected savings) are likely the key drivers of the model performance. Savings for Tier II participants, on the other hand, are large and statistically significant. Tier II participants saved an average of 2,042 kWh per year, which represents 11.3% of their baseline usage. Savings from Tier II weatherization measures are 2,075 kWh per year, while savings from HVAC replacements/upgrades are 1,709 kWh per year.

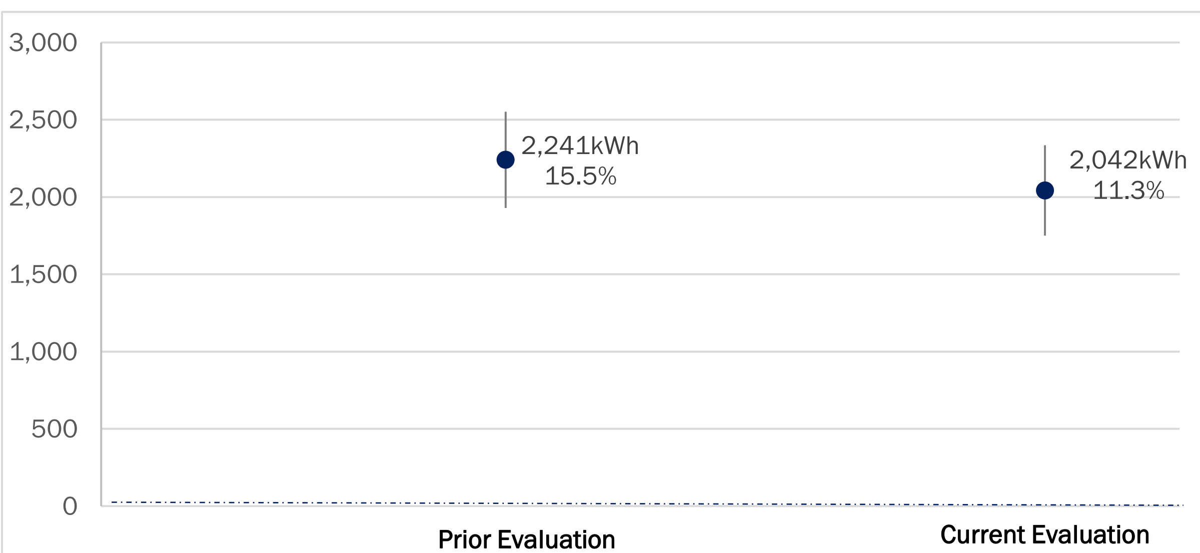
Table 8. Annual Per-Participant Energy Savings from Consumption Analysis

Program Component	Modeled Treatment Participants	Per-Participant Baseline Energy Use (kWh/yr)	Ex Post Annual Savings per Participant (kWh)	Average Annual Savings per Participant (% of Baseline Use)	
			kWh Savings	90% Confidence Interval	
Tier I	55	10,198	-391[a]	-1,107 to 325	-3.8%
Tier II	469	18,087	2,042	1,750 to 2,334	11.3%
Tier II Weatherization Measures	*438*	*18,087*	*2,075*	*1,767 to 2,383*	*11.5%*
HVAC Replacement/Upgrade	*40*	*18,087*	*1,709*	*472 to 2,945*	*9.5%*

[a] Savings for Tier I participants are not statistically significant at 90% confidence.

Compared to the prior evaluation, our Tier II results represent a small, but statistically not significant reduction in annual per household savings. Figure 3 compares the Tier II results from the two evaluations. As can be seen in the figure, the error bounds around the two savings estimates overlap, indicating that the difference between the two estimates is not statistically significant.

Figure 3. Comparison of Tier II Savings to Prior Evaluation



4.2.2 Engineering Analysis

This section provides the results of the engineering analysis, including ISRs and ex post deemed energy and demand savings estimates for each measure offered by the Weatherization Program. In addition, this section summarizes total program and per household savings estimates for the 2016–2018 evaluation period, by project type; provides insight into the contribution of various measures to Tier I and Tier I savings; and presents the Tier I and Tier II demand-to-energy ratios (used to develop Tier I and Tier II demand savings).

Measure Verification Results

Our measure verification analysis showed high ISRs for all measures, as shown in Table 9. DEC Weatherization participants reported that 100% of LEDs, 93% of door weather-stripping, and 85% of efficient showerheads remained in service at the time of the survey. Additionally, while 22% of participants did not recall receiving faucet aerators, 96% of those that did recall having them installed reported that they were still installed at the time of the survey.

Table 9. First Year Measure In-Service Rates

Measure Category	Verification Rate	Installation Rate	Persistence Rate	ISR[a]
LEDs	100%	100%	100%	100%
Faucet Aerators	78%	100%	96%	74%
Showerheads	94%	100%	90%	85%
Door Weather-stripping	99%	Not Asked	91%	93%
Air Sealing	96%	Not Asked	Not Asked	96%
Insulation	98%	Not Asked	Not Asked	98%
Refrigerator	95%	Not Asked	100%	95%
Heating System	100%	Not Asked	100%	100%
Pipe Insulation*				100%
Water Heater Insulation Wrap*				100%
Duct Sealing/Insulation*				100%
CFLs**				84%
Water Heater Temp Adjustment**				100%
Heating System Tune-Up**				90%

[a] Note that each rate is developed as the average of respondent-level rates. As such, the ISR may not equal the product of the three other rates.

* Not verified through the participant survey and assumed 100% ISR

** ISR based on 2015 DEC Weatherization participant survey

Ex Post Deemed Savings Results

Table 10 provides the estimated gross per-unit energy and demand savings for all measures installed through the DEC Weatherization Program. As described in Section 4.1.2, we based the measure-level savings on secondary research and applied Weatherization Program-specific assumptions on household characteristics, where applicable.

Table 10. Ex-Post Per-Unit Deemed Savings Estimates

Measure	Tier	Per-Unit Energy Savings (kWh)	Per-Unit Summer peak demand (kW)	Per-Unit Winter peak demand (kW)
Water Heating				
DWH Pipe Insulation (10' sections)	Tier I	142	0.016	0.016
DWH Tank Insulation	Tier I	82	0.009	0.009
Water Heater Temp Adjustment	Tier I	59	0.007	0.007
Low-Flow Showerhead	Tier I	118	0.009	0.017
Low-Flow Aerator	Tier I	74	0.005	0.010
Lighting				
13W CFL	Tier I	16	0.002	0.001
18W CFL	Tier I	35	0.005	0.003
5W Generic LED	Tier I	20	0.003	0.001
5W Specialty LED	Tier I	20	0.003	0.001
9W LED	Tier I	34	0.005	0.002
Air Sealing and Weather Stripping				
Air Sealing (per home)*	Tier I	896	0.310	0.150
Door Weather Stripping (per door)*	Tier I	28	0.010	0.005
Insulation				
Attic Insulation - Cellulose, Blown - R-30*	Tier II	1.0	0.0001	0.0004
Attic Insulation - Cellulose, Blown - R-38*	Tier II	1.1	0.0001	0.0004
Attic Insulation - Fiberglass, Blown - R-30*	Tier II	1.0	0.0001	0.0004
Attic Insulation - Fiberglass, Blown - R-38*	Tier II	1.1	0.0001	0.0004
Belly Fiberglass Loose*	Tier II	0.9	0.0001	0.0003
Floor Insulation - Fiberglass, Batts - R-19*	Tier II	0.9	0.0001	0.0004
Wall Insulation - Fiberglass, Blown - R-13*	Tier II	0.8	0.0001	0.0003
Wall Insulation - Cellulose, Blown - R-13*	Tier II	0.8	0.0001	0.0003
Knee Wall Insulation*	Tier II	0.9	0.0001	0.0004
Manufactured Home Roof Cavity*	Tier II	0.9	0.0001	0.0004
Heating System				
Heating System Tune-up (per system)	Tier I	488	0.023	0.088
Duct Insulation (per system)*	Tier II	261	0.042	0.095
Duct Sealing (per system)*	Tier II	1,316	0.210	0.479
HVAC Upgrade/Replacement				
Heat Pump Upgrade (per heat pump)	Tier II	834	0.096	0.313
Heat Pump Replacement (per heat pump)	Tier II	1,438	0.168	0.541
Refrigerator				
ENERGY STAR® Refrigerator (15 cu. ft.)	Tier I	936	0.107	0.107
ENERGY STAR® Refrigerator (18 cu. ft.)	Tier I	692	0.079	0.079
ENERGY STAR® Refrigerator (21 cu. ft.)	Tier I	835	0.095	0.095

* Weighted based on mix of 2016–18 participants with different heating fuel and cooling equipment.

Total Program and Per-Household Savings

We calculated total program savings for the evaluation period by applying the ISRs shown in Table 9 to the per-unit estimates shown in Table 10. We then multiplied these ISR-adjusted per-unit estimates by the respective measure quantities in the program tracking database.

Table 11 summarizes total gross program energy and demand savings, by measure, for the 2016–2018 evaluation period. It also shows average measure quantity per participating household.

Table 11. Engineering Analysis Total Gross Savings by Measure

Measure	Unit	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Average Qty per Household
Water Heating					
DWH Pipe Insulation	Water heaters	92,443	10.55	10.55	0.4
DWH Tank Insulation	Water heaters	45,237	5.16	5.16	0.3
Water Heater Temp Adjustment	Water heaters	3,557	0.41	0.41	< 0.1
Low-Flow Showerhead	Showerheads	54,085	3.93	7.85	0.3
Low-Flow Aerator	Aerators	46,290	3.15	6.30	0.5
Lighting					
13W CFL	Lamps	21,352	3.16	1.53	0.8
18W CFL	Lamps	23,842	3.53	1.71	0.4
5W Generic LED	Lamps	669	0.10	0.05	< 0.1
5W Specialty LED	Lamps	669	0.10	0.05	< 0.1
9W LED	Lamps	24,529	3.63	1.76	0.4
Air Sealing and Weather Stripping					
Air Sealing	Households	1,160,999	378.85	218.77	0.72
Door Weather Stripping	Households	44,890	14.46	8.66	0.88
Insulation					
Attic Insulation - Cellulose, Blown - R-30	Sq. Feet	49,514	6.88	19.07	28
Attic Insulation - Cellulose, Blown - R-38	Sq. Feet	85,168	11.83	32.80	46
Attic Insulation - Fiberglass, Blown - R-30	Sq. Feet	357,907	49.71	137.84	202
Attic Insulation - Fiberglass, Blown - R-38	Sq. Feet	377,195	52.39	145.27	204
Belly Fiberglass Loose	Sq. Feet	172,431	23.95	66.41	110
Floor Insulation - Fiberglass, Batts - R-19	Sq. Feet	359,150	49.88	138.32	229
Wall Insulation - Fiberglass, Blown - R-13	Sq. Feet	19,646	2.73	7.57	10
Wall Insulation - Cellulose, Blown - R-13	Sq. Feet	13,602	1.89	5.24	15
Knee Wall Insulation	Sq. Feet	7,657	1.06	2.95	5
Manufactured Home Roof Cavity	Sq. Feet	79,721	11.07	30.70	51
Heating System					
Heating System Tune-up	Households	161,797	6.03	30.28	0.2
Duct Insulation	Households	3,682	0.50	1.43	< 0.1
Duct Sealing	Households	1,265,635	176.00	487.21	0.5

Measure	Unit	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Average Qty per Household
HVAC Upgrade/Replacement					
Heat Pump Upgrade	Households	158,449	18.30	59.54	0.1
Heat Pump Replacement	Households	185,559	21.66	69.73	0.1
Refrigerator					
ENERGY STAR Refrigerator (15 cu. ft.)	Refrigerators	68,827	7.85	7.85	< 0.1
ENERGY STAR Refrigerator (18 cu. ft.)	Refrigerators	112,883	12.88	12.88	0.1
ENERGY STAR Refrigerator (21 cu. ft.)	Refrigerators	124,387	14.19	14.19	0.1

Table 12 summarizes total and per household gross program energy and demand savings, by project type.

Table 12. Engineering Analysis Gross Program Savings

Project Type	Unique Participating Households	Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)
Total Program Savings				
Tier I	176	178,487	53.6	30.8
Tier II	1,387	4,662,487	809.0	1,469.8
Tier II Weatherization Measures	*1,146*	*4,318,480*	*769.1*	*1,340.6*
HVAC Replacement/Upgrade	*318*	*344,008*	*40.0*	*129.3*
Refrigerator Replacement	404	306,097	34.9	34.9
Total	1,706	5,147,071	897.6	1,535.6
Average Savings per Household				
Tier I	176	1,014	0.305	0.175
Tier II	1,387	3,362	0.583	1.060
Tier II Weatherization Measures	*1,146*	*3,768*	*0.671*	*1.170*
HVAC Replacement/Upgrade	*318*	*1,082*	*0.126*	*0.406*
Refrigerator Replacement	404	758	0.086	0.086

Measure Mix and Contribution to Tier I and Tier II Savings

Based on program-tracking data, almost all Tier I and Tier II participants (96% and 97%, respectively) received air sealing. The vast majority (91%) of Tier II participants also received insulation, and 74% received duct system sealing or insulation—measures not offered to Tier I participants. Larger shares of Tier II participants than Tier I participants received water heating measures, weather-stripping, lighting, and heating system tune-ups. Overall, 24% of participants received a new refrigerator and 19% an HVAC replacement or upgrade. Notably, 8% of participants only received a new refrigerator and 14% only received an HVAC replacement/upgrade.

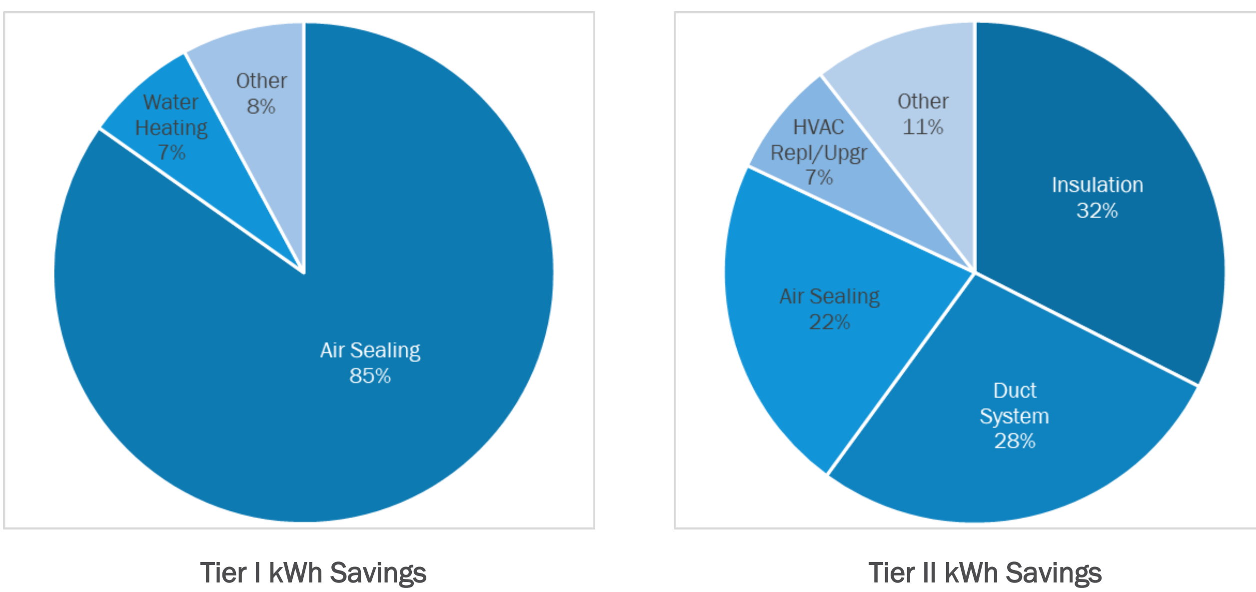
Table 13. Measure Mix

Measure Category	% of Participating Households Receiving Measure Category [a]		
	All Participants (N=1,706)	Tier I Participants (N=176)	Tier II Participants (N=1,146)
Air Sealing	75%	96%	97%
Insulation	61%	n/a	91%
Duct System	50%	n/a	74%
Water Heating	50%	31%	70%
Weather-stripping	43%	35%	59%
Lighting	26%	26%	35%
Heating System Tune-Up	19%	6%	27%
Refrigerator Replacement	24%	19%	17%
HVAC Replacement/Upgrade	19%	1%	7%

[a] Values are based on program-tracking data and do not incorporate ISRs.

Based on ex post gross engineering analysis results, Tier I savings during the evaluation period came primarily from air sealing (85%). Another 7% came from water heating measures and 8% came from other Tier I measures (including heating system tune-ups, 3%; lighting measures, 3%; and weather-stripping, 2%). Tier II savings, on the other hand, were dominated by insulation (32%), duct system sealing and insulation (28%), and air sealing (22%). HVAC replacements/upgrades accounted for 7% of engineering-based Tier II savings during the evaluation period, while other Tier II measures (including water heating measures, 5%; heating system tune-ups, 3%; and lighting and weather-stripping, 1% each) contributed 11% (see Figure 4).

Figure 4. Measure Contribution to Total Tier I and Tier II Energy Savings



Demand-to-Energy Ratios

Using the estimated savings from Table 12, we calculated overall kW-per-kWh savings ratios, by Tier (see Table 14). We used these ratios to estimate per household net demand savings for Tier I and Tier II.

Table 14. Engineering Demand-to-Energy Ratios

Project Type	Total Gross Energy Savings (kWh)	Summer Coincident Peak Savings (kW)	Winter Coincident Peak Savings (kW)	Summer Ratio Multiplier (summer demand/energy savings)	Winter Ratio Multiplier (winter demand/energy savings)
Tier I	178,487	53.62	30.80	0.0003004	0.0001726
Tier II	4,662,487	809.04	1,469.84	0.0001735	0.0003152

4.2.3 Tier I Savings

A comparison of installed units (inclusive of evaluation-specific ISRs) between the two evaluation periods shows that participants during the 2016–2018 evaluation period were more likely to complete air sealing and received more weather stripping than participants during the 2015–16 evaluation period but installed fewer efficient lamps (CFLs or LEDs). In addition, the average Tier I home during the 2016–18 evaluation period was less likely to receive a heating system tune-up or implement any of the five water heating measures offered by the program.

Applying 2016–2018 per unit savings for Tier I participants to installed units results in annual per household Tier I savings of 1,014 kWh during the current evaluation period, compared with 1,103 kWh for the prior evaluation period. The resulting Tier I Savings Ratio is 0.92 (1,014 kWh / 1,103 kWh), meaning that based on the measure mix and installed measure quantities, per household Tier I savings for the 2016–18 evaluation period could be expected to be 92% of Tier I savings for the 2015-16 evaluation period.

Table 15 summarizes the comparison between Tier I participants in the two evaluation periods.

Table 15. Tier I Savings Comparison with Participants from Prior Evaluation

Measure	Savings Unit	Installed Units / Participant [a]		2016-18 per Unit kWh Savings [b]	Per Participant kWh Savings	
		2015-16	2016-18		2015-16	2016-18
Air Sealing and Weather Stripping						
Air Sealing	Home	0.90	0.92	926.6	831	852
Door Weather Stripping	Door	0.56	0.62	30.2	17	19
Lighting						
CFL 13W	Lamp	2.20	0.41	16.2	36	7
CFL 18W	Lamp	0.64	0.29	35.5	23	10
LED 5W Generic	Lamp	-	0.03	20.3	-	1
LED 5W Specialty	Lamp	-	0.08	20.3	-	2
LED 9W	Lamp	-	0.36	34.5	-	12
Heating System						
Heating System Tune Up	System	0.11	0.05	603.9	65	31

Measure	Savings Unit	Installed Units / Participant [a]		2016-18 per Unit kWh Savings [b]	Per Participant kWh Savings	
		2015-16	2016-18		2015-16	2016-18
Water Heating						
DWH Pipe Insulation	10' Section	0.28	0.19	141.8	40	27
DWH Tank Insulation	System	0.26	0.21	82.1	21	17
Water Heater Temp Adjustment	System	0.10	0.02	59.3	6	1
Low Flow Showerheads	Showerhead	0.23	0.14	118.1	27	17
Low Flow Aerators	Aerator	0.50	0.24	74.4	37	18
Total Tier I Savings					1,103	1,014

[a] Inclusive of evaluation-specific ISRs

[b] Savings represent averages for Tier I participants only and are exclusive of ISRs.

Applying the Tier I Savings Ratio of 0.92 to the Tier I consumption analysis result from the prior evaluation (262 kWh per household) results in estimated per household Tier I savings of 241 kWh for the 2016–18 evaluation period:

*Final Per Household Tier I Savings = 0.92 * 262 kWh = 241 kWh*

4.3 References

The following sources were used in the engineering analysis:

- ASHRAE Fundamentals. Appendix: Design Conditions for Selected Locations. Chapter 14
- ENERGY STAR® Air Source Heat Pump Calculator
- Illinois Technical Reference Manual. Version 6.0. February 11, 2016
- Indiana Technical Reference Manual. Version 2.2. July 28, 2015
- Michigan Evaluation Working Group Showerhead and Faucet Aerator Meter Study Memorandum. June 2013
- Mid-Atlantic Technical Reference Manual. Version 9.0. October 2019
- Baseline refrigerator energy consumption based on test measurement data provided by Duke Energy for 142 refrigerators
- 2016–2018 DEC LI Weatherization program tracking database
- 2016–2018 DEC LI Weatherization participant survey conducted by Opinion Dynamics in 2020
- Opinion Dynamics Corporation. Duke Energy Carolinas – 2015 Low Income Weatherization Program Evaluation Report. June 13, 2018.

5. Process Evaluation—Weatherization Program

5.1 Researchable Questions

Based on discussions with Duke Energy program and evaluation, measurement, and verification (EM&V) staff, the evaluation team developed the following process-related research questions:

- Have there been any major process changes since the last evaluation, and what effects have they had on CAA participation levels, measure mix, and per-household savings?
- 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?
- Are participating agencies satisfied with the program? What are their barriers to program participation (i.e., are there limiting factors to achieving greater participation)?
- What policy barriers to agency participation still exist in the South Carolina portion of DEC's service area? What, if any, program process improvements can DEC make to enhance its impact in that state?
- Are participants satisfied with the program and measures received? What types of non-energy benefits have they received since participating?

5.2 Methodology

Our process evaluation relied on (1) interviews with program staff, the program coordinators (NCCAA and TRC), and six participating agencies; (2) review of program materials and program-tracking data; and (3) analysis of the participant survey.

The full survey instrument can be found in Appendix C.

5.3 Key Findings

5.3.1 Program Participation

The 2016–2018 program comprised the second, third, and fourth years of the DEC Weatherization Program. Between April 1, 2016 and December 31, 2018, 15 participating agencies in North Carolina served 1,706 households. The majority of participating households (81%) completed a Tier II project; 10% completed a Tier I project; and 24% received a new refrigerator (either in combination with a Tier I or Tier II project, or as a stand-alone measure).

Of the 15 participating agencies, eleven were already active during the prior evaluation period and four were new to the program. The 15 agencies submitted between 1 and 746 weatherization projects, with an average of 136 (Table 16.

Table 16. 2016-2018 CAA Projects by Tier

Agency	Tier I	Tier II	Refrigerator Replacement	Total
Blue Ridge Community Action Inc.	102	497	147	746
Blue Ridge Opportunity Commission	9	39	3	51
Cabarrus County Planning & Development Services	7	27	9	43
Central Piedmont Community Action Inc.*	0	2	0	2
Charlotte Area Fund Inc.*	0	0	18	18
Community Action Opportunities	12	159	25	196
Four Square Community Action Inc.	5	17	24	46
I CARE Inc.	1	13	1	15
Macon County Government	3	40	0	43
Mountain Projects Inc.	1	28	4	33
Piedmont Triad Regional Council	4	451	118	573
Rebuilding Together of the Triangle*	0	1	0	1
Resources for Seniors	14	39	16	69
Salisbury-Rowan Community Action Inc.*	1	8	1	10
Yadkin Valley Economic Development District Inc.	17	145	38	200

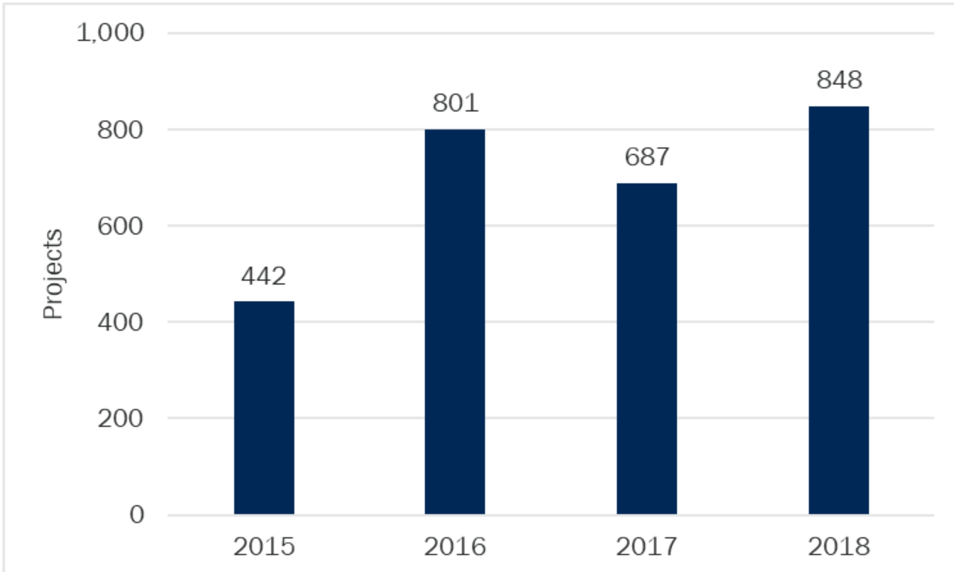
*Denotes agencies new to the DEC Weatherization program in the 2016–2018 evaluation period, based on a review of participating agencies in the 2015–2016 evaluation period.

During the evaluation period, the program provided incentives for over 2,000 projects at 1,706 homes, all in North Carolina.[9] On an annual basis, 2018 represented the largest number of projects (848) since program initiation in 2015 while 2017 saw a dip in project completion (687) compared to 2016 (801).

Figure 5 shows the total number of projects completed each year, from 2015 through 2018. It should be noted that 2016 includes 290 projects from the prior evaluation period (which included January through March 2016).

[9] Projects are defined by project numbers found in the tracking database, which denotes HVAC and refrigerator replacements as separate projects when a participant also receives Tier I or Tier II measures.

Figure 5. DEC Weatherization Projects Per Year 2015-2018

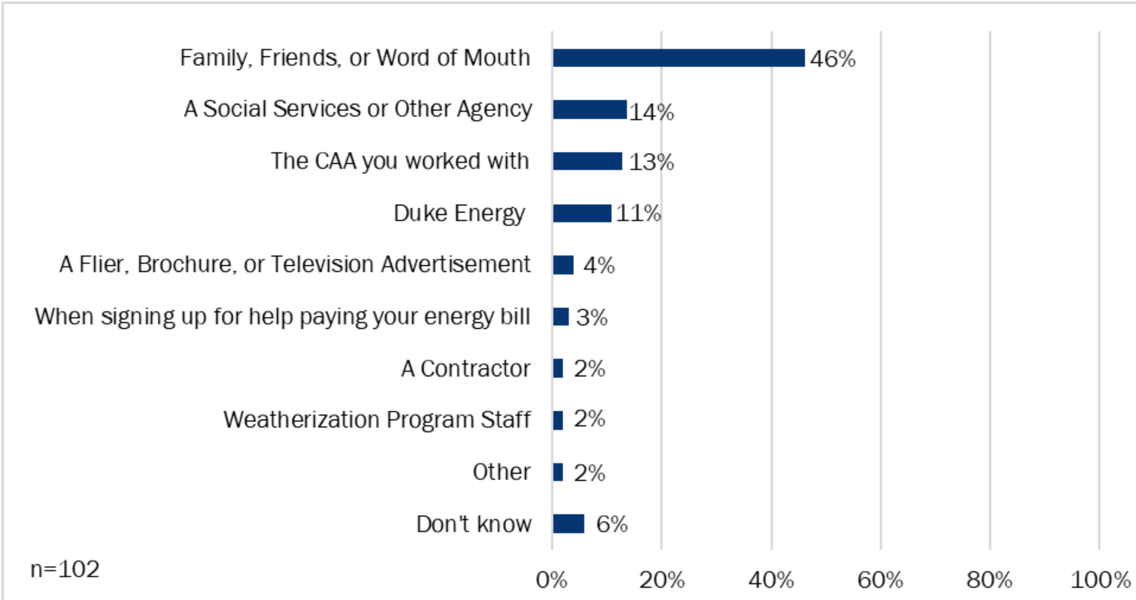


5.3.2 Program Outreach and Motivators of Participation

Agencies complete their own marketing and outreach to generate a local pipeline of State and DOE weatherization projects; Duke Energy does not conduct any additional marketing. Interviewed agencies (n=6) most often reported marketing the program through newspaper ads, fliers, in-person marketing (events and door-to-door canvassing), partnerships with other organizations, and their own websites (4/6). Only half of interviewed agencies market the program on social media and even fewer use mail (2/6) or television ads (1/6).

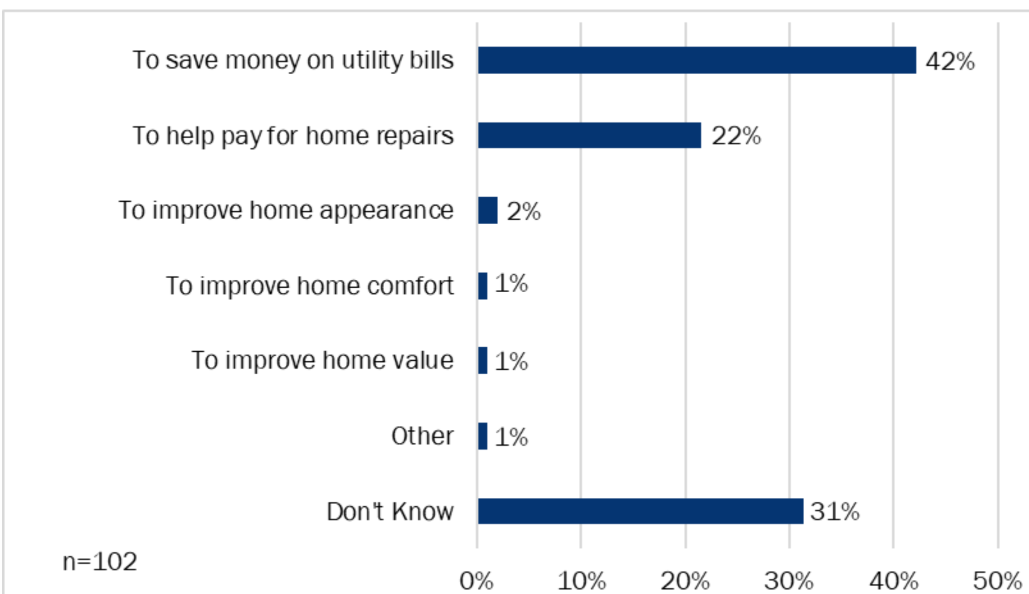
According to responses to the participant survey, nearly half (47%) of participants learned about the Weatherization Program through word of mouth; smaller shares of participants learned about the program through social services or another agency (14%), their CAA (13%), or directly from Duke Energy (11%) (see Figure 6).

Figure 6. How Participants First Heard About the DEC Weatherization Program (Multiple Response)



The main driver of customer participation is to save money on utility bills (42%) or to help pay for home repairs (22%) (see Figure 7). Interestingly, making the home more comfortable is not a main motivator for participation, even though it is a main non-energy benefit identified by participants (see Section 5.3.4).

Figure 7. Participants' Main Motivation in Signing Up for Weatherization



5.3.3 Participating Agencies' Program Experience

In general, agency staff expressed great appreciation for the DEC Weatherization Program and emphasized the high level of need for weatherization services among their clients. DEC Weatherization projects represent a large portion of weatherization jobs completed by the agencies and half of interviewed agencies utilized the new participation channel in which they can submit projects for reimbursement that were not originally DOE or State WAP projects. Most interviewed agencies provide additional services for their clients outside of weatherization, but all reported their clients have difficulty paying high energy bills. Agencies did not significantly change how they implement or participate in the program since the last evaluation, and policy barriers in South Carolina continued to prevent program participation in the state.

Agency Participation Summary

All but one agency we interviewed (5/6) had been involved with the DEC Weatherization Program prior to the current evaluation period; the only new agency we interviewed reported first participating in the DEC Weatherization Program in May 2016. Most interviewed agencies (5/6) reported they complete weatherization projects through DOE/State WAP while half (3/6) also complete projects through LIHEAP. One agency reported they only complete refrigerator replacement projects for the DEC Weatherization Program, although they provide other services to their clients outside of the Weatherization Program. Three agencies indicated they had utilized the new participation channel, in which they completed and submitted projects that were not originally DOE or State WAP projects. Overall, agencies submit an average of 81% of their total weatherization projects to DEC for reimbursement. All interviewed agencies reported that they submit 100% of eligible projects for DEC Weatherization Program reimbursement. Table 17 presents an overview of agency activity and program participation during the evaluation period.

Table 17. Agency Activity and Participation

Agency Metrics	Average	Range
Number of DEC projects (n=6)	306	18 to 746
Share of DEC projects relative to all weatherization jobs (n=5)	81%	64% to 91%
Percent of all weatherization jobs that were originally DOE funded (n=5)	21%	15% to 40%
Percent of all weatherization jobs that were originally LIHEAP funded (n=3)	66%	60% to 70%
Percent of eligible projects submitted for DEC Weatherization Program reimbursement (n=5)	100%	100% to 100%

Key Services and Customer Concerns

Most interviewed agencies (4/6) perform a wide variety of services in their communities beyond weatherization; only two interviewed agencies reported they exclusively provide weatherization services and health and safety upgrades to their clients' homes. Half of agencies (3/6) also have senior assistance and/or nutrition programs, and many agencies perform other necessary work in their communities through workforce development programs (2/6), childcare and education programs (1/6), and environmental compliance programs (1/6).

All six interviewed agencies reported that the biggest housing/energy concern their clients face are extremely high energy bills, which can be a struggle to pay on a low or fixed income. Half of interviewed agencies (3/6) also noted their clients' homes were in need of repairs or upgrades, such as gaps in doors or missing insulation. Two agencies reported their clients have trouble maintaining adequate indoor temperatures. One interviewee reported their clients sometimes resort to dangerous ways of warming their homes, saying "when your heat breaks you wind up … getting gallon jugs and putting kerosene in them and getting a kerosene heater and bringing it into your house. Then it smokes your house up but you're warm and it's dangerous."

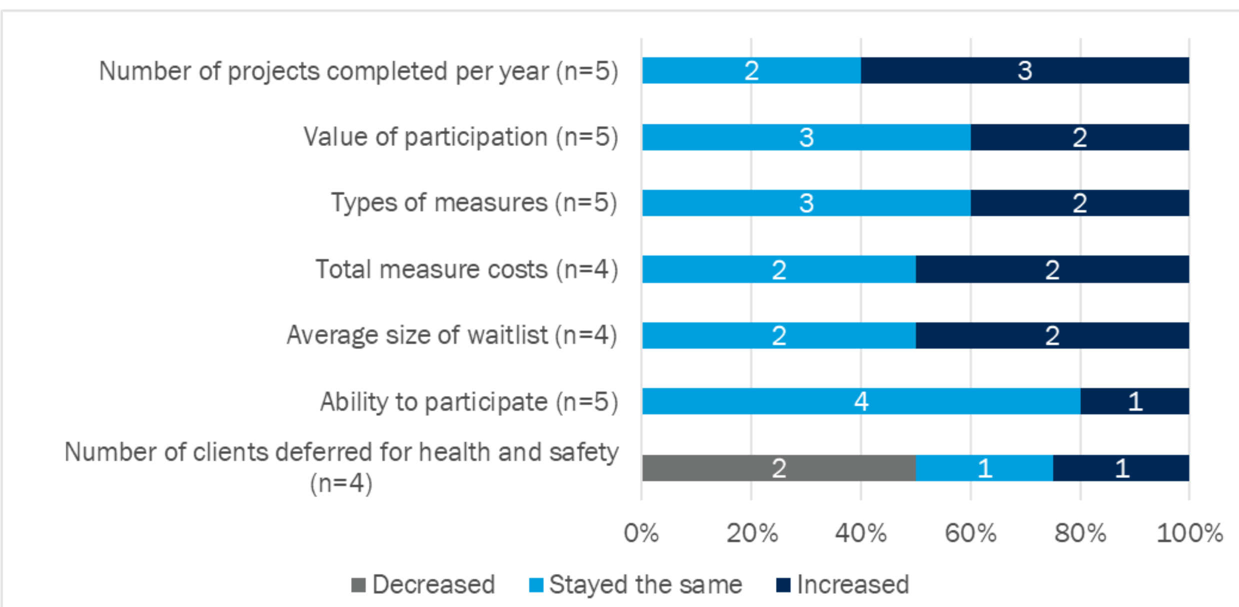
Program Changes

In 2018, the DEC Weatherization Program introduced a new participation channel in which agencies could submit for reimbursement qualifying weatherization projects funded from their operating budget or another source. Prior to this change, agencies could only submit qualifying DOE/State WAP projects for DEC Weatherization reimbursement. This change allowed agencies other than CAAs, such as non-profit organizations, to be able to deliver program services to their clients in North and South Carolina. DEC made this change in an effort to bypass the strict DOE rules for how agencies spend weatherization funds and to increase program participation in South Carolina. Three out of six agencies indicated they used this new participation channel, utilizing grants, operating budgets, and credit at local home improvement stores to fund the projects before they received reimbursement from DEC.

Interviewed agencies that also participated in the program during the prior evaluation period (2015 to Q1 2016, n=5) noted only minimal changes in how they delivered or participated in the DEC Weatherization Program during the evaluation period. Two of these five agencies reported they did not change anything about how they delivered or participated in the program since the last evaluation. One agency noted they were able to hire additional staff and serve more clients on their deferral list, and another agency noted they started submitting for HVAC replacement projects during this evaluation period. One agency reported they decreased spending on health and safety due to the loss of a $3,000 per house payment for health and safety measures from DEC. The agency noted this occurred in 2017 or 2018, when the funds for the Helping Home Fund (HHF) ran out.

To further understand specific changes to program implementation, we asked agency staff to identify changes that may have occurred in a variety of program areas over the past four years. The most frequently reported change was an increase in the number of projects completed per year (3/5). Figure 8 summarizes agency responses.

Figure 8. Changes to Agency Participation



Agency staff noted that changes to the types of measures installed include HVAC replacements (1/6) and the new measures DEC added to the program during this evaluation period, including roof cool seal (1/6). One agency noted their ability to participate increased over the last four years since they were able to complete weatherization jobs at more homes.

We also asked the returning agencies if there have been any changes over the last four years in how they coordinate the implementation of multiple weatherization programs. Half of agencies reported no changes (2/4). One agency reported their coordination efforts tend to change within their funding cycle, rather than from year to year, but have not changed substantially over the last four years. Another agency reported they increased outreach efforts to other community agencies and nonprofits, and ensure their partnering agencies are aware of Weatherization Program requirements so they can get referrals.

Policy Barriers

Our last evaluation identified significant policy barriers to agency participation in the DEC Weatherization Program in both states but specifically in South Carolina. During the current (2016–2018) evaluation period, many interviewed agencies in North Carolina reported being able to complete more projects per year and reduce the number of people they defer for health or safety reasons; however, policy barriers remain in South Carolina, and not one South Carolina agency participated during the evaluation period.

In 2015, DOE's policies in North Carolina required that agencies spend DEC funding within the same program year. This limited agencies' willingness to participate in the first year of the program because they were not certain that they could spend both the DEC and State WAP funding. This hesitancy led North Carolina agencies to request less than the full value of available funds. Since then, DOE revised its policy, allowing North Carolina agencies to use DEC Weatherization funds as 'unrestricted' income beginning in 2016. As noted above, participating agencies are now requesting funding for 100% of their eligible projects. The North Carolina agencies' annual number of DEC program-eligible State WAP projects provided an upper bound to the amount of funding Duke Energy reasonably expected to distribute each year until the recent addition of the new participation channel. This new participation channel allows participating agencies to submit completed DEC Weatherization projects for reimbursement, regardless of the original funding source. Three of the six interviewed agencies indicated they used this new participation channel, and used funds from other programs, grants, or their operating budgets to pay for the project before receiving reimbursement from Duke Energy.

In South Carolina, agencies continue to struggle to participate in the DEC Weatherization Program. According to NCCAA, South Carolina has a relatively high need for weatherization services and could benefit greatly from DEC Weatherization funding. DOE considers DEC Weatherization Program reimbursements in South Carolina "program income," and agencies must return any unspent program income to DOE at the end of the WAP fiscal year. This could result in DOE reducing funding allocations to the South Carolina agencies in future program years. To prevent this, the State WAP does not allow South Carolina agencies to participate in the DEC Weatherization Program. In addition, NCCAA reported that CAAs in South Carolina are entirely state funded, and CAA employees are considered "state-paid employees." While CAAs receive enough funding from the state to cover their payroll, they often do not have funds left over to pay for weatherization projects, and CAA employees are barred from working on projects using privately funded grants, including DEC Weatherization projects. One of the goals of the new participation channel was to overcome these barriers by allowing non-profits or other non-CAA organizations to provide program services. The program has so far remained unsuccessful in expanding program services into South Carolina, however, despite this new participation channel. NCCAA and TRC believe that the program will continue to struggle in South Carolina as long as these state policies remain in place.

Growing the Program

During the previous evaluation, 12 agencies participated in the DEC Weatherization Program. Since then, one agency left and four new agencies joined the program, bringing the total number of participating agencies in the 2016–2018 evaluation period to 15. Program administration staff reported that they do not perform agency recruitment for the program, and new agencies typically start participating in the program due to reassigned service territories. Program administration staff indicated that some new agencies tend to complete HVAC or refrigerator replacement projects due to the “safer” nature of those projects (in terms of agencies knowing the reimbursement amount upfront), and oftentimes homes are in need of HVAC replacements (if they do not have working heat) before they can receive weatherization services through the State WAP. Program administration staff also noted that participating agencies can be non-profit agencies that do not specialize in weatherization or home upgrades due to the new flexible participation channel. This option is particularly attractive for South Carolina as restrictions surrounding State WAP and the use of private funds continue to be a policy barrier for weatherization agencies in the state.

A minor barrier to agency interest found in the last evaluation was a limited capacity to spending program funding once agencies received it due to funding restrictions surrounding State WAP projects, particularly in South Carolina. Although no new projects were completed in South Carolina during the evaluation period, many agencies in North Carolina were able to spend their DEC Weatherization reimbursements, and three of six interviewed agencies indicated they could weatherize more homes or otherwise increase their participation in the program if the program offered more money.

5.3.4 Non-Energy Impacts

NEIs include a range of occupant health, safety, and economic outcomes that participants may realize beyond the energy and cost savings of energy-efficient upgrades. NEIs can provide significant additional benefits to participants and can be a powerful motivator for program participation.

The participant survey included questions about changes in electricity bills and in different aspects of the home’s comfort following program participation. Most Weatherization Program participants reported that their summer and winter electricity bills were lower compared to before they participated in the program and that they experienced other beneficial changes. Beneficial NEIs reported by two-thirds or more of participants include increased home comfort in both summer and winter, reduced draftiness, and better lighting. Fewer than half of respondents reported a reduction in outdoor noise and home maintenance costs (Table 18). In addition, a small share of respondents (less than 20%) reported other beneficial changes as a result of their participation, including improved quality of life, improved water efficiency in their homes, and improved home safety.

Table 18. Impacts Reported by Participants

Impact Category	Positive Change	No Change/ About the Same	Negative Change
Energy Impacts			
Summer electricity bills (n=99)[a]	73% *Bills are lower*	24%	3% *Bills are higher*
Winter electricity bills (n=99)[a]	58% *Bills are lower*	32%	10% *Bills are higher*
Non-Energy Impacts			
Home comfort in the summer (n=102)	76% *More comfortable*	22%	2% *Less comfortable*
Home comfort in the winter (n=101)	70% *More comfortable*	26%	4% *Less comfortable*
Home draftiness (n=100)	68% *Less drafty*	26%	6% *More drafty*
Lighting (n=9)[b]	67% *Better*	33%	0% *Worse*
Amount of outdoor noise heard when all windows are closed (n=98)	46% *Less noise*	49%	5% *More noise*
Home maintenance costs (n=96)	33% *Lower costs*	53%	14% *Higher costs*

[a]Asked only of those who pay their own electric bill.

[b]Asked only of those who received LEDs.

These findings suggest the Weatherization Program provides value to participants beyond energy savings. Increased home comfort and reduced draftiness could be beneficial for customer health and safety, especially as climate change alters temperature patterns. Improved lighting provides a higher sense of safety in and around the home. Lower energy bills and home maintenance costs help alleviate energy burdens and allow customers to spend their money on essential items, such as food and medicine.

DEC should consider providing information regarding improved home comfort, draftiness, and lighting quality to agencies to help them market the program. Duke could also use this information to recruit new agencies to the program whose clients face high energy bills or uncomfortable homes in the winter and summer.

5.3.5 Program Satisfaction and Strengths

Overall, program administration staff, implementing agency staff, and participants are all highly satisfied with the DEC Weatherization Program:

- **NCCAA and TRC program administration staff gave the program a satisfaction score of six out of six, saying they were very satisfied and "we'd love to do more but we've got what we've got, and it's made a big difference."** Program administration staff are particularly pleased with the new flexible participation channel for agencies, who are no longer required to complete DOE or LIHEAP projects to be reimbursed by DEC. This allows for other nonprofits, not just CAAs, to participate in the program, which could help reduce the policy barriers to participation in South Carolina. Program administration staff are also extremely pleased with their interactions with Duke Energy and reported that Duke Energy has been a great partner to them and the CAAs. They also reported the program has likely reduced the size of agency waitlists and agencies have been able to serve more people than they would have otherwise. In addition, program administration staff noted HVAC and refrigerator replacement projects as program strengths, which allow other agencies or non-profits to participate in the program, as well as the recent increase in the incentive for refrigerator replacements. Program administration staff noted they would like to increase participation, but they are satisfied with the work they do, and it makes a big difference in the lives of clients.

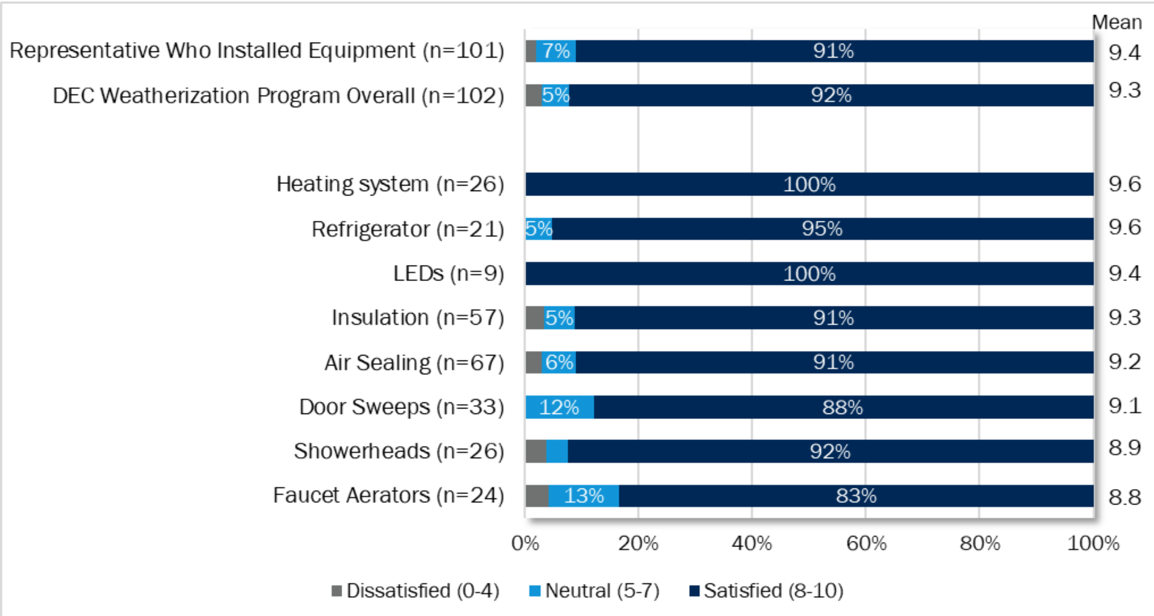
- **Agency staff are very satisfied with the program as well, giving it an average rating of 5.9 out of 6 (n=6).** Agency staff reported few issues with implementation and underscored the value of the program to their communities. Agencies are particularly satisfied with logistical elements of the program, and most interviewed agency staff members noted program organization, communication, and the ease of participation and reporting requirements as key program strengths (5/6). One staff member mentioned the flexibility of reimbursements was a key program strength and another highlighted the program's role in their agency serving more clients. Agency staff frequently provided unprompted praise for program administrative staff during our interviews, one saying "… the folks that were back and just willing to help you any way they could to implement and get this program going. The resources were phenomenal, the teamwork. I've never seen anything like it. It was just great."

  As noted above, only one of the interviewed agencies indicated they began participating in the program during the evaluation period. This agency reported no issues with blending Duke funds with other sources of funding, obtaining DEC reimbursements, or meeting participation or documentation requirements. This agency also participates in the State WAP and the Blue Cross Blue Shield home upgrade program. When asked to compare the DEC Program to the other weatherization and home upgrade programs they participate in, this agency staff member reported there were no major implementation differences, aside from the State WAP eligibility guidelines surrounding heating fuel type.

- **Participants are also satisfied with all components of the program.** As shown in Figure 9, 94% of participants reported that they were satisfied with the program overall, and 93% reported that they were satisfied with the weatherization representative who installed the equipment.[10] Moreover, across the measures we verified, most participants were satisfied with the equipment they received (ranging from 83% of those who received faucet aerators to 100% of participants who received LEDs and efficient heating systems). Common reasons for dissatisfaction with equipment include participants not satisfied with the performance of the equipment (low pressure from faucet aerators or showerheads) and not noticing a difference in their home following installation of air sealing or insulation.

[10] Satisfied is defined as a rating of 8 to 10 on a scale of 0 to 10, where 0 means "not at all satisfied" and 10 means "very satisfied."

Figure 9. Participant Satisfaction with DEC Weatherization Program and Equipment



- **The DEC Weatherization Program helps to alleviate the biggest home and energy concern agencies reported their customers faced: high energy bills.** All interviewed agencies reported paying their energy bills was a key issue for their customers and saving money on energy bills was the most common motivator for participating in the program (reported by 42% of survey respondents). Survey results suggest the program is helping participants in this respect, with 73% of respondents reporting lower summer electricity bills and 58% of respondents reporting lower winter electricity bills following participation in the program.

- **The program is delivering substantial non-energy benefits to program participants including improved home comfort in the summer and winter, reduced draftiness, better lighting, and, to some extent, lower outdoor noise levels and home maintenance costs.** Several survey respondents also mentioned additional benefits they have experienced since participating in the program, including improved quality of life, safer homes, and increased water efficiency. Participating agencies can utilize this research as a way to market the program to hesitant clients.

5.3.6 Program Challenges and Opportunities for Improvement

While all interviewed agencies were highly satisfied with the program overall, most (4/6) also noted some challenges in program implementation. Two agencies reported they wished the program provided more funds to agencies, either through more measures covered by the program, such as stove or natural gas furnace replacements, or increased funds for health and safety repairs. Two agencies also noted they experienced internal staffing issues during the evaluation period, which prevented them from completing more projects. One of these agencies reported the biggest challenge they had was recruiting employees to perform the actual weatherization work on homes and explained that when they informed applicants of the nature of the job, many turned the position down. One agency reported a challenge for them was getting new participants to provide firsthand testimonials for use in marketing materials. This agency staff member explained that new participants were often wary of letting others know they participated in the program because “you don't want everybody to know that you got your heating system fixed because they might come steal it.”

Interviewed NCCAA and TRC staff acknowledged one particular challenge for participating agencies is the reimbursement amount for energy saving measures, particularly for HVAC and refrigerator replacements. While the incentive amount for refrigerator replacements recently increased, the incentive for HVAC replacements has not, and agencies struggle to pay for these measures in the allotted cost cap. Program administrators also noted that the inconsistent funding environment CAAs often have to deal with is a challenge, since the program year starts July 1 but CAAs do not receive state funds until October 1. CAAs would often have to lay-off staff during the summer because they simply do not have the funds available to spend on payroll.

Suggestions for Program Changes

When asked for suggestions on how Duke Energy could improve the program to be more effective in the future, most agencies (4/6) reported the program could be improved by providing program funds for more measures, such as stove/oven replacements, natural gas furnace replacements, or additional health and safety upgrades. Agency staff also suggested Duke Energy could increase program marketing efforts (2/6), provide educational materials to customers about the program and the benefits of energy efficiency in their homes (2/6), and provide additional training to agency staff (2/6).

Program administration staff suggested revising the fixed payment model and pivoting to a reimbursement model. For example, program administration staff suggested providing agencies up to $4,000 for Tier II measures, and not just reimbursing a fixed cost for each unit of the approved measures each agency installs. They also suggest “stacking” Tier II and HVAC replacement dollars, so a single home could be eligible for $4,000 in Tier II measures plus $6,000 for an HVAC replacement.

Program administrators also suggest increasing health and safety funds. Agency staff cannot weatherize a home that is unsafe. Many homes are being left out of the program, due to lack of funds for needed health and safety improvements, and Duke Energy does not realize any savings from those homes. Programs like the HHF provide some support for health and safety, but many agencies have to fund these upgrades from their operating budget or another source so they can complete weatherization. Program administration staff suggest an HHF-type program that covers the DEC service territory to provide funding for health and safety upgrades.

6. Process Evaluation—Durham Pilot

In 2018, Duke Energy launched a new weatherization pilot based in Durham, North Carolina. The Durham Pilot provided weatherization services and health and safety upgrades to 206 income-qualified Durham residents between October 2018 and December 2019.

As part of our evaluation of the DEC Low Income Weatherization Program, we conducted a limited process evaluation of the Durham Pilot, addressing the following research objectives:

- How do program design, implementation, and participation of the Durham Pilot compare to the DEC Weatherization Program?
- What are the relative advantages and disadvantages of the two program designs?
- How do the two offerings compare in terms of per-home savings potential?

This limited process evaluation included an in-depth interview with pilot staff and a focused program-tracking database analysis to document program design, identify early implementation successes and challenges, and make comparisons to the Weatherization Program.

6.1.1 Pilot Overview

Duke Energy launched the Durham Pilot in 2018, with the intent to determine how and if the current DEC Weatherization Program design could be improved and expanded into Duke Energy Progress (DEP) service territory. A secondary intent of the pilot was to determine if a different funding model could be used to expand weatherization services into South Carolina, where current DEC Weatherization Program funds qualify as program income, which limits CAA participation in the program.

Duke Energy conducted this pilot in Durham, North Carolina due to a combination of factors. DEC ran the Low Income Neighborhood Energy Savers (NES) Program in Durham, and preliminary customer data collected from the NES Program indicated there was a high density of potentially qualified customers in the Durham area. Durham Pilot staff noted that many people who participated in the NES Program could derive additional benefits from weatherization services, and DEC would realize greater electric savings if they provided those services to customers. In addition, the program administrator, NCCAA, is headquartered in Raleigh, making the logistics of launching the pilot there appealing to pilot staff.

The Durham Pilot was designed to bring weatherization services to customers who may not have been able to receive these services from a CAA. The pilot had eligibility requirements similar to Tier II of the Weatherization Program (income of no more than 200% of Federal Poverty Guidelines and energy usage of at least 7 kWh per square foot) and offered the same measures (prioritizing insulation, air sealing, and duct sealing, and offering baseload lighting and DHW measures). The pilot did not offer a Tier I option for lower usage customers. Similar to the Weatherization Program, it offered HVAC upgrades and replacements as part of Tier II services as well as refrigerator replacements.

6.1.2 Comparison to DEC Weatherization Program

Although DEC designed the Durham Pilot to provide the same services to customers as the DEC Weatherization Program, there are a few key differences in the design and implementation of the two offerings:

- **Program Implementation.** The Durham Pilot relied on Duke Energy staff and NCCAA, rather than agencies, to complete weatherization projects. Durham Pilot staff were responsible for providing all funding, program services, and oversight for each Durham Pilot project. Pilot staff hired independent, qualified contractors to go to homes to complete assessments and install energy saving measures. Durham Pilot staff were also responsible for following up with participants on any issues.
- **Program Eligibility.** Participation in the pilot was limited to income-eligible customers with energy usage of at least 7 kWh per square foot. Unlike the Weatherization Program, the pilot did not offer a Tier I option for lower usage customers.
- **Marketing and Outreach.** The Durham Pilot conducted proactive marketing and outreach for the program by microtargeting NES Program participants and other potentially qualified customers with letters and other program materials. This is in stark contrast to the Weatherization Program, wherein CAAs are responsible for marketing the program. Durham Pilot staff reported that “with this design, we have the information where we're going to the customers versus sitting back and waiting for the customers to come to us.” Durham Pilot Staff also reported that qualified customers were often not aware of the pilot or that Duke Energy provided energy saving programs like this.
- **Customer Prioritization:** The Durham Pilot served qualified customers on a first come, first served basis. In contrast, CAAs operating through the Weatherization Program must prioritize homes with lead, small children, or elderly occupants when providing weatherization services due to DOE and State WAP requirements. This can result in some customers waiting several years for vital weatherization services. Durham Pilot staff recalled a particular customer, a veteran, who waited nine years for weatherization services since they did not meet the high priority criteria.
- **Measure Cost:** Duke Energy paid the full cost of each measure in the Durham Pilot, compared to a percentage of each measure in the Weatherization Program. CAAs are responsible for covering the remainder of the measure cost, either through funds from another program (such as State WAP or LIHEAP) or through their operating budget. While this funding approach is less cost-effective than rebating a portion of the cost, it allowed for higher percentage of more comprehensive projects than the Weatherization Program. It might also allow Duke Energy to expand weatherization services into DEP territory and South Carolina. Weatherization Program funds qualify as program income in South Carolina, which affects federal funding for CAAs in the state and prevents them from participating in the program.

6.1.3 Early Successes and Pilot Advantages

Although pilot staff did not formally survey customers, they reported high participant satisfaction with the program and the services they received. The program served customers who, according to pilot staff, may have had to wait for years before receiving services from the DEC Weatherization Program. Interviewed staff relayed participant feedback that the contractors were respectful, worked hard to help them, and often understood the participants’ situation. Pilot staff were commonly told by participants that they did not know Duke Energy offered any programs of this nature and felt they could trust program staff. As one pilot staff member put it, “We can count on one hand the number of issues that arose, and those issues that did arise were resolved pretty quickly.”

Interviewed pilot staff remarked that it was easier to work directly with the program administrator, as opposed to delegating the work to CAAs. Additionally, Pilot staff identified having access to important customer data as another advantage of not relying on CAAs for implementation. This customer data enabled Pilot staff to identify and target customers most in need of weatherization services and provide education on ways to lower energy costs and burden. Pilot staff also reported that customers may be hesitant to participate in the DEC Weatherization Program due to the bureaucracy associated with applying for a federal or state assistance program. Since the Durham Pilot did not leverage DOE or State WAP projects, the administrative burden on customers was greatly reduced.

6.1.4 Pilot Challenges

Although Durham Pilot staff were generally satisfied with how the Pilot performed, they did encounter a few implementation challenges. Some customers (about 5% of applicants) who made initial contact with Durham Pilot staff did not follow up with their information, which left Pilot staff uncertain if these customers were still interested in the program. Program staff also reported it was a challenge to get some qualified customers to schedule their in-home assessment with a qualified contractor. Program staff sent letters to customers informing them they would lose their spot in the program if they did not make an appointment.

Another issue for the Durham Pilot was having to turn down customers because the health and safety upgrades their homes required exceeded the resources of the program. This is a common issue for many weatherization programs, including the Weatherization Program, and the Durham Pilot staff partnered with other programs and agencies such as Habitat for Humanity and the HHF to provide health and safety upgrades for many participants.

Finally, the funding approach of covering the full project cost without contributions by agencies might make this program design difficult to implement on a larger scale.

6.1.5 Pilot Participation and Outcomes

The Durham Pilot served 206 customers between October 2018 and December 2019. In total, the pilot funded 148 Tier II projects, including 52 HVAC replacements, and replaced 123 refrigerators. The pilot partnered with the HHF to provide up to $3,000 for health and safety upgrades before providing weatherization services. The pilot did not have any savings or participation goals, nor did pilot staff have any expectations of how the pilot would perform.

Durham Pilot staff did not directly compare participant characteristics or pilot activity to the Weatherization Program, and limited data prevents a full savings comparison between the two offerings. As part of our limited process evaluation, we analyzed program tracking data and compared key participant metrics across the two offerings. Key differences include:

- Participants in the Durham Pilot, on average, had slightly smaller homes and slightly higher energy use intensities.
- A smaller percentage of Durham Pilot participants have electric heat.
- A larger percentage of Durham Pilot participants live in multifamily homes.

Table 19. Comparison of Participant Characteristics

Participant Metrics	Durham Pilot (N=206)	Weatherization Program (N=1,706)
Average Annual Income	$20,138	$17,477
Average Square Footage	1,189	1,311
Estimate Annual Electricity Usage (kWh)	13,808	14,030
Estimated Energy Use Intensity (kWh/sqft)	11.6	10.7
Participants with Electric Heating	57%	65%
Participants in Multifamily Homes	19%	5%
Participants in Single Family Homes	81%	95%

While a full savings comparison between the pilot and the Weatherization Program was not possible within the scope of this evaluation, a comparison of the types of projects completed through the two offerings and the measure mix provides interesting insights into potential savings. It should be noted, however, that these insights are merely directional and intended for guidance purposes only.

Table 20 compares the percentage of participants who completed various types of weatherization projects. As noted above, the pilot did not offer a Tier I option, while 10% of Weatherization Program participants completed a (lower-savings) Tier I project. While a higher percentage of Weatherization Program participants completed a Tier II project (81% compared to 72%), pilot Tier II projects were more likely to include both weatherization measures and an HVAC replacement/upgrade (34% compared to 6%). In addition, a much higher percentage of pilot participants received a new refrigerator (60% compared to 24%), and more than half of them also completed a Tier II project (similar to Weatherization Program refrigerator recipients). This comparison suggests a higher savings potential (based on project type alone) for pilot participants compared to Weatherization Program participants.

Table 20. Comparison of Project Types

Project Type	% of All Participants	
	Durham Pilot (N=206)	Weatherization Program (N=1,706)
Tier I	0%	10%
Tier II	72%	81%
Wx Measures & HVAC Replacement/Upgrade	*34%*	*6%*
Weatherization Measures Only	*65%*	*77%*
HVAC Replacement/Upgrade Only	*1%*	*17%*
Refrigerator Replacements	60%	24%
Refrigeration Replacement & Weatherization	*52%*	*55%*
Refrigerator Replacements Only	*48%*	*45%*

A comparison of measures included in Tier II projects (see Table 21) shows additional differences between the pilot and the Weatherization Program. While both offerings provided most Tier II participants with air sealing and insulation, pilot participants were less likely to receive duct system insulation/sealing and much less likely to receive water heating measures and weather stripping. No pilot Tier II participants received a heating system tune-up, compared to 27% of Weatherization Program participants. On the other hand, higher shares of pilot participants received lighting measures (57% compared to 35%) and HVAC replacements/upgrades (35% compared to 7%).

Given the relatively high savings impact of air sealing, insulation, and duct sealing/insulation, and the significant savings associated with HVAC replacements/upgrades, this comparison suggest a savings potential of the pilot on par with or even higher than for the Weatherization Program.[11] However, it also appears that some opportunities for savings might have been missed as few pilot participants received water heating measures, weather stripping, and heating system tune-ups. Given that the pilot targeted Durham, NC—an area previously served by the NES Program, which offered some of the same measures—it is possible that some of the participants not provided with these measures did not have a need for them.

Table 21. Comparison of Tier II Measure Mix

Measure Category	% of Tier II Participants	
	Durham Pilot (N=148)	Weatherization Program (N=1,387)
Air Sealing	92%	97%
Insulation	90%	91%
Duct System	65%	74%
Lighting	57%	35%
HVAC Replacement/Upgrade	35%	7%
Water Heating	22%	70%
Weather Stripping	9%	59%
Heating System Tune-Up	0%	27%

[11] It should be noted that savings from many of these measures depend on installed quantities as well as home characteristics, such as space and water heating fuel types. Detailed consideration of these factors was out of the scope of this analysis.

7. Key Findings and Recommendations

During the evaluation period, 1,706 households participated in the Weatherization Program, completing over 2,000 projects. The majority of participants (81%) completed a Tier II project; only 10% of participants completed a Tier I project. In addition, 24% received a replacement refrigerator, either as a stand-alone measure (8%) or in combination with Tier I or Tier II services (15%).

7.1 Key Impact Findings

Based on our impact analysis, we estimate that the projects completed during the evaluation period generate close to 3.2 million kWh of annual energy savings, 539 kW of annual summer coincident demand savings, and 935 kW of annual winter coincident demand savings. Tier II participants account for the largest share to program-level savings (89%) while Tier I participants and refrigerator replacements account for 1.3% and 9.6%, respectively, of total program energy savings.

Table 22 presents annual per-household and program-level net ex post savings for the evaluation period.

Table 22. Summary of Impact Results

Project Type	Number of Participants	Net Annual Savings Per Household			Net Annual Program Savings		
		Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)	Energy (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Tier I	176	241	0.0724	0.0416	42,398	12.7	7.3
Tier II	1,387	2,042	0.3544	0.6438	2,832,531	491.5	892.9
Refrigerator Replacement	404	758	0.0864	0.0864	306,097	34.9	34.9
Total [a]	1,706				3,181,027	539.2	935.2

[a] The total number of unique participants is smaller than the sum of project types since some households complete more than one project.

7.2 Key Process Findings

The process evaluation found that the DEC Weatherization Program continues to benefit from previously established relationships, implementation processes, and program-tracking systems. Program and implementation staff reported no major changes to the program since the previous evaluation aside from the new participation channel established in 2018. Participating agencies also reported minimal changes to how they implement and participate in the Weatherization Program, and many reported the DEC funds allow them to complete more weatherization jobs than they would have otherwise.

Key process findings include:

- **Program Participation.** Participation in the Weatherization Program has been increasing steadily since the program began in 2015. Agencies work hard to inform clients about the program through multiple advertising channels (newspaper ads, in-person events, agency websites, etc.) and half of interviewed agencies indicated the number of projects they complete each year is increasing.

- **New Participation Channel.** Prior to 2018, agencies could only submit projects originally funded by the State WAP for reimbursement from Duke Energy. Now, agencies may submit for reimbursement projects they originally funded through their operating budget or another source. This opened the possibility of non-CAA organizations, such as non-profit organizations, to participate in the program and bring Weatherization Program services to their clients. Half of the agencies we interviewed indicated they had used this new participation channel. One agency, a non-profit organization, indicated they used this participation channel exclusively and only performed refrigerator replacements since their organization was not equipped to perform more extensive weatherization on clients' homes.

- **Satisfaction.** The process evaluation showed high satisfaction with the Weatherization Program. Interviewed agency staff often provided unprompted praise for the program implementation team and underscored the importance of the program to their clients. Agencies found the logistical elements of the program—including program organization, communication, and reporting—to be key program strengths. Participants were also highly satisfied with the program overall. A key concern for participants is high energy bills, and survey results suggest the program is helping participants in this respect, with 73% and 58% of respondents reporting lower summer and winter electricity bills, respectively, following participation in the program.

- **Non-Energy Impacts.** In addition to lowering energy bills, the Weatherization Program provides substantial non-energy benefits to participants including improved home comfort in the summer and winter, reduced draftiness, and better lighting. To a lesser extent, survey respondents also reported lower outdoor noise levels and home maintenance costs, improved quality of life, safer homes, and increased water efficiency.

- **South Carolina Policy Barriers.** Despite the new participation channel—introduced in 2018 to encourage participation by South Carolina agencies—barriers to program participation remain high in South Carolina, and no projects were completed in the state during this evaluation period. While the new participation channel has not yet resulted in program participation in the state, program staff continue to conduct outreach and provide additional support to South Carolina agencies and to encourage future program participation.

- **Durham Pilot.** Between October 2018 and December 2019, Duke Energy offered a weatherization pilot in Durham, North Carolina, which served a total of 206 customers. One goal of this pilot was to determine if the current DEC Weatherization Program design and funding model could be improved to expand program services to South Carolina and into the Duke Energy Progress (DEP) service territory. The limited process evaluation of the Durham Pilot found key differences between the pilot and the Weatherization Program in program eligibility, implementation, and measure mix:

  - Not relying on agencies to implement the program made the Durham Pilot implementation smoother and more flexible, and access to customer data allowed Pilot staff to target the program to the customers who needed it most. Since the Durham Pilot was entirely funded by DEC, participants did not need to spend time completing federal or state assistance program applications, which greatly reduced administrative burden on participants.

  - Compared to DEC Weatherization projects in the evaluation period, Durham Pilot projects were more likely to include both weatherization measures and an HVAC upgrade. Additionally, Durham Pilot participants were more likely to receive a refrigerator replacement. Based on the measure mix, we believe that the Durham Pilot has the potential to provide per household savings on par with, or possibly greater than, the savings estimated for the DEC Weatherization Program. Since this evaluation did not include a formal impact assessment, however, more rigorous impact analysis would be required to quantify the savings of the Durham Pilot.

Overall, pilot staff were highly satisfied with the performance of the pilot and indicated that participants were particularly grateful for program services they may have otherwise waited years to receive. Given the continuing policy barriers in South Carolina, despite the new participation channel, a program design similar to the Durham Pilot could be a good option for bringing weatherization services to customers in South Carolina and/or the DEP service territory.

7.3 Evaluation Recommendations

We have developed the following recommendations based on the results of our evaluation:

- **Consider tracking several additional parameters within the program-tracking system to enhance the accuracy of future deemed savings estimates.** Our deemed savings review (see Appendix B) identified a few parameters that are currently not tracked in program data: (1) pre- and post- blower door results in units of reduced cubic feet per minute (CFM); (2) presence or type of cooling at participating homes; (3) water heating fuel of participating homes; and (4) the installed location (e.g., bathroom, kitchen) for each low-flow faucet aerator. Some of this information is currently collected in the participant survey but having it in the program-tracking data for the population of participants would enhance the accuracy of future deemed savings estimates. We therefore recommend asking weatherization agencies to enter this information into the program's tracking system, if available.

- **Consider changing the reimbursement structure or increase reimbursement amounts.** The current Tier II incentive structure provides up to $6,000 for Tier II projects. TRC and NCCAA indicated that agencies may struggle covering the cost of HVAC replacements with the current reimbursement amount, which has not increased since the program began in 2015. In addition, this reimbursement cap may also prevent participants from receiving weatherization services in addition to HVAC replacements/upgrades: Based on program-tracking data, only 6% of Tier II projects include both HVAC replacements/upgrades and other Tier II measures, compared to 34% in the Durham Pilot, which provided higher incentives. Agencies may be able to provide additional energy saving measures in Tier II homes, leading to deeper savings, if the overall Tier II incentive amount was increased.

- **Increase support to agencies in program marketing and outreach.** Agencies noted that communication and organization of the program were key strengths and frequently provided unprompted praise for staff at Duke Energy and NCCAA. One area agency identified for potential additional Duke assistance was marketing and outreach to help increase customer awareness of the program. This could be through information about the program on customer bills or on Duke Energy's website, or by developing testimonials from past program participants with examples of bill savings and other benefits—such as non-energy impacts (NEIs) reported by many surveyed participants—derived from their weatherization projects.

- **Explore options to increase the uptake of comprehensive weatherization projects though the new participation channel.** The new participation channel allows non-profit and other organizations to provide program services to customers who may not have been able to receive them otherwise. One objective of this channel was to overcome barriers to participation in South Carolina, as State policies prevent CAAs from participating in the program. Based on program-tracking data through April 2020, however, the new channel has not been successful in encouraging South Carolina organizations to participate in the program. In addition, information from our agency interviews suggest that some non-CAAs may not be equipped to facilitate the implementation of weatherization projects and thus limit their activity to equipment replacement. The program should continue to explore ways to promote participation in South Carolina, by identifying suitable partner organizations (with prior weatherization expertise) and/or providing non-CAA organization with additional support in implementing weatherization services.

- **Consider expanding the Durham Pilot to include the South Carolina service territory.** Given the substantial policy barriers that continue to block participation in South Carolina, one way to provide weatherization upgrades to South Carolina customers is to introduce a program design similar to the Durham Pilot. Based on our review of project types and measures installed through the pilot, the savings potential for a program design similar to the pilot appears to be on par with, or even greater than, savings observed for the Weatherization Program. In addition, pilot participants and staff were very satisfied with the experience, and there were very few implementation challenges. If policy barriers persist, or the new participation channel fails to increase participation in South Carolina, this may be an option to expand services in the state.

8. Summary Form

Duke Energy Carolinas
Low Income Weatherization Program

Completed EM&V Fact Sheet

Program Description

The DEC Weatherization Program reimburses local implementing agencies that have recently completed qualifying weatherization projects at Duke Energy customer homes. Electric conservation measures are provided at no cost to the customer. A tiered project structure is used to allocate reimbursements to agencies: Tier I applies to low usage homes and offers air sealing and low-cost energy efficiency upgrades (including lighting and low-flow aerators and showerheads); Tier II applies to higher usage homes and offers more comprehensive energy efficiency measures (including insulation and HVAC upgrades/ replacements) in addition to Tier I measures.

Date	April 16, 2021
Region(s)	Duke Energy Carolinas
Evaluation Period	April 1, 2016–December 31, 2018
Annual kWh Savings (ex post net)	3,181,027 kWh
Coincident kW Impact (ex post net)	Summer: 539.2 kW Winter: 935.2 kW
Per Participant kWh Savings	Tier I: 241 kWh Tier II: 2,042 kWh Refrigerator: 758 kWh
Measure Life	Not evaluated
Net-to-Gross Ratio	N/A
Process Evaluation	Yes
Previous Evaluation(s)	June 2018

Evaluation Methodology

The evaluation team performed a process and gross impact evaluation.

The process evaluation included a participant survey and interviews with participating surveys. We also performed a limited process analysis of the Durham Pilot.

The gross impact evaluation included an engineering analysis and a consumption analysis and leveraged results from the prior evaluation.

Impact Evaluation Details

- We determined annual per household energy savings for Tier II participants using consumption analysis.
- We determined annual per household energy savings for Tier I participants based on a combination of engineering analysis results and results from the prior evaluation.
- We estimated demand savings for Tier I and Tier II participants based on engineering analysis-based demand-to-energy ratios, applied to energy savings.
- We developed savings for refrigerator replacements and HVAC replacements/ upgrades through engineering analysis.
- The engineering analysis applied deemed savings values to measures distributed and in service. In-service rates were calculated based on information collected in the participant survey.

9. DSMore Table

The Excel spreadsheet containing measure-level inputs for Duke Energy Analytics is provided below. Per-measure savings values in the spreadsheet are based on the impact analyses reported above. The evaluation scope did not include updates to measure life assumptions.

DSMore - DEC
Weatherization Prog

For more information, please contact:

Antje Flanders
Vice President

617-492-1400 tel
617-497-7944 Fax
aflanders@opiniondynamics.com

1000 Winter Street
Waltham, MA 02451

Reimagine tomorrow.

2019-2020 Power Manager Evaluation Report

Submitted to Duke Energy Carolinas

June 23, 2021

Principal authors:
Eric Bell, Principal
Candice Potter, Principal
Greg Sidorov, Consultant
Kristofer Hoyt, Project Analyst
Andrew Hauser, Analyst

Contents

1 Executive Summary 1
1.1 Impact Evaluation Key Findings 1
1.2 Time-Temperature Matrix and Demand Reduction Capability 3
1.3 Process Evaluation Key Findings 5

2 Introduction 7
2.1 Key Research Questions 7
2.1.1 Impact Evaluation Research Questions 7
2.1.2 Process Evaluation Research Questions 7
2.2 Program Description 8
2.3 Participant Characteristics 8
2.4 2019 Event Characteristics 11

3 Methodology and Data Sources 13
3.1 Data Sources 13
3.1.1 Impact Evaluation Data Sources 13
3.1.2 Process Evaluation Data Sources 13
3.2 Data Management and Cleaning 13
3.3 Randomized Control Trial Analysis Design 15
3.4 Within-Subjects Analysis Design 18
3.5 Process Evaluation Methodology 19

4 Randomized Control Trial Results 22
4.1 Overall Program Results 22
4.2 Comparison of Impacts by Event Start Time 25
4.3 Weather Sensitivity of AC Load and Demand Reductions 27
4.4 Key Findings 28

5 Within-Subjects Results 29

5.1 Within-Subjects Event Impacts 29

5.2 Key Findings 31

6 Demand Reduction Capability 32

6.1 Methodology 32

6.2 Demand Reduction for Emergency Conditions 34

6.3 Key Findings 37

7 Process Evaluation 38

7.1 Survey Disposition 38

7.2 Program and Event Awareness 39

7.3 Program Experience 43

7.4 Motivation, Satisfaction, and Potential Barriers to Program Participation 45

7.5 Interview Findings 49

7.5.1 Program Offer and Enrollment Goals 50

7.5.2 Power Manager Program Operations 52

7.5.3 Program Monitoring and Postseason Program Maintenance 54

7.5.4 Upcoming Program Changes and Initiatives 54

7.6 Key Findings 55

8 2020 Impact Evaluation 56

8.1 Summary of Results 56

8.2 Methodology 57

8.2.1 15-minute vs. 30-minute Interval Data 57

8.3 Impact Analysis Findings 58

8.3.1 Comparison with 2019 Event Impacts 59

8.4 Demand Reduction Capability 60

9 Conclusions and Recommendations 63

9.1 Impact Evaluation Conclusions and Recommendations 63

9.2 Process Evaluation Conclusions and Recommendations.................... 64

List of Figures

Figure 1-1: 2019 Demand Reduction Capability - 100°F Maximum Temperature 4
Figure 1-2: Demand Reduction Capability – 100°F Event Period Temperature 5
Figure 2-1: Duke Energy Carolinas Service Territory 9
Figure 2-2: Power Manager Participation Over Time 10
Figure 2-3: Household Loads by Size Decile 11
Figure 3-1: Randomized Control Trial Design 15
Figure 3-2: Average Customer Loads on the Hottest Non-Event Days by Feeder 17
Figure 3-3: Within-Subjects Regression Model Selection 18
Figure 4-1: Average Customer Loads and Impacts for RCT Event Days 24
Figure 4-2: Load Profiles for Cascading Operations on August 19 and September 17 26
Figure 4-3: Weather Sensitivity of Impacts for Cascading and General Population Events 27
Figure 4-4: Whole-House Loads by Temperature 28
Figure 5-1: Within-Subjects Load Impacts for August 9 Emergency Event 30
Figure 5-2: Within-Subjects Load Impacts for September 9 Event..30
Figure 6-1: Weather Sensitivity of Percent Load Impacts and Household Loads.......................33
Figure 6-2: Time Temperature Matrix Development Process 33
Figure 6-3: Demand Reduction Capability – 100°F Event Period Temperature 35
Figure 6-4: Demand Reduction Capability – 100°F Daily Maximum Temperature (2019) 36
Figure 7-1: Please rate your discomfort using a scale of one to five, where one means “not at all uncomfortable” and five means “very uncomfortable.” Response Frequencies Weighted by Mode, N_t = 13 and N_c = 11 41
Figure 7-2: “Do you think a Power Manager event occurred in the past few days?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 42
Figure 7-3: “About what time did you first notice this event?” Response Frequencies Weighted by Mode, N_t = 10 and N_c = 8 43
Figure 7-4: “What type of thermostat(s) do you have?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 45
Figure 7-5: “Which of the following reasons was most important to you when enrolling?” Response Frequencies Weighted by Mode, N_t = 63 and N_c = 59 46
Figure 7-6: “How would you rate the following statements about Power Manager?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 47
Figure 7-7: “How likely is it that you will stay enrolled in Power Manager? Would you say…?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 49
Figure 7-8: Power Manager Outreach Material Featured in March 2019 MyHER Reports.........51
Figure 7-9: Spring Reminder and Thank-You Postcard 53
Figure 8-1: Comparison of 2019 and 2020 Event Impacts..59
Figure 8-2: Demand Reduction Capability – 100°F Event Period Temperature (2020)..............61

List of Tables

Table 1-1: Demand Reductions for Individual 2019 Events 1
Table 1-2: Demand Reductions for Individual 2020 Events 3
Table 2-1: 2019 Event Operations and Characteristics 12
Table 3-1: 2019 Event Data Issues Summary 14

Table 3-2: Feeder Group Assignment 16
Table 3-3: Measures of Bias and Precision 19
Table 3-4: Summary of Process Evaluation Activities 19
Table 4-1: Randomized Control Trial per Customer Impacts 22
Table 4-2: Average Impacts by Event Start Time (2019) 27
Table 5-1: Within-Subjects per Customer Impacts 29
Table 6-1: Per Customer Impacts by Daily Maximum Temperature and Event Start Time (2019) 37
Table 7-1: Survey Disposition 39
Table 7-2: “Was there any time today when the temperature in your home was uncomfortable?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 40
Table 7-3: What do you think caused the temperature to be uncomfortable? Response Frequencies Weighted by Mode, N_t = 13 and N_c = 11 41
Table 7-4: “How did you determine that an event was occurring?” Response Frequencies Weighted by Mode, N_t = 10 and N_c = 8 43
Table 7-5: “How frequently do you or someone else in your household use your air conditioning system?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73 44
Table 7-6: “What suggestions do you have for improving Power Manager?” n=48 48
Table 7-7: “Why are you not at all likely to stay enrolled in Power Manager?” N_t = 4 and N_c = 4 49
Table 8-1: 2020 Event Impacts 56
Table 8-2: Per Customer Event Impacts 58
Table 8-3: Estimated Per Household, Per Device, and Aggregate Impacts 60
Table 8-4: Per Customer Impacts by Daily Maximum Temperature and Event Start Time (2020) 62

Equations

Equation 1: Standard Error Calculation for Randomized Control Trial 17

1 Executive Summary

This report presents the results of the 2019 Power Manager impact and process evaluations for the Duke Energy Carolinas territory, as well as results of a supplemental 2020 impact analysis. Power Manager is a voluntary demand response program that offers incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioner's outdoor compressor and fan during summer days with high energy usage. Through the program, events may be called to help lessen electricity use during times of high demand. During normal shed events, a remote signal is sent to participating load control devices that reduce customers' air conditioner use. During emergency shed operations, all devices are initiated to quickly shed loads and deliver larger demand reductions.

1.1 Impact Evaluation Key Findings

The 2019 impact evaluation is based on a randomized control trial. All Power Manager program participants who had a load control device installed by the start of the summer were randomly assigned to one of six groups – a primary group made up of 75% of the population, and five research groups, each made up of 5% of the population. During each event, one or more of the smaller research groups (each comprising approximately 11,000 customers) is withheld as a control group in order to provide an estimate of energy load profiles absent a Power Manager event. During the summer of 2019, approximately 238,000 households were actively participating in Power Manager and had load control devices.

Impacts were estimated using an RCT approach for all but two events called in 2019. By design, the test event called on August 9 dispatched the full program population and did not withhold a control group. The general population event on September 9 also lacked a control group due to event programming error. As a result, an RCT design could not be applied for these two events. Instead, impacts for these events were estimated using a within-subjects approach, summarized in Section 5. The event called on 7/19 included a side-by-side test of emergency and normal operations in order to estimate the incremental demand reductions due to emergency operations. Table 1-1 summarizes the demand reductions attained during each event in 2019.

A few key findings of the 2019 impact analysis are worth highlighting:

- Demand reductions were 0.73 kW per household for the average general population event.
- On average, emergency shed produced impacts that were 0.45 kW greater than normal shed events.
- In general, the magnitude of demand reductions grows larger when temperatures are higher and resources are needed most.
- The time-temperature matrix predicts 1.54 kW load reduction per household for a 1-hour event at 100°F beginning at 4:00PM.

Table 1-1: Demand Reductions for Individual 2019 Events

Event Date	Shed Type	Event Period	Reference Load	Impact	90% Confidence		% Impact	90%Confidence		Max Event Temp[1]
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
7/15/2019	Normal	4:00PM - 6:00PM	3.65	-0.92	-0.96	-0.88	-25.2%	-24.1%	-26.2%	91.3°F
7/19/2019	Emergency	4:00PM - 4:30PM	3.60	-1.09	-1.13	-1.05	-30.4%	-29.3%	-31.5%	92.6°F
8/9/2019	Emergency	4:30PM - 5:00PM	3.45	-1.26	-1.08	-1.45	-36.6%	-31.2%	-41.9%	92.1°F
8/19/2019	Normal	12:00PM - 1:00PM	2.84	-0.58	-0.63	-0.53	-20.4%	-18.7%	-22.1%	89.9°F
	Normal	2:00PM - 3:00PM	3.33	-0.65	-0.70	-0.60	-19.6%	-18.1%	-21.2%	91.3°F
9/9/2019	Normal	4:00PM - 4:00PM	3.26	-0.69	-0.79	-0.58	-21.1%	-17.9%	-24.3%	90.8°F
9/12/2019	Normal	3:00PM - 6:00PM	3.43	-0.75	-0.78	-0.71	-21.8%	-20.7%	-22.9%	92.9°F
9/17/2019	Regular	12:00PM - 1:00PM	2.11	-0.29	-0.33	-0.25	-13.8%	-11.7%	-15.9%	88.3°F
	Regular	2:00PM - 4:00PM	2.77	-0.37	-0.43	-0.32	-13.4%	-11.5%	-15.3%	89.6°F
	Regular	4:00PM - 6:00PM	3.14	-0.68	-0.72	-0.64	-21.8%	-20.5%	-23.0%	89.5°F
	Regular	6:00PM - 7:00PM	3.16	-0.55	-0.61	-0.50	-17.5%	-15.7%	-19.2%	87.1°F
9/26/2019	Regular	4:00PM - 6:00PM	2.94	-0.58	-0.62	-0.55	-19.8%	-18.6%	-21.1%	89.0°F
Average General Population Event			**3.32**	**-0.73**	**-0.79**	**-0.68**	**-22.0%**	**-20.3%**	**-23.6%**	**90.4°F**

The findings from 2019 indicated that the impacts were likely affected by one or more issues arising from regional/locational dispatch signals, complexities stemming from the EM&V feeder group assignments, or possibly some other unidentifiable factor(s). Following the 2019 event season, Duke Energy undertook efforts to identify and address the possible issues and requested that Nexant complete a subsequent impact analysis on the 2020 event season. The results of the 2020 impact analysis are presented independently in Section 8 of this report.

The 2020 analysis methodology differed from the analysis approach used in 2019 in a few fundamental ways. First, the 2020 impact analysis relied entirely on a within-subjects analysis framework rather than a RCT. This alternate approach was required in order to accommodate the simplified configuration of the program population, which dispatched events at the full program level without any control group. Second, the 2020 analysis also utilized a small subset of customers from among the program's population who were discovered to have 15-minute interval meter data, rather than the expected 30-minute interval data. This group benefitted the analysis by enabling Nexant to better assess impacts achieved during events having durations that were not multiples of 30 minutes (i.e. events lasting 15 or 45 minutes), but did not supplant the full program population as the basis for the 2020 impact analysis.

Key findings of the 2020 impact analysis are summarized as follows:

- Emergency shed event impacts ranged from 0.89 kW to 1.17 kW.
- The general population event held on September 11 produced load impacts of 0.60 kW.
    - The magnitude of impacts observed during the September 11 event can be explained by relatively low temperatures observed on that day; the event was

[1] Maximum event temperatures are based on system average temperatures among eight weather stations.

called by the Energy Control Center in order to maintain system integrity rather than in response to extreme weather.

- The 2020 event impacts are similar to those in 2019 when controlling for similar dispatch conditions.
- If emergency shed becomes necessary on a day where the event temperature is 100°F, Power Manager can deliver 1.59 kW of demand reductions per household during a one-hour event at 4:00PM.

Table 1-2: Demand Reductions for Individual 2020 Events

Event Date	Shed Type	Event Period	Reference Load	Impact	90% Confidence		% Impact	90%Confidence		Max Event Temp
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
6/3/2020	Emergency	3:30PM - 3:45PM	2.93	-0.89	-0.72	-1.06	-30.5%	-24.6%	-36.3%	87.1
6/22/2020	Emergency	4:30PM - 4:45PM	3.14	-1.17	-0.88	-1.46	-37.2%	-27.9%	-46.5%	85.6
8/27/2020	Emergency	4:30PM - 4:45PM	3.30	-1.04	-0.77	-1.32	-31.5%	-23.2%	-39.9%	87.4
9/2/2020	Emergency	4:30PM - 4:57PM	3.47	-1.05	-0.89	-1.22	-30.4%	-25.7%	-35.1%	89.9
9/11/2020	Normal	4:30PM - 5:12PM	3.02	-0.60	-0.41	-0.80	-20.0%	-13.5%	-26.4%	83.5

1.2 Time-Temperature Matrix and Demand Reduction Capability

A key objective of the 2019 impact evaluation was to quantify the relationship between demand reductions, temperature, hour-of-day, and cycling levels. This was accomplished by estimating loads under historical weather conditions and applying observed percent load reductions from the 2019 events. The resulting tool, referred to as the time-temperature matrix, allows users to predict the program's load reduction capability under a wide range of temperature and event conditions.

In an ideal program year, a large number of events would be called under a variety of different weather conditions, dispatch windows and cycling strategies so that demand reduction capability could be estimated for a wide range of operating and planning scenarios. In actuality, opportunities for program events can be sporadic and based on uncertain weather projections, such that they occur infrequently and under fairly similar conditions. The time-temperature matrix is based on a total of 12 events called on eight separate event days during the 2019 program season. Event periods ranged from 30 minutes to 3 hours in length, and occurred on days with maximum event period temperatures ranging from 87°F to 93°F.[2]

Figure 1-1 shows the demand reduction capability of the program if emergency shed becomes necessary on a day with a maximum temperature of 100°F during the event window and a 1-hour event duration. Individual customers are expected to deliver 1.54 kW demand reduction.

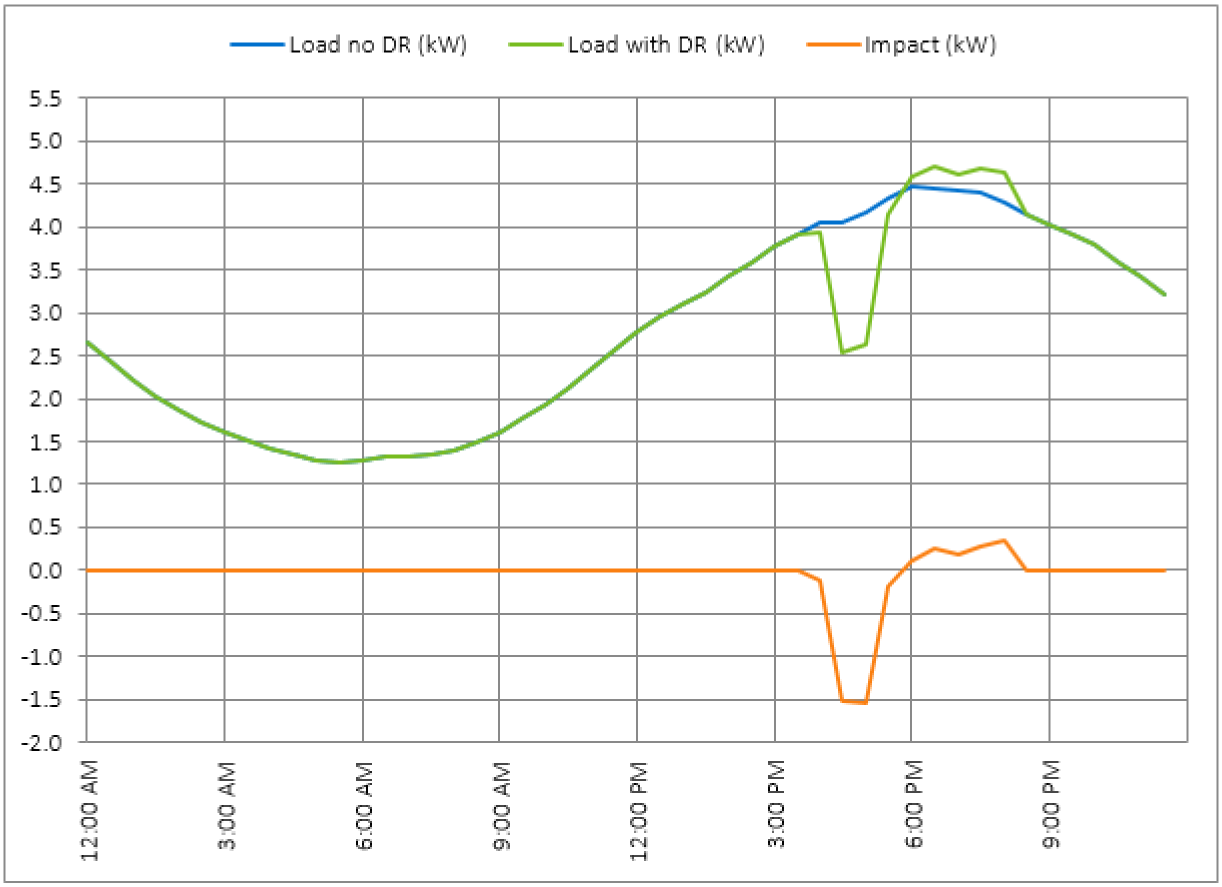
[2] Due to the scale of the DEC territory, temperatures referenced here are average temperatures (i.e. "system temperatures"), based on eight weather stations throughout the DEC territory.

Because there are approximately 238,000 customers, the expected aggregate system load reduction is 365 MW.

Figure 1-1: 2019 Demand Reduction Capability - 100°F Maximum Temperature

Inputs	
Dispatch Type	Emergency Dispatch
Event Start Time	4 PM
Event Duration	1
Event Period Max Temp	100
# Customers	238,000

Event Window Average Impacts		
Load without DR	4.12	kW per customer
Load with DR	2.58	kW per customer
Impact per Customer	-1.54	kW per customer
Program Impact	-365.4	MW
% Impact	-37.3	%



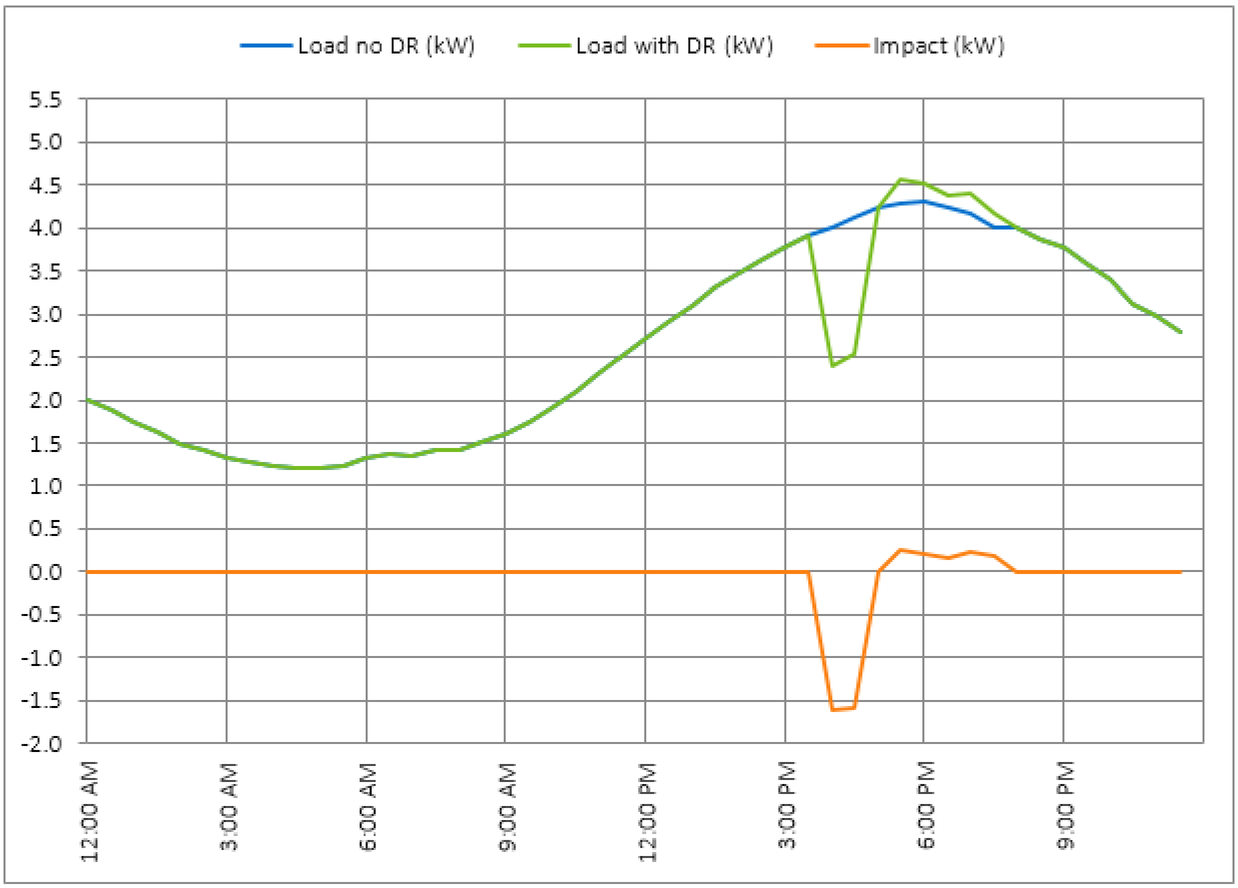
The additional data provided by the 2020 impact analysis allowed for a reconditioned time-temperature matrix to be developed utilizing a combined dataset of 2019 and 2020 event impacts. To produce this combined time-temperature matrix, models were developed based on a hot, one-hour emergency event starting at 4:00 PM and a 24-hour temperature profile with a temperature of 100°F from 4:00 PM to 5:00 PM. Additionally, because no emergency events in 2019 or 2020 exceeded 30 minutes in duration, a ratio was applied to adjust the half-hour impact to a full-hour impact using 2019 events that were at least one hour in duration.

Using the combined time-temperature matrix, based on a combined set of event data from 2019 and 2020, the tool predicts that a one-hour emergency event starting at 4:00 PM with an event temperature of 100°F will deliver 1.59 kW of demand reduction capability per customer dispatched. With a program population of approximately 238,000 customers, the expected aggregate reduction is 380 MW.

Figure 1-2: Demand Reduction Capability – 100°F Event Period Temperature

Inputs	
Dispatch Type	Emergency Dispatch
Event Start Time	4 PM
Event Duration	1
Event Period Max Temp	100
# Customers	238,000

Event Window Average Impacts		
Load without DR	4.06	kW per customer
Load with DR	2.47	kW per customer
Impact per Customer	-1.59	kW per customer
Program Impact	-379.5	MW
% Impact	-39.3	%



1.3 Process Evaluation Key Findings

The process evaluation was designed to inform efforts to continuously improve the program by identifying strengths and weaknesses, opportunities to improve program operations, adjustments likely to increase overall effectiveness, and sources of satisfaction or dissatisfaction among participating customers. The process evaluation consisted of telephone interviews with key program managers and implementers, a post-event survey implemented immediately after an event, and a nonevent survey implemented on the event day, but dispatched only to customers for whom the event was not called.

Key findings from the process evaluation include:

- 145 Power Manager participants were surveyed within 24 hours of the July 15 event, which had a high temperature of 92°F with a maximum heat index of 97°F.
- Of the 145 customers interviewed, 72 customers experienced the event and 73 customers did not experience the event. This nonevent group survey was used to establish a baseline for comfort, event awareness, and other key metrics.
- A majority of all respondents, 72%, reported that they are familiar with the Power Manager program, down from the last evaluation cycle.
- About 18% of both sets of survey respondents—those who had and those who had not experienced the event—reported that their homes were uncomfortable. There is no increase in customers' thermal discomfort due to Power Manager events.
- 52% of respondents reported that "Earning a credit on my bill" is the primary reason they are Power Manager participants.
- Overall, 87% of participants are "very" or "somewhat" likely to remain in the program.
- 83% of respondents "strongly" or "somewhat" agreed that they would recommend the Power Manager program to others.
- New installations and quality control reinstallations, replacements, and repairs substantially exceeded goals.
- The Power Manager staff and vendors are customer focused and undertake a number of activities before, during, and after the load control season to ensure that the program administration and implementation runs smoothly, and that participants are satisfied with their Power Manager program experience.
- Yukon software system has been upgraded with the "Assets" package that provides increased functionality and granularity in calling Power Manager events.
- Effective communication strategies amongst stakeholders is an ongoing strength of the program.

2 Introduction

This report presents the results the 2019 Power Manager program impact and process evaluations, as well as results of a supplemental 2020 impact analysis, for the Duke Energy Carolinas (DEC) jurisdiction. Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce the use of their central air conditioner's outdoor compressor and fan on summer days with high energy usage.

Because Duke Energy has full deployment of smart meters in DEC territory, and has access to Power Manager customers' interval data, the impact evaluation is predominantly based on a randomized control trial that randomly assigned customers to six different groups prior to the 2019 event season. During each event, at least one of the groups is withheld to serve as a control group and provide an estimate of customer's load usage profiles absent a Power Manager event. The randomized control trial approach was applied to all normal Power Manager operations where a valid control group was available, as well as to test events designed to address a set of specific research questions.

In addition to estimating load impacts during 2019 events, this study enables the estimation of the program's demand reduction capability under a range of weather and dispatch conditions. Average customer load reductions, as well as aggregate system capacity, is estimated as a function of event type, event start time, event duration, and maximum event temperature.

The process evaluation uses survey data from both treatment and control customers, as assigned for impact analysis, gathered during a non-emergency event. As in the impact analysis, responses from control group customers served as a baseline from which treatment effects on the customer experience may be measured. In addition, the evaluation uses interview data and analyses of program documentation and the program database to offer analytic context for evaluating survey results, as well as to offer insight into program operations.

2.1 Key Research Questions

The study data collection and analysis activities were designed to address the following research questions:

2.1.1 Impact Evaluation Research Questions

- What demand reductions were achieved during each event called in 2019?
- Do impacts vary based on the hour(s) of dispatch?
- Do impacts vary based on temperature conditions?
- What is the magnitude of the program's aggregate load reduction capability during extreme conditions?

2.1.2 Process Evaluation Research Questions

- What is the extent to which participants are aware of events, bill credits, and other key program features?

- What is the participant experience during events?
- What are the motivations and potential barriers for participation?
- What are the processes associated with operations and program delivery?
- What are the program's strengths and areas for potential improvement?

2.2 Program Description

Power Manager is a voluntary demand response program that provides incentives to residential customers who allow Duke Energy to reduce their central air conditioner's outdoor compressor and fans on summer days with high energy usage. All Power Manager participants have a load cycling switch device installed on the outdoor unit of their qualifying air conditioners. If customers have more than one air conditioner, all units must be equipped with a load control device. The device enables the customer's air conditioner to be cycled off and on to reduce load when a Power Manager event is called. Duke Energy initiates events by sending a signal to participating devices through its own paging network, which instructs the switch devices to systematically cycle the air conditioning system on and off, reducing the aggregate runtime of the unit during events.

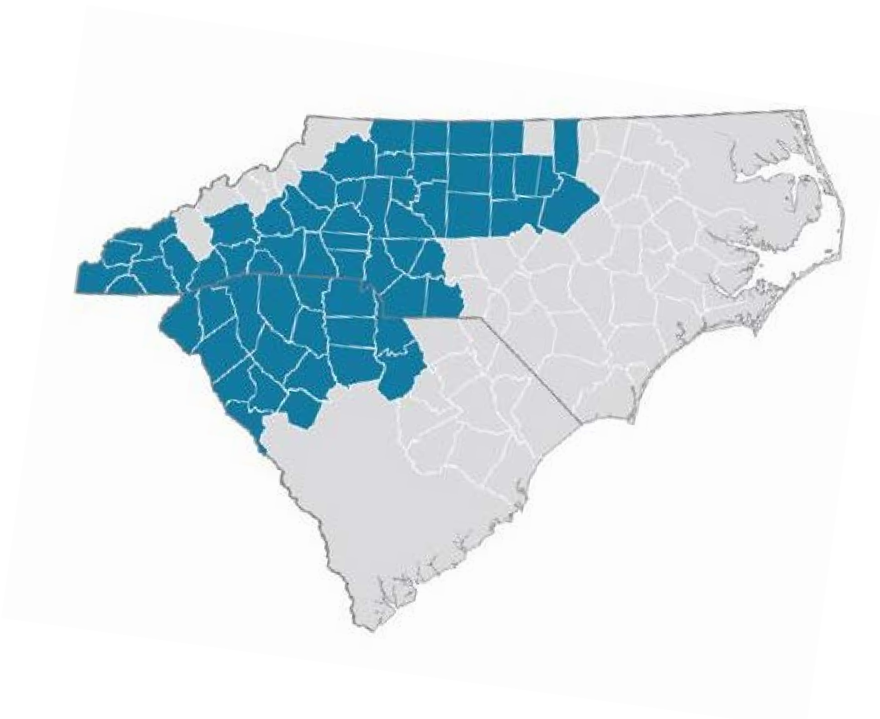
Power Manager events typically occur from June through September in DEC territory, but are not limited to these months. Participants receive financial incentives for their participation in the form of $8 credits applied to their July through October electric bills ($32 in annual credits).

In DEC territory, Duke Energy uses a cycling algorithm known as *TrueCycle*. The algorithm uses learning days to estimate air conditioners' runtime (or duty cycle) as a function of hour-of-day and temperature at each specific site, and aims to curtail load demand by a specified amount. In general, Power Manager events fall into two categories: regular shed events, during which customers are cycled at 64% or the less frequently used 50%, and emergency full-shed events, during which customers are shed at 100%. For purposes of regulatory reporting, emergency full-shed is used to estimate program capability.

2.3 Participant Characteristics

Duke Energy serves approximately 2.25 million residential customers in DEC service territory, which spans a large portion of the western half of North Carolina and northwestern South Carolina (Figure 2-1). During the summer 2019, nearly 238,000 customers - or more than 10% of the residential population - were part of Power Manager.

Figure 2-1: Duke Energy Carolinas Service Territory



To enroll in Power Manager, customers must own a single-family home located in DEC service territory and have a functional central air conditioning unit with an outdoor compressor. Figure 2-2 depicts Power Manager program enrollment over time.

Figure 2-2: Power Manager Participation Over Time[3]

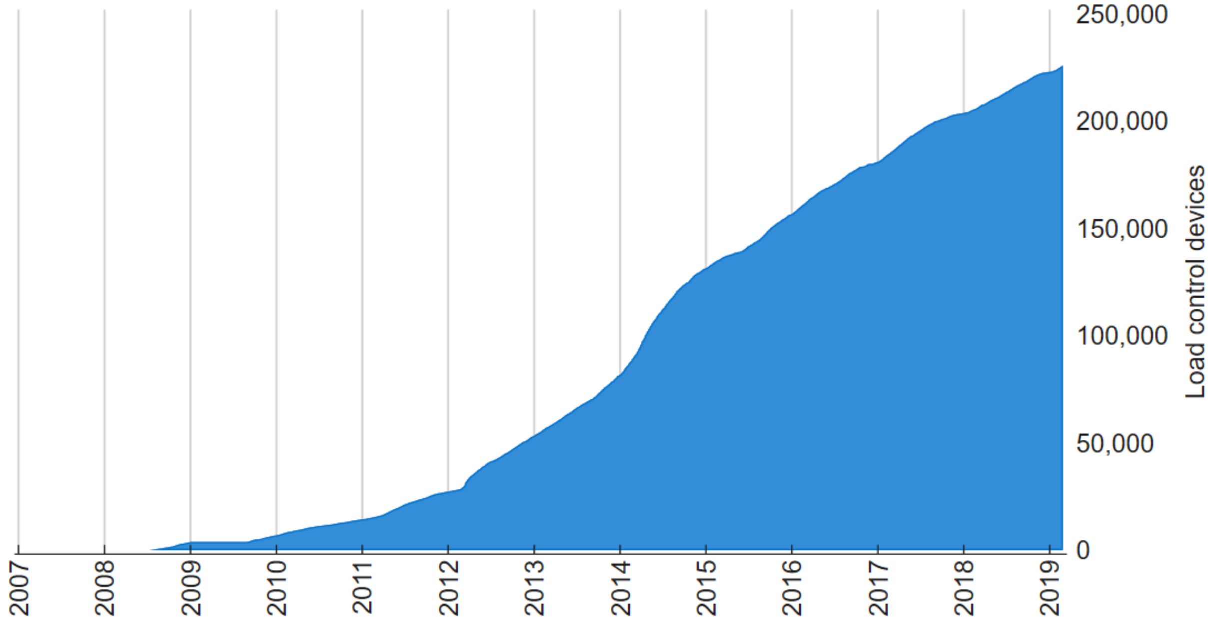
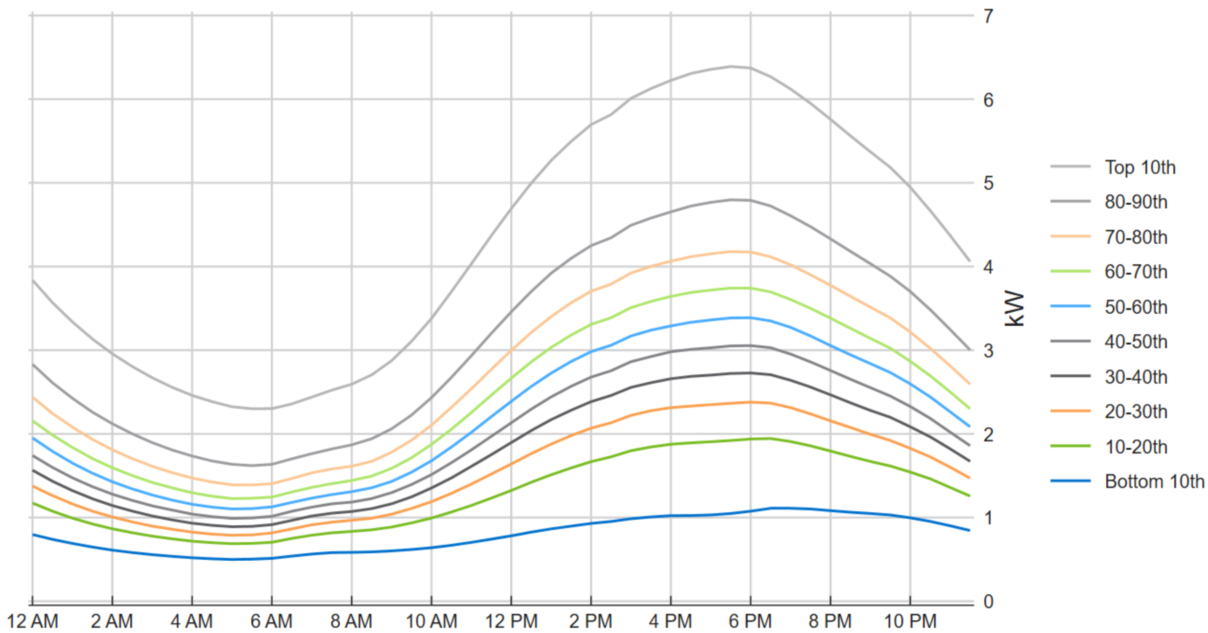


Figure 2-3 shows the hourly household loads for different customer groups. The customers were classified into ten equally sized groups, known as deciles, based on their household consumption during hot, non-event days. Each line represents the hourly loads for the average customer in each decile.

[3] Participation growth presented in Figure 2-2 is based on historical enrollment records made available to Nexant for the Power Manager program, and do not reflect participation and/or enrollments in prior load control programs that were integrated into the current Power Manager program.

Figure 2-3: Household Loads by Size Decile



Household loads varied substantially, reflecting different occupancy schedules, comfort preferences, and thermostat settings.[4] Roughly 30% of loads exceeded 4 kW during the peak period. As with any program, some enrollees use little or no air conditioning during late afternoon hours on hotter days. These customers are, in essence, free riders. The bulk of the costs for recruitment, equipment, and installation have already been sunk for these customers and, as a result, removing these customers may not improve cost effectiveness substantially. However, given the availability of smart meter data, Nexant recommends assessing nonparticipant afternoon loads on hotter days prior to marketing in order to target customers who are cost effective to enroll.

2.4 2019 Event Characteristics

Duke Energy dispatched Power Manager events 12 times in 2019. All general population events occurred either between 4:00PM and 6:00PM or between 3:00PM and 6:00PM. Emergency events were dispatched twice, once on July 19 as part of a side-by-side event, where emergency dispatch was released simultaneously alongside normal dispatch operations, and once on August 9, where all customers were dispatched at once under emergency shed. The side-by-side dispatch framework allowed for direct comparison of emergency event performance compared to general dispatch. Temperatures during events ranged from 87°F to 93°F.[5] Table 2-1 summarizes 2019 event conditions.

[4] It is assumed that household-level demand on these days is predominantly due to AC use; however, other factors could contribute to the varying customer loads.

[5] Due to the scale of the DEC territory, temperatures referenced here are average temperatures (i.e. “system temperatures”), based on eight weather stations throughout the DEC territory. Actual daily maximum temperatures on event days ranged from 91°F to 98°F across the jurisdiction.

Table 2-1: 2019 Event Operations and Characteristics

Event Date	Event Period	Type of Event	Customers Dispatched	Control Group	Max Event Temp	Notes
7/15/2019	4:00PM - 6:00 PM	GP	180,444	6,919	91.3°F	Normal shed Feeder 1 control
7/19/2019	4:00PM - 4:30PM	M&V	6,917	180,317	92.6°F	Emergency shed Feeder 1 dispatched
	4:00PM - 5:00PM	M&V	-	-	-	No feeders dispatched (Programming error)
8/9/2019	4:30PM - 5:00PM	M&V	186,258	-	92.1°F	Emergency shed Full population dispatched
8/19/2019	12:00PM - 1:00PM	M&V	6,886	172,561	89.9°F	Normal shed Feeder 1 dispatched
	1:00PM - 2:00PM	M&V	-		-	Feeder 2 not dispatched (Programming error)
	2:00PM - 3:18PM*	M&V	6,432		91.3°F	Normal shed Feeder 3 dispatched
9/9/2019	4:00PM - 6:00PM	GP	184,981	-	90.8°F	Normal shed No control group
9/12/2019	3:00PM - 6:00PM	GP	178,487	6,357	92.9°F	Normal shed Feeder 3 control
9/17/2019	12:00PM - 1:00PM	M&V	6,854	6,339	88.3°F	Normal shed Feeder 1 dispatched
	1:00PM - 2:00PM	M&V	-		-	No feeders dispatched (Programming error)
	2:00PM - 4:00PM	M&V	6,353		89.6°F	Normal shed Feeder 3 dispatched
	4:00PM - 6:00PM	M&V	158,249		89.5°F	Normal shed Feeder 10 dispatched
	6:00PM - 7:00PM	M&V	6,884		87.1°F	Normal shed Feeder 4 dispatched
9/26/2019	4:00PM - 6:00PM	GP	177,525	6,858	89.0°F	Normal shed Feeder 4 control

** Event was ended early due to rain.*

Duke Energy dispatched three research events during 2019. The first was held on July 19 and overlaid a group of customers dispatched under emergency shed operations simultaneously alongside a group dispatched under normal shed operations. Here, the objective was to assess how the magnitude of emergency shed impacts compares to traditional operations. Two subsequent events, called on August 19 and September 17, were designed to measure the effect of time-of-day on event impacts. During these “cascading events” multiple groups of customers were dispatched successively such that, as one group’s dispatch was ending, the next group’s dispatch was beginning.

3 Methodology and Data Sources

This section details the study design, data sources, sample sizes, and analysis protocols for the impact and process evaluations.

3.1 Data Sources

3.1.1 Impact Evaluation Data Sources

The impact analysis relied on four primary datasets:

1) Participant data that identified customer account numbers and feeder assignments;
2) End-use AMI data in 30-minute intervals for all participants for the entire program event season (May thru September);
3) Event data for all DEC Power Manager events in 2019, which identified treatment and control feeders, event type, and start/end times for each event, and;
4) Hourly weather data for the entire summer, which informed the selection of proxy days for the within-subjects analysis, as well as establish the impact-weather relationship for the time-temperature matrix.

The data was provided by Duke Energy at the end of the 2019 Power Manager season. All subsequent datasets used for impact analysis were created from a combination of these primary datasets.

3.1.2 Process Evaluation Data Sources

The process analysis relied on four primary data sources:

1) Program documentation and program database
2) In-depth interviews with key program stakeholders
3) Post-event participant surveys
4) Nonevent program participant surveys

Program documentation was provided before, during, and after the 2019 Power Manager season, while interview and survey data was gathered during the 2019 Power Manager season.

3.2 Data Management and Cleaning

All data sets were thoroughly cleaned and validated to ensure that impacts were estimated using only reliable observations from customers who were properly dispatched on event days. The analysis benefitted from a full population-based approach, allowing Nexant to logically exclude customers who were found to have incomplete or questionable load data, while still maintaining large enough sample sizes to produce highly precise estimates.

Recent evaluations of DEC Power Manager found incidence of device failure, signaling deficiency, or other technical dysfunction that prevented a portion of customers from being dispatched as planned for certain events. Specifically, in 2016, Nexant found that approximately 6.5% of load control devices were not functioning properly during the event season, and were unable to contribute load impacts to the program. With this in mind, and working with a more robust set of customer data, Nexant was careful to monitor individual groups' responses to each event called in 2019, and to adapt the analysis wherever appropriate in order to produce the most accurate and authentic results.

During the course of the 2019 analysis, Nexant discovered that, in many cases, an entire feeder group was not dispatched according to program planning. In other cases, smaller, but still detectable, portions of feeder groups were not dispatched as programmed. Table 3-1 summarizes the dispatch issues that affected the 2019 Power Manager events. Subsequent discussions with Duke Energy revealed that most dispatch issues were the result of programming error associated with the establishment of the randomized control trial feeder groups, and not due to any paging tower or other technical dysfunction with the program's equipment.

Table 3-1: 2019 Event Data Issues Summary

Affected Segment(s)	Affected Event(s)		Summary of Issue	Resolution
Feeder 2	7/15/2019 7/19/2019	8/19/2019 9/17/2019	Feeder 2 was not dispatched as planned for all general population events due to programming error.	Affected segment was excluded from the analysis for all affected events.
Control groups	9/9/2019 9/12/2019	9/17/2019 9/26/2019	A portion of control groups showed signs of dispatch during events, resulting in biased reference loads.	Affected customers were excluded from the analysis for all affected event days.
Customers with outlier usage	All events		A portion of groups observed abnormal usage patterns during events, resulting in biased reference loads.	10% of customers with abnormal usage were removed from the analysis.

In general, Nexant was able to work around the issues described in Table 3-1 by excluding customers from the analysis whose systems did not behave as planned on given event days and, in most cases, the analysis was unaffected. However, one prevalent outcome of the issues described in Table 3-1 is that feeder 2 presented aberrant usage behavior in virtually all events where they were designated as treatment. Because the issues associated with feeder 2 were so widespread, Nexant opted to eliminate the entire group from the impact analysis. As a result, the September 9 event was affected such that feeder 2 was no longer usable as a control group, as planned. In lieu of a control group, Nexant performed a within-subjects analysis to estimate impacts for the September 9 event rather than an RCT.

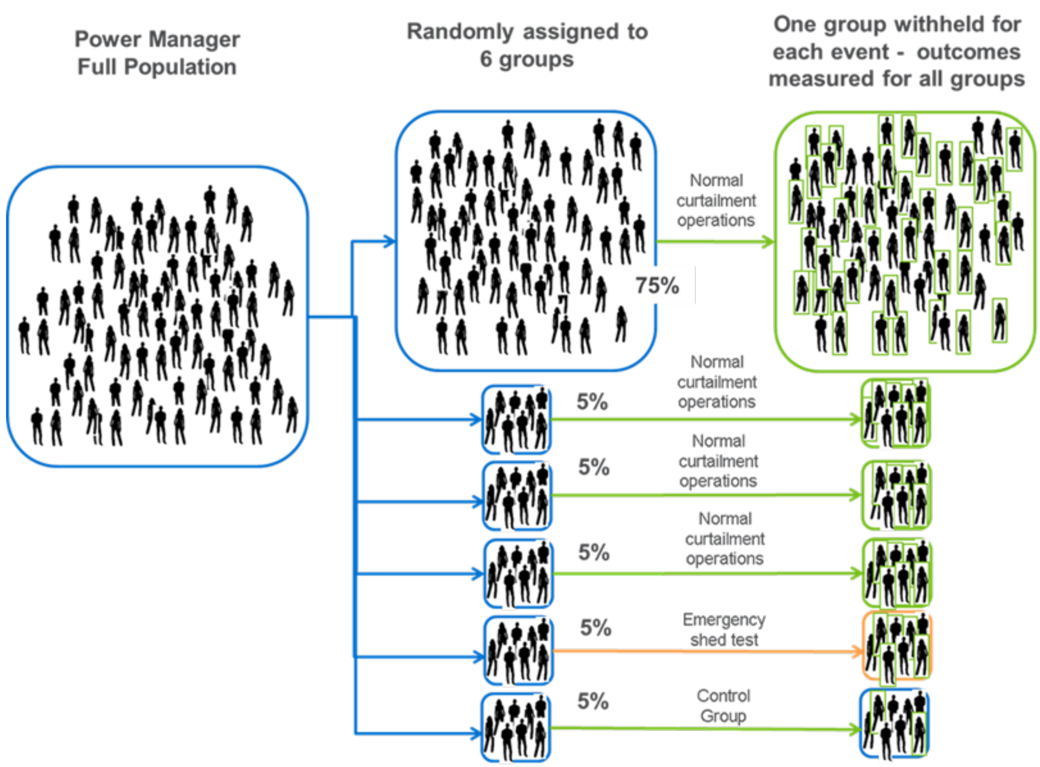
3.3 Randomized Control Trial Analysis Design

Randomized control trials are well-recognized as the gold standard for obtaining accurate impact estimates and have several advantages over other methods:

- They require fewer assumptions than engineering-based calculations;
- They allow for simpler modeling procedures that are effectively immune to model specification error; and
- They are guaranteed to produce accurate and precise impact estimates, provided proper randomization and large sample sizes.

The RCT design randomly assigns the Power Manager population into six groups – a primary group consisting of 75% of the population and five research groups, each consisting of 5% of the population. For each event, groups are assigned as either treatment or control according to Duke Energy's operational plan.[6] All devices assigned to the treatment group are controlled during the event window, while devices assigned to the control group are withheld and continue to operate normally. As a result of random group assignment, the only systematic difference between the treatment and control groups is that one set of customers is curtailed while the other group was not. Figure 3-1 shows the conceptual framework of the random assignment.

Figure 3-1: Randomized Control Trial Design



[6] The emergency shed test event on August 9 dispatched all program participants and therefore, no control group was withheld.

All customers who were enrolled in the program and had addressable load control devices installed by the start of the 2019 summer were randomly assigned into six distinct groups.[7] Table 3-2 summarizes the number of devices and the number of accounts assigned to each group. By design, the primary general population group includes 75% of participants, approximately 170,000 participants. The remaining five research groups each include 5% of participants, or roughly 11,000 customers each.

Table 3-2: Feeder Group Assignment[8,9]

Feeder Group	Number of Accounts	Number of Devices
10	169,326	203,428
1	11,221	13,458
2	11,225	13,586
3	11,312	13,510
4	11,306	13,560
5	11,311	13,668
Total	**225,701**	**271,210**

The purpose of creating six distinctive, randomly assigned groups was twofold. First, it allowed for side-by-side testing of cycling strategies, event start times, or other operational aspects to help optimize the program. Second, it allowed Duke Energy to alternate the group being withheld as control for each event, increasing fairness and helping to avoid exhausting individual customers by dispatching them too often solely for research purposes.

To ensure that random group assignment was properly implemented, average loads for each of the six groups were compared to each other for all non-event days with temperatures reaching 90°F or higher.[10] Figure 3-2 shows average loads for each feeder group on these hottest, non-event days. Feeder loads are nearly identical, which provides strong evidence that the random group assignment effective. It also emphasizes the high degree of precision provided by an effective RCT design for estimating the counterfactual.

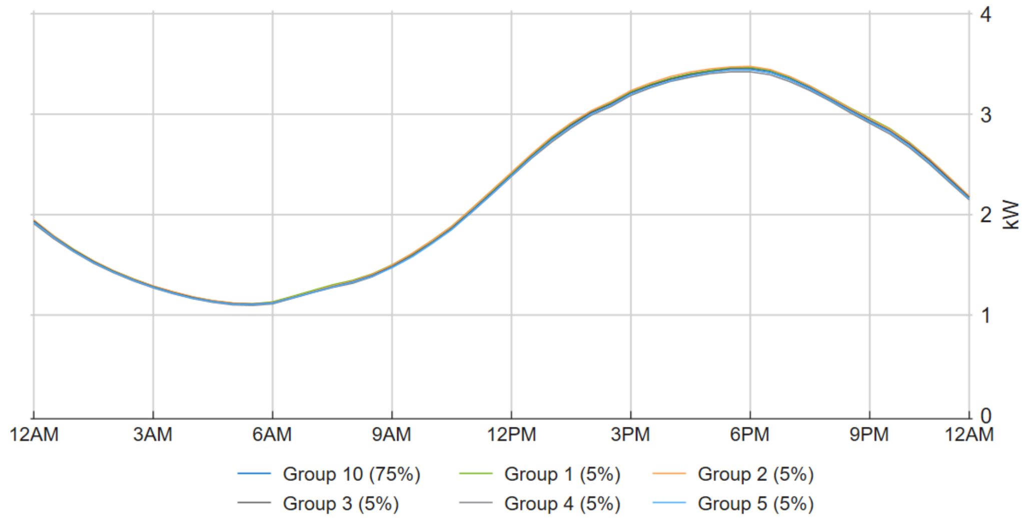
[7] Some households have multiple load control devices; in these instances the homes were randomly assigned such that all devices in a given home were in the same group.

[8] The number of accounts and devices presented in Table 3-2 reflect the enrollment counts included in the participation extract provided to Nexant following the summer 2019 Power Manager season and used in the original 2019 evaluation. They do not represent the updated program population of approximately 238,000 accounts and 288,000 devices enrolled at the time of the report submission.

[9] Account and device counts exclude participants who were not assigned to a feeder group in the dataset received by Nexant.

[10] A total of 18 non-event weekdays reached at least 90°F in 2019.

Figure 3-2: Average Customer Loads on the Hottest Non-Event Days by Feeder



For each event, one of the five smaller research groups was withheld to serve as a control group and establish the electricity load patterns in the absence of curtailment, i.e. the baseline. Within the experimental framework of a RCT, the average usage for control group customers provides an unbiased estimate of what the average usage for treatment customers would have been if an event had not been called. Therefore, estimating event day load impacts requires simply calculating the difference in loads between the treatment and control groups during each interval of the event window, as well as for the hours immediately following the event when snapback can occur. Demand reductions calculated in this way reflect the net impacts and inherently account for offsetting factors, such as device failures, paging network communication issues, and customers' use of fans to compensate for curtailment of air conditioners.

Impacts are calculated simply by taking the difference in loads between the treatment and control groups. However, additional statistical metrics, such as standard error, are calculated in order to evaluate whether these differences are meaningful, as well as whether different cycling strategies could produce significantly different impacts. The standard error is then used to calculate 90% confidence bands, which are additional measures used to describe the statistical accuracy of the impact estimate. The standard error is calculated using the formula shown in Equation 1.

Equation 1: Standard Error Calculation for Randomized Control Trial

$$Std.Error\ of\ Difference\ between\ Means_i = \sqrt{\frac{sd_c^2}{n_c} + \frac{sd_t^2}{n_c}}$$

Where:

- *sd* = standard deviation
- *n* = sample size
- *t* = indicator for treatment group
- *c* = indicator for control group
- *i* = individual time intervals

3.4 Within-Subjects Analysis Design

Although an RCT approach has many implicit advantages that make it the preferred method for estimating impacts, it is not applicable when no valid control group is available to establish the counterfactual. In these cases, when events were called absent a control group, a within-subjects approach was used, whereby customer loads observed on similar non-event days were used to establish the counterfactual against which to compare treatment loads. This approach works because the program intervention is introduced on some days, and withheld on other days that could otherwise be considered event-worthy, allowing for comparison of load patterns with and without load control.

A key consideration of the within-subjects design is how to select a model that generates the most precise and accurate counterfactual, and by extension impacts. In many cases, multiple counterfactuals may be plausible, but result in varying estimations of impacts. Using non-event days with similar temperature conditions, regression modeling was applied to estimate the demand reduction as the difference between the predicted baseline loads and the actual event day loads. In order to identify the regression model that best predicts the counterfactual, a rigorous model selection process is applied, whereby ten distinct model specifications were tested and ranked using various accuracy and precision metrics. The best performing model was selected and used to estimate the counterfactual for actual event days. Figure 3-3 summarizes the regression model selection process.

Figure 3-3: Within-Subjects Regression Model Selection

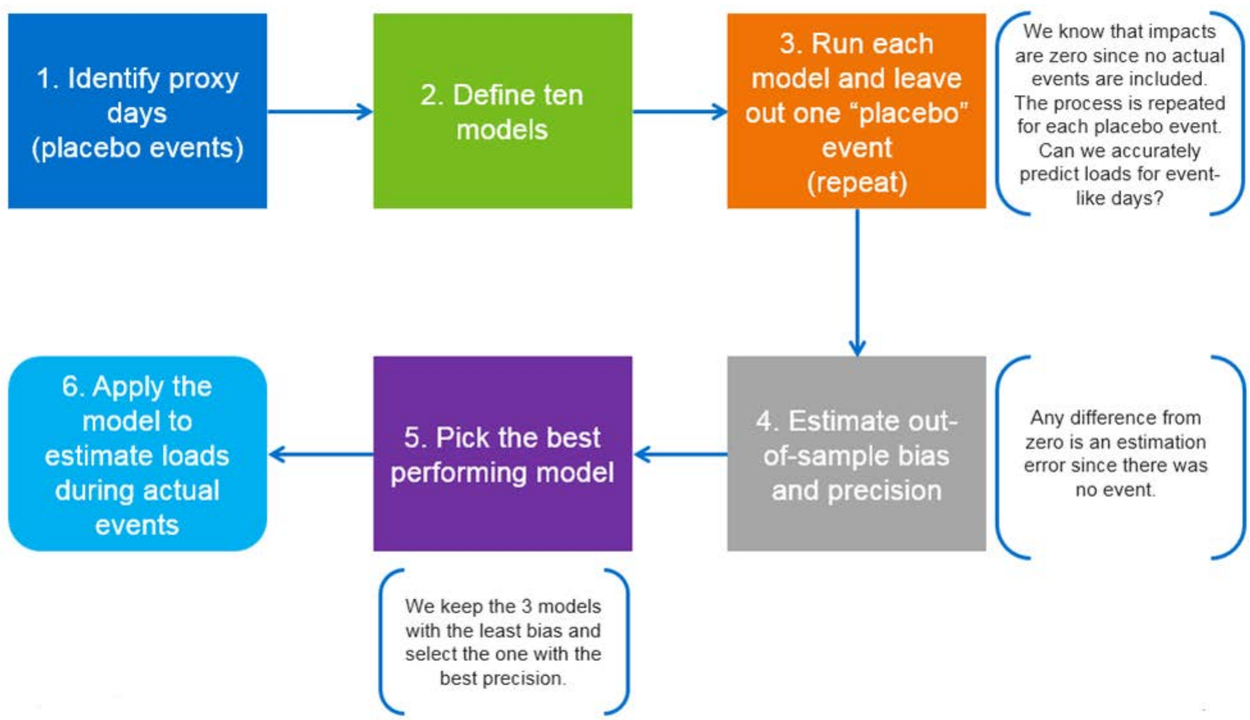


Table 3-3 summarizes metrics for bias and precision. Bias metrics measure the tendency of different approaches to over or under predict and are measured over multiple out-of-sample days. The mean percent error (MPE) describes the relative magnitude and direction of the bias.

A negative value indicates a tendency to under predict and a positive value indicates a tendency to over predict. The precision metrics describe the magnitude of errors for individual event days and are always positive. The closer they are to zero, the more precise the model prediction. The absolute value of the mean percentage error is used to select the three model candidates with the lowest bias. The coefficient of variation of the root mean square error, or CV(RMSE), metric is used to identify the most precise model from the three models with the least bias.

Table 3-3: Measures of Bias and Precision

Type of Metric	Metric	Description	Mathematical Expression
Bias	Average Error	Absolute error, on average	$AE = \frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)$
	Mean Percentage Error (MPE)	Indicates the percentage by which the measurement, on average, over or underestimates the true demand reduction	$MPE = \frac{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)}{\bar{y}}$
Precision	Root Mean Squared Error	Measures how close the results are to the actual answer in absolute terms, penalizes large errors more heavily	$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2}$
	CV(RMSE)	Measures the relative magnitude of errors across event days, regardless of positive or negative direction (typical error)	$CV(RMSE) = \frac{RMSE}{\bar{y}}$

3.5 Process Evaluation Methodology

Table 3-4: Summary of Process Evaluation Activities

Data Collection Technique	Description of Analysis Activities Using Collected Data	Sample Size	Precision / Confidence Level
Document and database review	Review of program documentation, including program manuals, customer communications, as well as the program database. These materials provide evidence of program operations, as well as how these operations are aligned with program savings and other goals.	NA	NA
Interviews of key contacts	Interviews with Duke Energy staff will document program processes, identify strengths/weaknesses and provide a foundation for understanding the customer experience.	4	NA
Post-event survey	Phone and web survey of Power Manager customers who experienced an event, to assess event awareness, satisfaction, customer experience and comfort during events, and motivations for participation.	72	90/10
Nonevent survey	Phone and web survey of Power Manager customers for whom an event was not called. Nonevent survey data provide a baseline with which to compare post-event responses, to establish levels of event awareness, satisfaction, customer experience and comfort during events, and motivations for participation.	73	90/10

The process evaluation included four primary data collection tasks in order to achieve the research objectives listed in Table 3-4.

Review program documentation and analyze program database—Process evaluation should be guided by a thorough understanding of the primary activities of any program, the marketing messages used to recruit and support participants, and any formal protocols that guide processes. For demand response programs, it is particularly important to understand the event notification procedures, any opt-out processes that exist, and how bill credits are communicated and applied. It is also important to understand how the program opportunity is communicated and the types of encouragement provided to participating households. These communications are often the source of program expectations, which can affect participant satisfaction. To support this task, Nexant requested copies of internal program manuals and guidelines as well as copies of marketing materials. The program database analysis consisted of an examination of program tenure, load curtailed per household, and other variables that inform indications of program progress.

In-depth interviews with key program stakeholders—Program stakeholders include program staff and implementation contractors with insight into program plans and operations, emerging issues, and the expected customer experience. The interviews conducted for the 2019 evaluation informed the customer survey design and confirmed the evaluation team's understanding of key program components.

Goals of the interviews included:

- Understanding marketing and recruitment efforts, including lessons learned about the key drivers of enrollment;
- Identifying "typical" Power Manager households, including characteristics of households that successfully participate for multiple years;
- Describing event processes;
- Understanding opt-out procedures;
- Confirming enrollment incentive levels and how event incentives are explained to customers;
- Understanding the customer experience;
- Identifying any numeric or other program performance goals (kW enrollment, number of households, notification timelines) established for Power Manager;
- Describing the working relationship between Duke Energy and the program implementers, including the allocation of program responsibilities; and
- Understanding emergent and future concerns, and plans to address them.

Post-event surveys—Guided by information obtained from stakeholder interviews and a review of program guidance documents (including any notification protocols), Nexant developed a survey for participating customers that was deployed immediately following a demand response event. The survey was designed to be deployed via phone and email to maximize response rate in the 24- to 48-hour window following an event. The post-event survey addressed the following topics:

- Awareness of the specific event day and comfort during the event;
- Any actions taken during the event to increase household comfort: Do participants report changing AC settings, using other equipment (including window units, portable units, or ceiling fans) to mitigate heat buildup? Were participants home during the event? Are they usually home during that time period?
- Satisfaction with the Power Manager program, the event bill credits earned, and the number of events typically called;
- Expectations and motivations for enrolling: What did participants expect to gain from enrollment? To what extent are they motivated to earn incentive payments versus altruistic motivations such as helping to address electricity shortfalls during periods of high peak demand and/or reducing the environmental effects of energy production?; and
- Retention and referral: Do participants expect to remain enrolled in the program in future years? Would they recommend the program to others?

To ensure that the survey accurately assessed the experiences of customers during a curtailment event, questions were finalized and fully programmed prior to the event, to enable deployment within 24 hours after an event. Working with Duke Energy and the impact evaluation team, Nexant prepared a random sample of participant households prior to event notification to receive the post-event survey. This sample was linked to the survey software and ready to deploy as soon as the event ended. Any participants for whom email addresses were available received an email invitation with a link to the survey URL. Up to half of the expected sample (34 households) were surveyed by phone to ensure completes by both modes and improve representativeness.

Nonevent program surveys—In addition to the post-event survey, the evaluation team prepared a survey to be deployed immediately following a hot, nonevent day. This nonevent day survey was nearly identical to the post-event survey to facilitate comparison with the results of the event day survey, with only references to specific event awareness removed. Like the post-event survey, the nonevent survey was developed, approved, and programmed prior to the demand response season to enable immediate deployment on a sufficiently comparable nonevent day. The nonevent survey sample was developed prior to the demand response season and linked to the programmed survey. Similar to the post-event survey, a survey link was sent via email to participants with email addresses, simultaneous with the phone deployment, improving the representativeness of the sample.

4 Randomized Control Trial Results

One of the primary goals of the impact evaluation is to understand the load impacts associated with the Power Manager program under a variety of temperature and event conditions. General population events were targeted to understand the available load reduction capacity under a variety of temperature conditions during normal operations, while emergency shed events were used to demonstrate the program's capacity for shorter duration events under more extreme conditions. In addition, three of the event days were used for experimental events intended to answer specific research questions. Section 4.1 presents overall program results for all event days, including general population and emergency shed events. Section 4.2 details the results of the research events. Section 4.3 investigates weather sensitivity of impacts for 2019 RCT events.

4.1 Overall Program Results

The load impact estimates resulting from the RCT analysis for the general population events and research events are presented in Table 4-1. The load impacts presented for each event, along with their confidence intervals, are the average per household changes in load during the indicated dispatch windows. Results for the jurisdiction wide emergency event called on August 9, as well as the general population event September 9 event, are presented separately in Section 5.

Table 4-1: Randomized Control Trial per Customer Impacts

Event Date	Shed Type	Event Period	Reference Load	Impact (kW)	90% Confidence		% Impact	90%Confidence		Max Event Temp
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
7/15/2019	Normal	4:00PM - 6:00PM	3.65	-0.92	-0.96	-0.88	-25.2%	-24.1%	-26.2%	91.3°F
7/19/2019	Emergency	4:00PM - 4:30PM	3.60	-1.09	-1.13	-1.05	-30.4%	-29.3%	-31.5%	92.6°F
8/19/2019	Normal	12:00PM - 1:00PM	2.84	-0.58	-0.63	-0.53	-20.4%	-18.7%	-22.1%	89.9°F
	Normal	2:00PM - 3:00PM	3.33	-0.65	-0.70	-0.60	-19.6%	-18.1%	-21.2%	91.3°F
9/12/2019	Normal	3:00PM - 6:00PM	3.43	-0.75	-0.78	-0.71	-21.8%	-20.7%	-22.9%	92.9°F
9/17/2019	Normal	12:00PM - 1:00PM	2.11	-0.29	-0.33	-0.25	-13.8%	-11.7%	-15.9%	88.3°F
	Normal	2:00PM - 4:00PM	2.77	-0.37	-0.43	-0.32	-13.4%	-11.5%	-15.3%	89.6°F
	Normal	4:00PM - 6:00PM	3.14	-0.68	-0.72	-0.64	-21.8%	-20.5%	-23.0%	89.5°F
	Normal	6:00PM - 7:00PM	3.16	-0.55	-0.61	-0.50	-17.5%	-15.7%	-19.2%	87.1°F
9/26/2019	Normal	4:00PM - 6:00PM	2.94	-0.58	-0.62	-0.55	-19.8%	-18.6%	-21.1%	89.0°F
Average General Population Event			**3.32**	**-0.73**	**-0.79**	**-0.68**	**-22.0%**	**-20.3%**	**-23.6%**	**90.4°F**

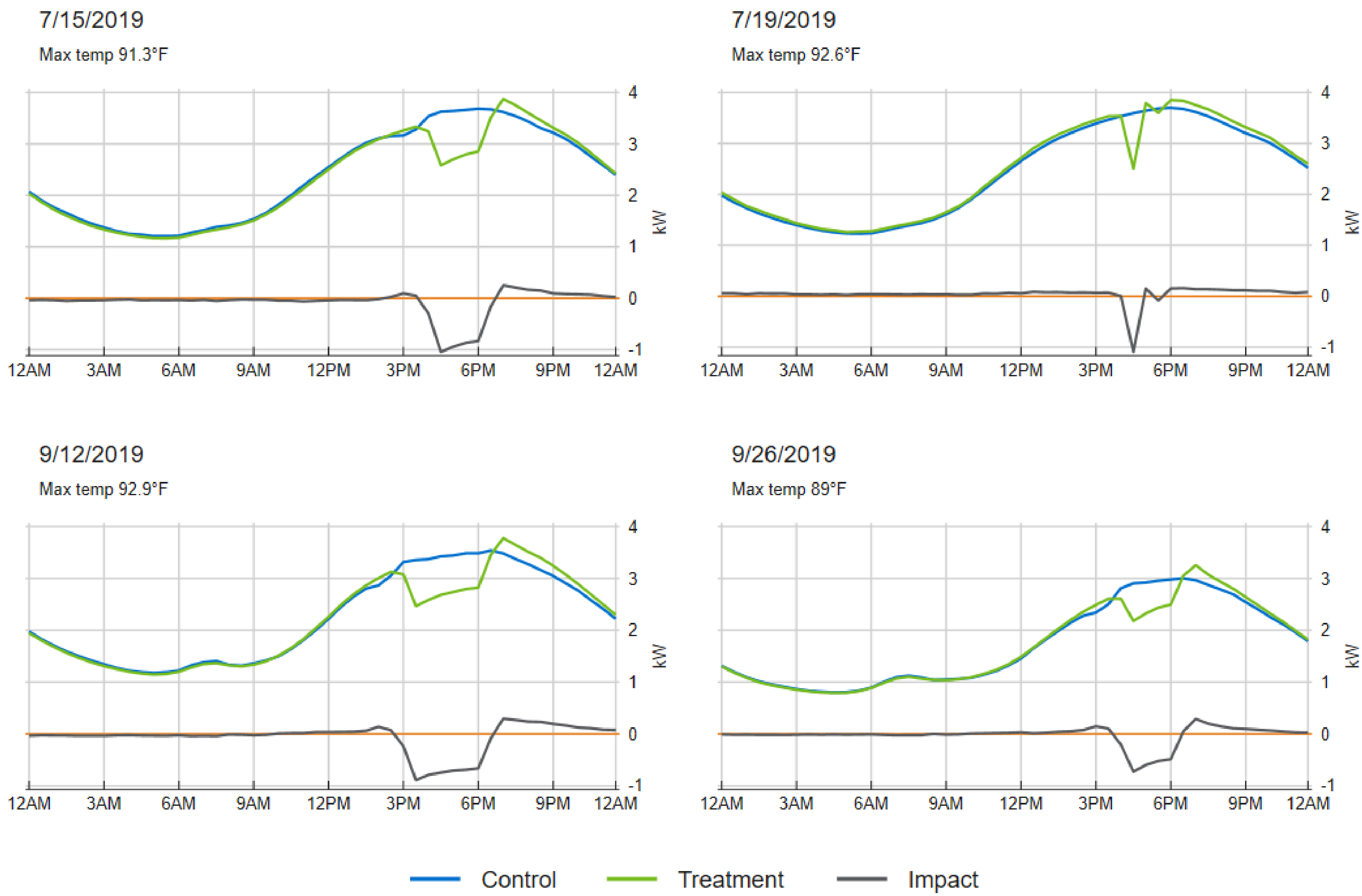
Overall load impacts for the average customer ranged between 0.58 kW and 0.92 kW during normal operations. The emergency shed event produced higher load impacts compared to general population events, with an average per household impact of 1.09 kW.

At least 5% of the population was held back as a control group during each event (excluding the jurisdiction-wide emergency test event) in order to establish the baseline. While withholding a control group is an essential component of the RCT research design, it adversely affects the aggregate performance of the program, since customers being withheld do not contribute load reduction to the total impact. In order to extrapolate the total load reduction achieved by the entire program during a given event, the average per household impact is multiplied by the total number of enrolled participants. For example, had all program customers been dispatched under normal operation on July 15, the program would have delivered approximately 208 MW load reduction. If instead, all customers had been dispatched using emergency operations on July 19, the aggregate program impact would have been 246 MW.

The RCT results implicitly take device inoperability (and other offsetting factors) into account. Because randomized group assignment was utilized effectively, each of the individual test groups accurately represents the overall percentage of customers with inoperable devices from among the entire population. As such, the estimated load impacts are appropriately de-rated by the inherent equivalence of non-working devices included in each of the test groups, and do not require any independent adjustment to account for device inoperability.

Event impacts are displayed graphically in Figure 4-1, with the average customer load profiles shown for the treatment and control groups. In Figure 4-1, the blue line represents the average load from control group customers, the green line reflects average load of the customers participating in the event, and the black line shows the average load impact (the difference between the control group and participant customer loads). All of the events show a clear drop in treatment group loads during the event dispatch period, as well as a small snapback in energy usage during the hours immediately following the events. Furthermore, most events show an instantaneous and prominent load drop during the first 30-minute interval of the dispatch period, underpinning the immediate, collective response of the load control devices once the event signal is received.

Figure 4-1: Average Customer Loads and Impacts for RCT Event Days



4.2 Comparison of Impacts by Event Start Time

Two events in 2019 were called in a cascading fashion, designed to assess the effect of dispatch time on event impacts. Cascading events are characterized by a rotating sequence of discrete events, where individual groups are dispatched separately at different times throughout the day. The design of these events allows for a comparison of achievable impacts at different times of day.

The first event, called on August 19, involved two separate dispatches at 12:00PM and 2:00PM, respectively. Although it was intended to include various other dispatch groups at other times, the sequence was ended early due to inclement weather that caused a sudden drop in temperatures throughout the service territory. Despite this, Nexant was able to generate useable impacts for the two events dispatched. The second series of cascading events was called on September 17 and included four distinct events called at varying times between 12:00PM and 6:00PM. Impacts for each of these days are presented together in Figure 4-2.

Figure 4-2: Load Profiles for Cascading Operations on August 19 and September 17

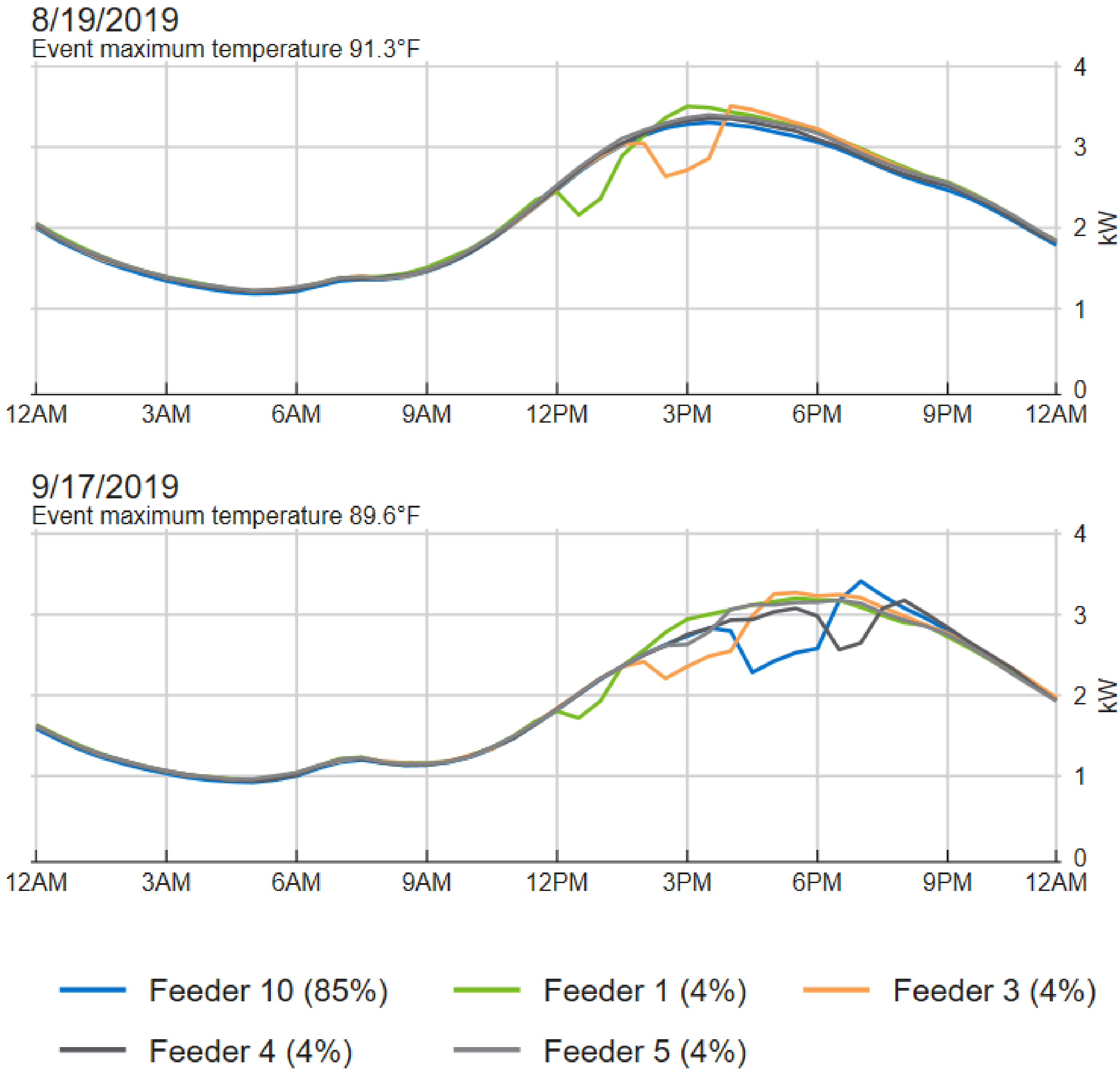


Table 4-2 summarizes impacts by event dispatch time resulting from the two cascading event days observed in 2019, based on available data. A key takeaway from the cascading comparisons is that the customers dispatched outside of peak hours (4:00PM to 6:00PM) appear to have produced load impacts that are smaller than the customers dispatched during the peak period. Nonetheless, the program generates discernible impacts throughout the afternoon.

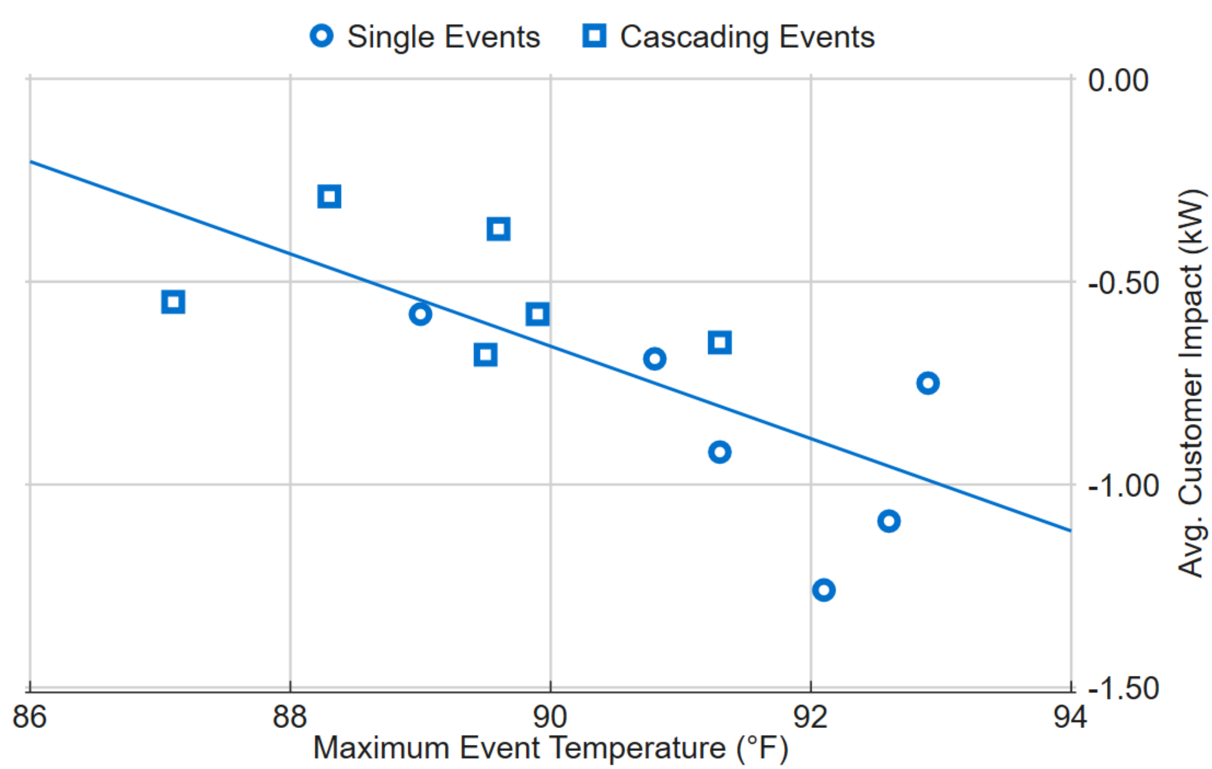
Table 4-2: Average Impacts by Event Start Time (2019)

Event Time	Average per Household Impacts		
	Aug 19	Sept 17	Average
12PM - 1PM	-0.58 kW	-0.29 kW	-0.44 kW
2PM - 4PM	-0.65 kW[11]	-0.37 kW	-0.51 kW
4PM - 6PM	n/a	-0.68 kW	-0.68 kW
6PM - 7PM	n/a	-0.55 kW	-0.55 kW

4.3 Weather Sensitivity of AC Load and Demand Reductions

The load reduction capacity of Power Manager is dependent on weather conditions, as shown in Figure 4-3. The plot shows the estimated average customer impact for each event as a function of daily maximum temperature. There is a distinct correlation between higher temperatures and greater load reduction capacity, with the general trend being higher impacts on hotter days. Cascading impacts similarly trend towards higher impacts during hotter conditions.

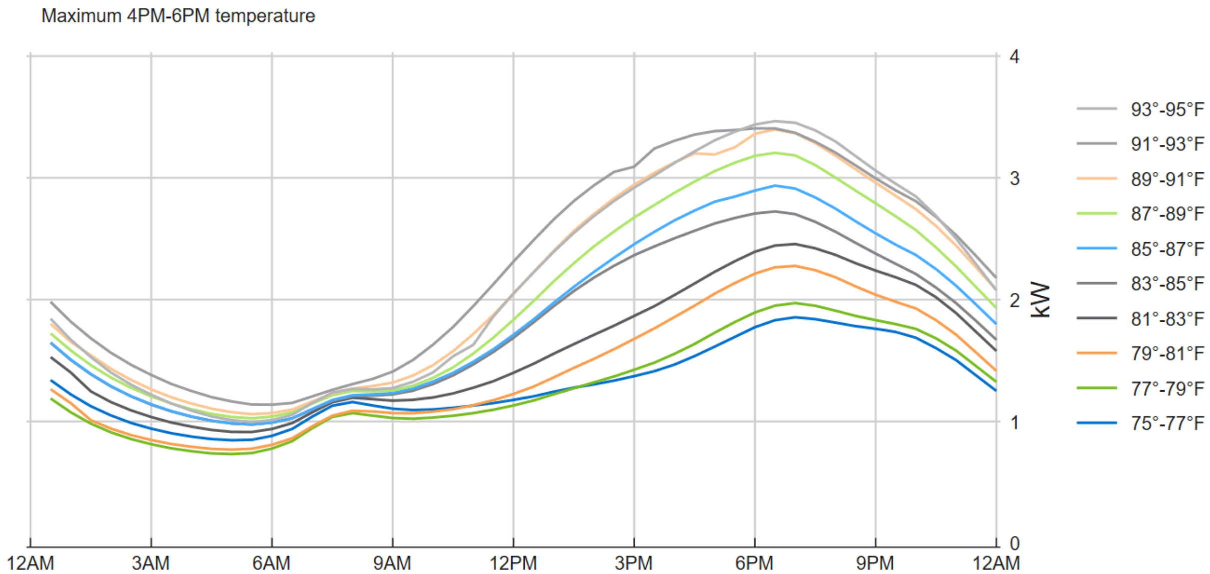
Figure 4-3: Weather Sensitivity of Impacts for Cascading and General Population Events



[11] Impacts for period 2:00PM to 3:18PM; event ended early due to inclement weather.

Both demand reductions and air conditioner loads grow with hotter temperatures. Figure 4-4 shows the weather sensitivity of whole house load for the average customer in Power Manager. All nonevent weekdays where temperatures reached at least 75°F between 4:00PM and 6:00PM were classified into two-degree temperature bins. The plot shows how the loads vary by hour as temperatures grow hotter.

Figure 4-4: Whole-House Loads by Temperature



The key finding is simple: demand reductions grow larger in magnitude when temperatures are hotter and resources are needed most. Because peak loads are driven by central air conditioner use, the magnitude of air conditioner loads available for curtailment grows in parallel with the need for resources. Not only are air conditioner loads higher, but the program performs at its best when it is hotter.

4.4 Key Findings

A few key findings are worth highlighting:

- Demand reductions were 0.73 kW per household for the average general population event.
- The 30-minute emergency shed event produced load impacts of 1.09 kW.
- Load impacts grow as events are called later in the day and closer to the residential system peak.
- Demand reductions grow when temperatures are hotter and resources are needed most.

5 Within-Subjects Results

In addition to the normal and emergency shed events described in Section 4, two events were called in 2019 that could not be estimated using an RCT approach. This first of these events was a jurisdiction-wide emergency shed test event, called to assess the full extent of program capability for demand reduction under emergency conditions. Under this scenario, the full program population is dispatched for the event and no customers are withheld as a control group. The second event, a general population event on September 9, lacked a valid control group due to dispatch programming error. Absent a control group for these events, Nexant employed a within-subjects analysis approach in order to quantify impacts. The analysis approach used is described in detail in Section 3.4. Table 5-1 summarizes impacts for each within-subjects event.

Table 5-1: Within-Subjects per Customer Impacts

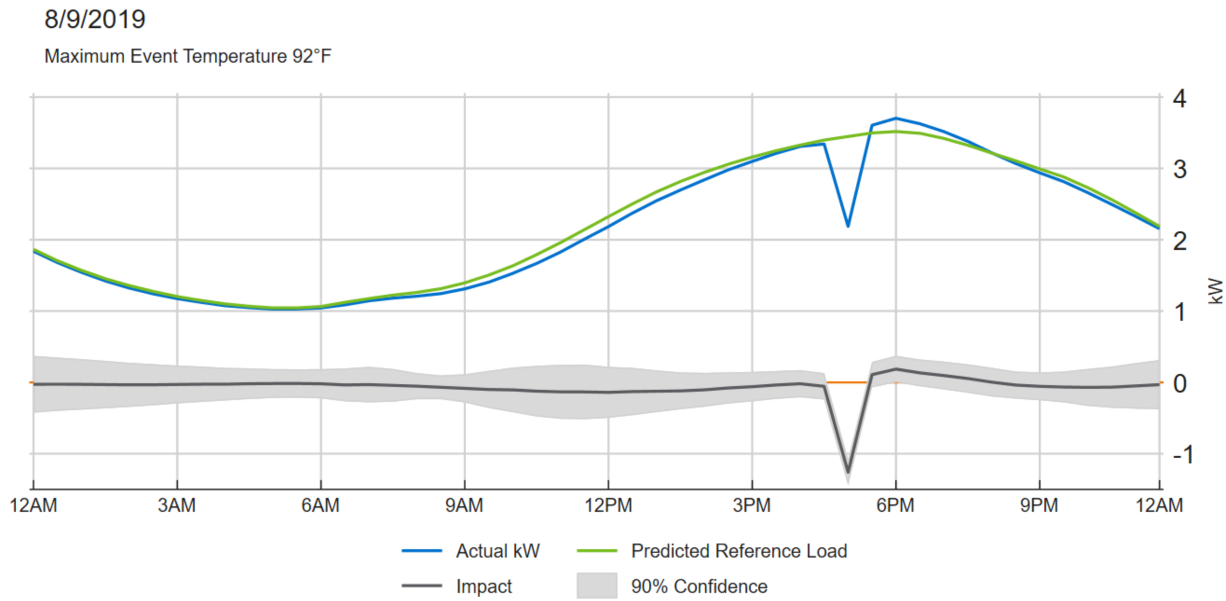
Event Date	Shed Type	Event Period	Reference Load	Impact	90% Confidence		% Impact	90%Confidence		Max Event Temp
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
8/9/2019	Emergency	4:30PM - 5:00PM	3.45	-1.26	-1.08	-1.45	-36.6%	-31.2%	-41.9%	92.1°F
9/9/2019	Normal	4:00PM - 6:00PM	3.26	-0.69	-0.58	-0.79	-21.1%	-17.9%	-24.3%	90.8°F

5.1 Within-Subjects Event Impacts

For each of these two events, a different set of proxy days was selected and used to generate the baseline loads through the process summarized in Figure 3-3. In this way, baselines were found that closely resembled the load patterns of the treatment groups during non-event hours, and accurately simulate the event period loads absent curtailment, i.e. the counterfactual.

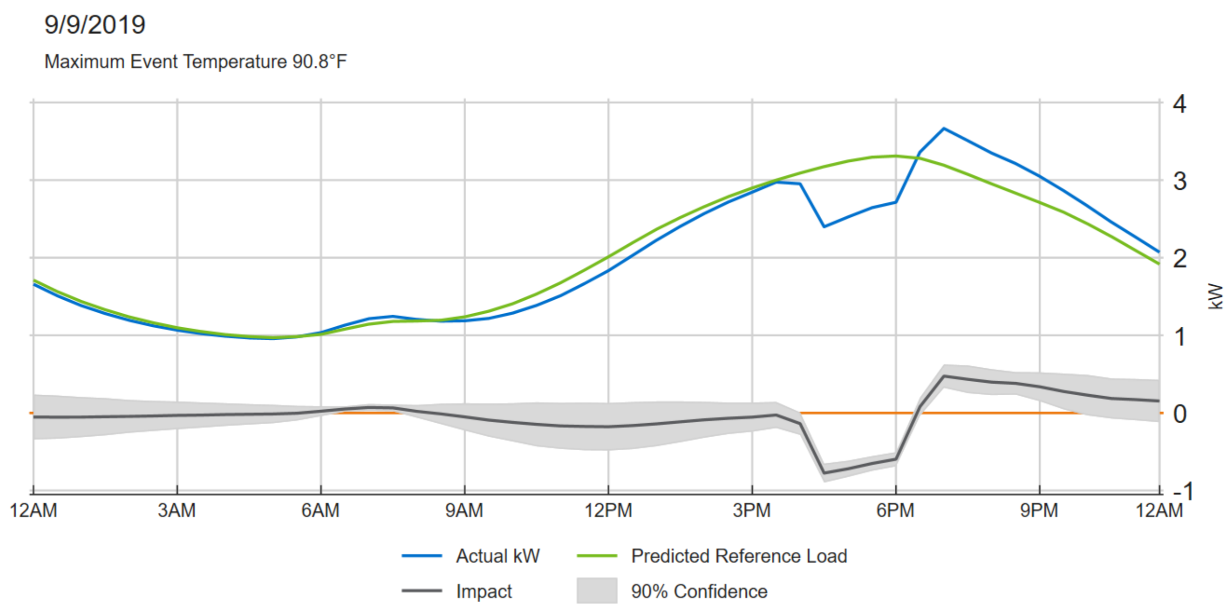
Load impacts for the August 9 and September 9 events are shown in Figure 5-1 and Figure 5-2, respectively. The average per household impact for emergency shed on August 9 was estimated to be 1.26 kW across the event period.

Figure 5-1: Within-Subjects Load Impacts for August 9 Emergency Event



Load impacts for the September 9 general population event were estimated to be 0.69 kW. This impact estimate is consistent with the impacts for the other normal shed events estimated via RCT.

Figure 5-2: Within-Subjects Load Impacts for September 9 Event



5.2 Key Findings

- The within-subjects methodology produced accurate reference loads against which to compare treatment loads, leading to highly reliable impact estimates.
- The normal shed event on September 9 produced impacts of 0.7 kW per household, roughly in line with impacts found for normal shed events via RCT.
- The 30-minute emergency shed event called on August 9 produced impacts of 1.26 kW per household, representing the largest single event impacts of 2019.

6 Demand Reduction Capability

A key objective of the 2019 impact evaluation was to quantify the relationship between demand reductions, temperature and hour of day. This was accomplished by estimating loads under historical weather conditions and applying observed percent load reductions from the 2019 events. The resulting tool, referred to as the time-temperature matrix, allows users to predict the program's load reduction capability under a wide range of temperatures and event conditions.

In Section 6.2, Nexant presents estimated load reduction capability of the program under two similar but distinct scenarios. The key difference between the two scenarios is the use of event period temperatures (i.e. the maximum system temperature observed *during the event period*) vs. maximum daily temperature (i.e. the maximum temperature observed *during the 24-hour event day*). Reasons for offering both scenarios are twofold: first, Duke Energy may select the findings they deem most suitable for regulatory reporting, internal dissemination, and/or other messaging needs, as well as ensure consistency in reported metrics across historical evaluations and/or jurisdictions. Second, by applying both event period temperatures and maximum daily temperatures, Nexant was able to report impacts for a wider range of extreme temperature conditions, supported by data observed during the 2019 program season.

In an ideal program year, a large number of events would be called under a variety of different weather conditions, dispatch windows and cycling strategies so that demand reduction capability could be estimated for a wide range of operating and planning scenarios. In actuality, opportunities for program events can be sporadic, and based on uncertain weather projections, such that they occur infrequently and under fairly similar conditions. In 2019, events were called under a somewhat narrow range of temperature conditions, with maximum temperatures events ranging from 87°F to 93°F. Additionally, no events reached the 100°F target used for estimating program capability. As a result, the ability to predict demand reduction capability across a broader range of conditions – particularly during extremely hot days – was somewhat inhibited.

6.1 Methodology

Figure 6-1 illustrates the weather sensitivity trends of percent load impacts and peak household demand on hot, non-event days. The figure, based on actual 2019 customer load data, shows that Power Manager demand reductions grow on a percentage basis as temperatures increase. At the same time, peak household loads available for curtailment also increase with temperature. The implication is that larger percent reductions are attainable from larger loads, when temperatures are hotter.

Figure 6-1: Weather Sensitivity of Percent Load Impacts and Household Loads

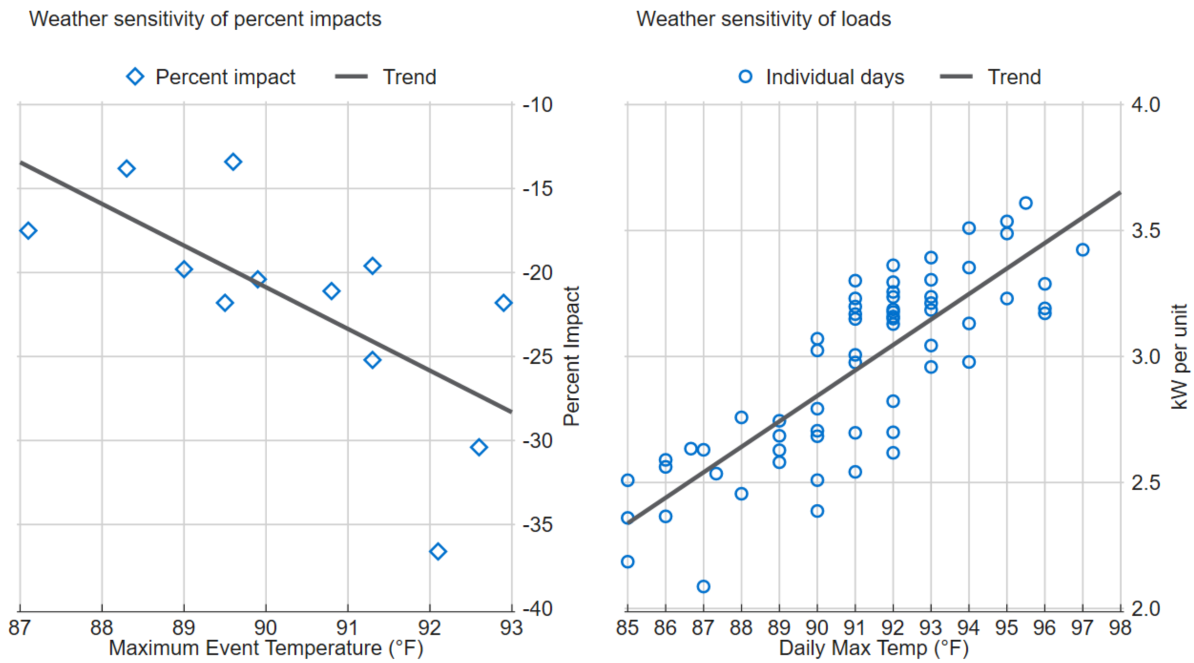
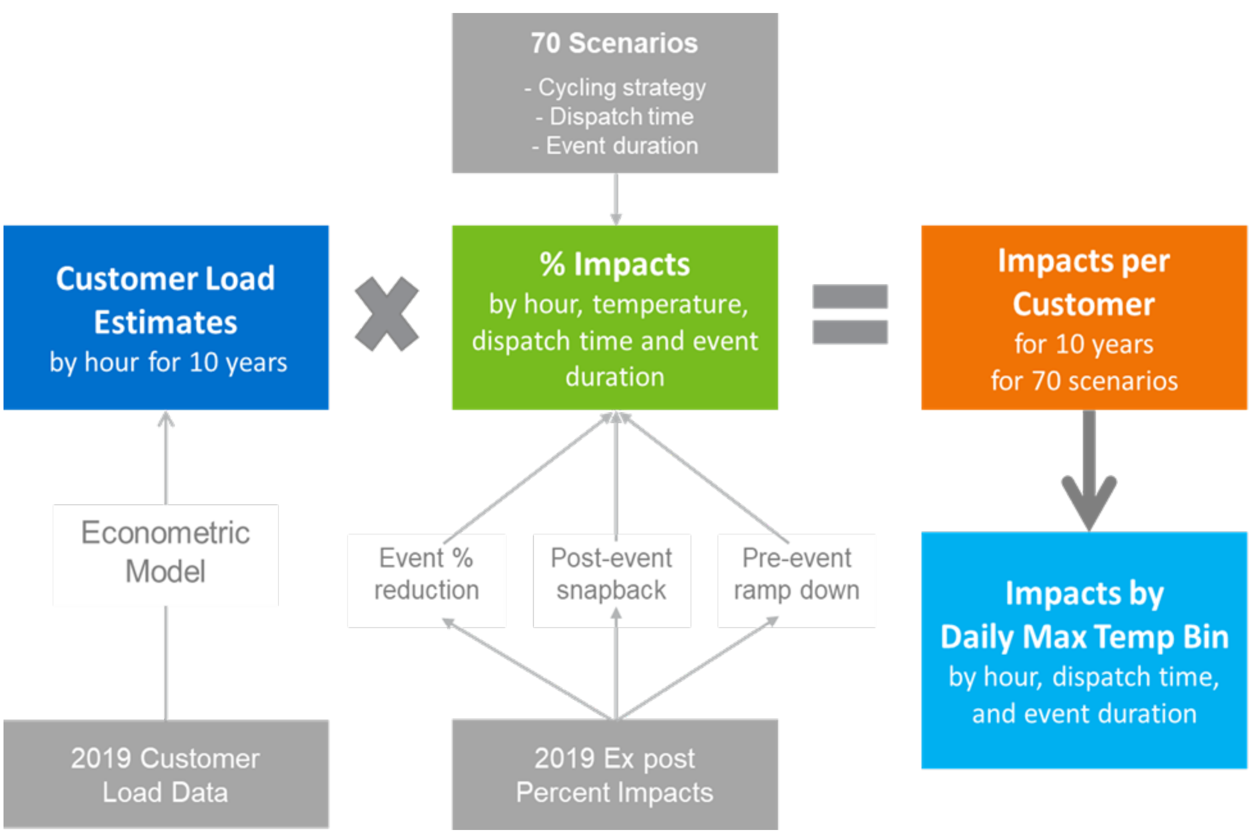


Figure 6-2 summarizes the process used to develop the 2019 time-temperature matrix for estimating demand reduction capability under various scenarios.

Figure 6-2: Time Temperature Matrix Development Process



The process depicted in Figure 6-2 was completed twice to produce two separate versions of the tool using each of the two temperature metrics. The process for each iteration involved the following primary components:

- Estimates of customer loads were developed by applying 2019 AMI data to the same regression models used to estimate impacts. All weekdays with daily average temperatures above 70˚F were included in the models. The 2019 usage patterns were applied to actual weather patterns experienced over the past ten years rather than hypothetical weather patterns.
- Estimates of the percent reductions were based on three distinct econometric models: load control phase-in, percent reductions during the event, and post-event snapback. The models were based on the percent impacts and temperatures experienced both during the event periods and throughout the event days.
- A total of 70 scenarios were developed to reflect various cycling/control strategies, event dispatch times, and event lengths.
- Estimated impacts per customer were produced by combining the estimated household loads, estimated percent reductions, and dispatch scenarios. The process produced estimated hourly impacts for each hot weekday during 2010-2019 under 70 scenarios.
- Multiple days were placed into 2-degree temperature bins and were averaged to produce an expected load reduction profile for each temperature bin.

6.2 Demand Reduction for Emergency Conditions

While Power Manager is typically dispatched for economic or research reasons, its primary function is to deliver demand relief during extreme conditions, when demand is high and capacity is constrained. Extreme temperature conditions can trigger emergency operations, which are designated to deliver larger demand reductions than normal event cycling. During emergency conditions, all program devices are instructed to instantaneously shed loads. While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager. A 1-hour emergency event starting at 4:00 PM and with a maximum temperature of 100°F during the event is provided in Figure 6-3. Under these conditions, individual customers are expected to deliver 1.54 kW of demand reduction over a one-hour event window. Because there are approximately 238,000 customers enrolled in Power Manager, the expected aggregate reduction is 365.4 MW.

Figure 6-3: Demand Reduction Capability – 100°F Event Period Temperature

Inputs	
Dispatch Type	Emergency Dispatch
Event Start Time	4 PM
Event Duration	1
Event Period Max Temp	100
# Customers	238,000

Event Window Average Impacts		
Load without DR	4.12	kW per customer
Load with DR	2.58	kW per customer
Impact per Customer	-1.54	kW per customer
Program Impact	-365.4	MW
% Impact	-37.3	%

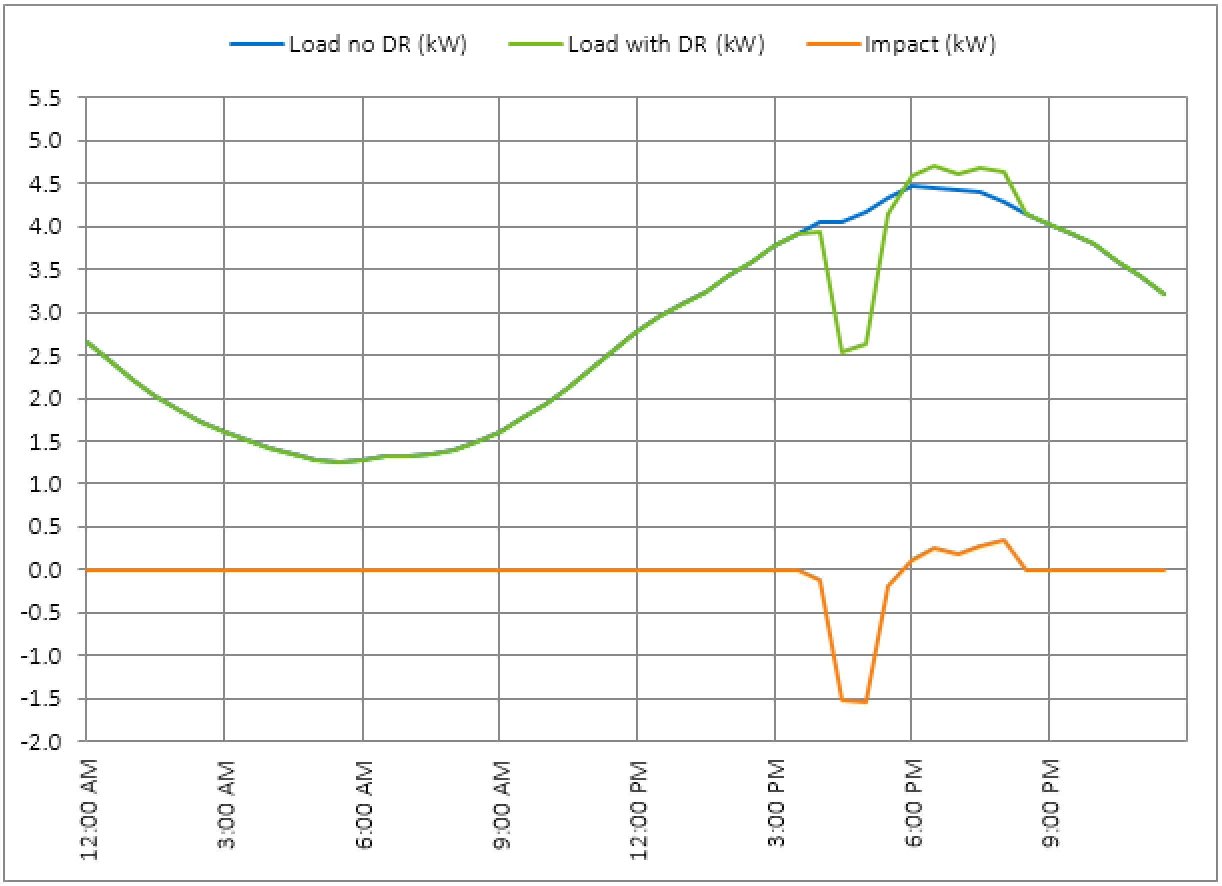


Figure 6-4 presents estimated load reduction capability under similar, but slightly different conditions. The distinction in Figure 6-4 is that impacts are estimated using daily maximum temperatures rather than event period temperatures. Stated another way, the estimates presented in Figure 6-4 assume that a temperature of 100°F was reached at some point during the event day but not necessarily during the event period, while the scenario shown in Figure 6-3 assumes that 100°F was reached during the 1-hour event. While this distinction may seem trivial, the implications for demand impacts are noteworthy. Per customer and aggregate program impacts using a 100°F daily maximum temperature are 1.13 kW and 269 MW, respectively.

Figure 6-4: Demand Reduction Capability – 100°F Daily Maximum Temperature (2019)

Inputs	
Dispatch Type	Emergency Dispatch
Event Start Time	4 PM
Event Duration (hours)	1
Maximum Daily Temperature	100
# Customers	238,000

Event Window Average Impacts		
Load without DR	3.65	kW per customer
Load with DR	2.52	kW per customer
Impact per Customer	-1.13	kW per customer
Program Impact	-269.0	MW
% Impact	-30.9	%

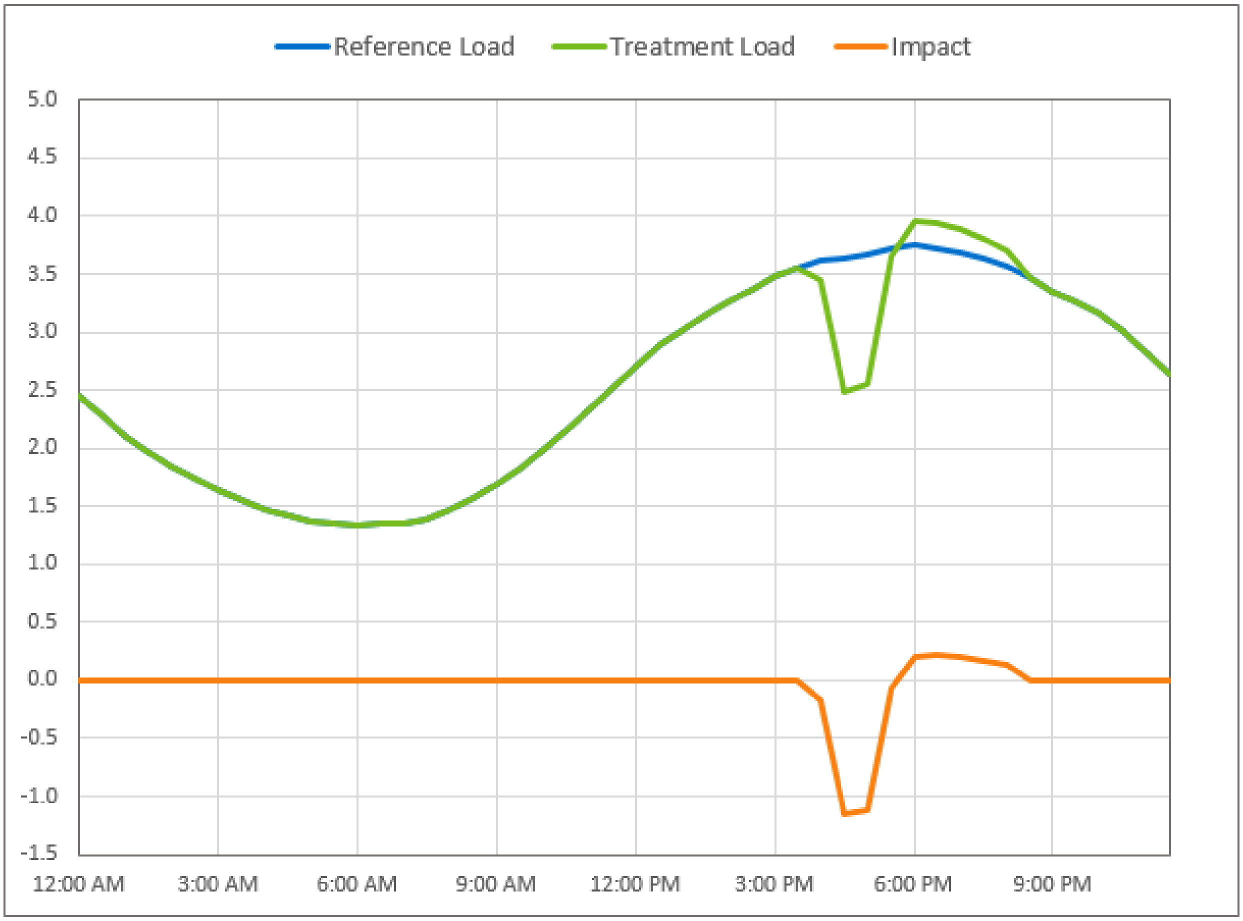


Table 6-1 displays the expected impacts for various event start times and maximum daily temperature conditions, given an emergency event with a one hour duration. The estimates shown are derived from the time-temperature matrix, and are therefore reliant on the empirical data observed during the 2019 program season. As such, the completion of Table 6-1 in its entirety required the use of daily maximum temperatures, rather than event period temperatures, as the conditional input for estimating impacts. Because none of the 2019 events experienced certain of the more extreme temperatures shown in Table 6-1, the time-temperature matrix was limited in its ability to predict loads under these conditions.

Table 6-1: Per Customer Impacts by Daily Maximum Temperature and Event Start Time (2019)

Daily Max Temperature	Event Start Time				
	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM
90°F	-0.56 kW	-0.66 kW	-0.75 kW	-0.80 kW	-0.82 kW
92°F	-0.63 kW	-0.74 kW	-0.82 kW	-0.87 kW	-0.90 kW
94°F	-0.74 kW	-0.86 kW	-0.94 kW	-0.97 kW	-0.98 kW
96°F	-0.77 kW	-0.89 kW	-0.97 kW	-0.99 kW	-1.02 kW
98°F	-0.85 kW	-0.99 kW	-1.09 kW	-1.11 kW	-1.15 kW
100°F	-0.88 kW	1.03 kW	-1.12 kW	-1.13 kW	-1.16 kW
102°F	-0.88 kW	-1.01 kW	-1.12 kW	-1.18 kW	-1.27 kW
104°F	-1.04 kW	-1.25 kW	-1.42 kW	-1.47 kW	-1.56 kW

Impacts increase as temperatures increase and as the event starts later in the day. Impacts increase with a later event start time because reference loads are generally increasing from 1:00 PM to 5:00 PM during the summer. In practice, event day impacts may vary due to unique weather patterns or day characteristics

6.3 Key Findings

Key findings from the development of the time-temperature matrix include:

- While emergency operations are rare and ideally avoided, they represent the full demand reduction capability of Power Manager.
- Power Manager demand reductions grow on a percentage basis as temperatures increase, and with deeper cycling. At the same time, peak household loads available for curtailment also increase with temperature.
- If emergency shed becomes necessary on a day where the maximum temperature during the event is 100°F, Power Manager can deliver 1.54 kW of demand reductions per household during a 1-hour event.
    - If 100°F is reached at some point during the day, but not necessarily during the event dispatch, Power Manager can deliver 1.13 kW of load reduction per household.
- Because there are approximately 238,000 Power Manager customers, the expected aggregate reductions total 365.4 MW under 100°F event period temperatures.
    - Aggregate load reductions are estimated to be 269 MW under 100°F daily maximum temperature conditions.
- The event start time also influences the magnitude of reductions which, generally, are larger during hours when customer loads are highest.

7 Process Evaluation

Process evaluation, particularly when combined with the insight obtained from impact evaluation, informs efforts to continuously improve programs by identifying program strengths and weaknesses, opportunities to improve program operations, program adjustments likely to increase overall effectiveness, and sources of satisfaction or dissatisfaction among participating customers. The primary objectives for the process evaluation component of the evaluation include:

- Assessing the extent to which participants are aware of events, bill credits, and other key program features;
- Understanding the participant experience during events: comfort, occupancy, thermostat adjustments, and strategies employed to mitigate heat;
- Identifying motivations and potential barriers for participation, including expectations, sources of confusion or concern, intention to stay enrolled, and likelihood of recommending the program to others;
- Documenting the operations, recruitment, enrollment, outreach, notification, and curtailment activities associated with program delivery; and
- Identifying program strengths and potential areas for improvement.

7.1 Survey Disposition

Nexant developed a survey for customers participating in the Power Manager program that was deployed immediately following a Power Manager event. In addition to the post-event survey, a nonevent survey was also deployed on a hot, nonevent day. This nonevent day survey was identical to the post-event survey to establish a baseline and facilitate comparison with the results of the event day survey. Both the event and nonevent surveys were administered to Power Manager participants. The survey was administered via phone and web to maximize response rates during the 24 hour window directly following a Power Manager event. The survey addressed the following topics:

- Awareness of the specific event day, including reasons for event day awareness (e.g. increased temperature in home, etc.)
- Levels of comfort, and any actions that increased household comfort during a Power Manager event. Do participants report changing AC settings, using other equipment (including window units, portable units, or ceiling fans) to mitigate heat buildup? Were participants home during the event? Are they usually home during that time period?
- Satisfaction with the Power Manager program and its attributes.
- Expectations and motivations for enrolling. What did participants expect to gain from enrollment? To what extent are they motivated to earn incentive payments versus altruistic motivations such as helping to address electricity shortfalls during periods of high peak demand and/or reducing the environmental effects of energy production?

- Do participants expect to remain enrolled in the program in future years? Would they recommend it to others?

Since event awareness and thermal comfort are primary areas of inquiry for the survey, the nonevent baseline data (from non-event, baseline group surveys) provides the opportunity to net out any propensity for thermal discomfort or belief that a Power Manager event is occurring that would naturally happen on any hot day of the summer. In this way, it is possible to evaluate whether statistically significant differences in event awareness and reports of thermal discomfort exist between customers who actually experience a Power Manager event and customers who do not.

The survey was completed by 74 customers on an event day (the event group) and 71 customers on a hot nonevent day (the nonevent or baseline group). All surveys were conducted on the day of the event or the nonevent. The overall response rate was 4.9%. The survey plan was to survey about 50% of respondents by phone and 50% via the web, but on the event day more people were reached by telephone than expected. The distribution of responses across modes, with response rates, is shown in Table 7-1. All responses in this section summarizing survey results have been weighted to reflect the survey design for 50% of completions by phone and web each. The high temperature on the event day was 92°F, but the system average temperature during the event period was 89°F due to rain in certain parts of the service area, while the maximum and average heat indexes were 97°F and 95°F, respectively.

Table 7-1: Survey Disposition

<table>
<tr><th>Total Survey Responses</th><th>Survey Responses by Group</th><th>Date</th><th>Temperature</th><th>Phone/ Web Distribution</th><th>Response Rate</th></tr>
<tr><td rowspan="4">145 Responses</td><td rowspan="2">74 Event Responses</td><td rowspan="4">Monday, July 15, 2019</td><td rowspan="4">High 92 °F
(avg. event temp. 89 °F)</td><td>70% Phone</td><td>5.9%</td></tr>
<tr><td>30% Web</td><td>3.4%</td></tr>
<tr><td rowspan="2">71 Baseline Responses</td><td>79% Phone</td><td>5.4%</td></tr>
<tr><td>21% Web</td><td>4.2%</td></tr>
</table>

A majority of households surveyed have two or fewer residents, and 11% of event and 14% of nonevent baseline households have four or more residents. Ninety-five percent of those who responded to a question on home ownership noted that they were homeowners. There was no difference in the age of respondents between the event and nonevent baseline groups; the mean age of respondents is 59. Not including those who did not answer the question, the most commonly reported level of education was a bachelor's degree: 31% of respondents said that they graduated from college. Nearly as many (27%) have some college or an associate's degree and 20% have a graduate or professional degree.

7.2 Program and Event Awareness

The customer surveys were designed with the key objective of evaluating participants' awareness of Power Manager events, but a few questions were also included to gauge participants' general awareness of the program and its key features. Every respondent who was contacted to complete the survey was a Power Manager participant at the time of the survey, and a majority of the respondents, 72%, reported that they are familiar with the Power Manager program.

Every Power Manager participant who was randomly selected to receive the post-event survey (the event group), experienced an actual Power Manager event that day, Monday, July 15. A total of 74 customers completed the post-event survey. A minority, 18%, of event group respondents reported that their homes were uncomfortable that day, while all of them experienced a load control event that afternoon. As a program with no pre-event notification, a decrease in thermal comfort in the home is the key factor for assessing event awareness. In North Carolina, with only 18% of respondents stating that they were uncomfortable on the day that they were surveyed, event awareness by that measure is quite low. However, it could also be that a number of those respondents would say that their home was uncomfortably hot at times on any hot day of the year, regardless of whether or not the Power Manager program had a load control event. To control for this possibility, another randomly selected group of Power Manager participants were also surveyed on Monday, July 15. Unlike the other group of surveyed participants, these customers had been pre-selected at the outset of the season to not be dispatched for load control. A total of 18% of respondents reported that their home was uncomfortable on this day, when they had not actually experienced a Power Manager event that day. There is no difference in the percentage of respondents in the post-event survey and the nonevent survey that stated that their homes were uncomfortable that day, so we have no evidence to support the hypothesis that the Power Manager event caused customers any additional discomfort that they would not have experienced or perceived anyway. The response frequencies are tabulated in Table 7-2.

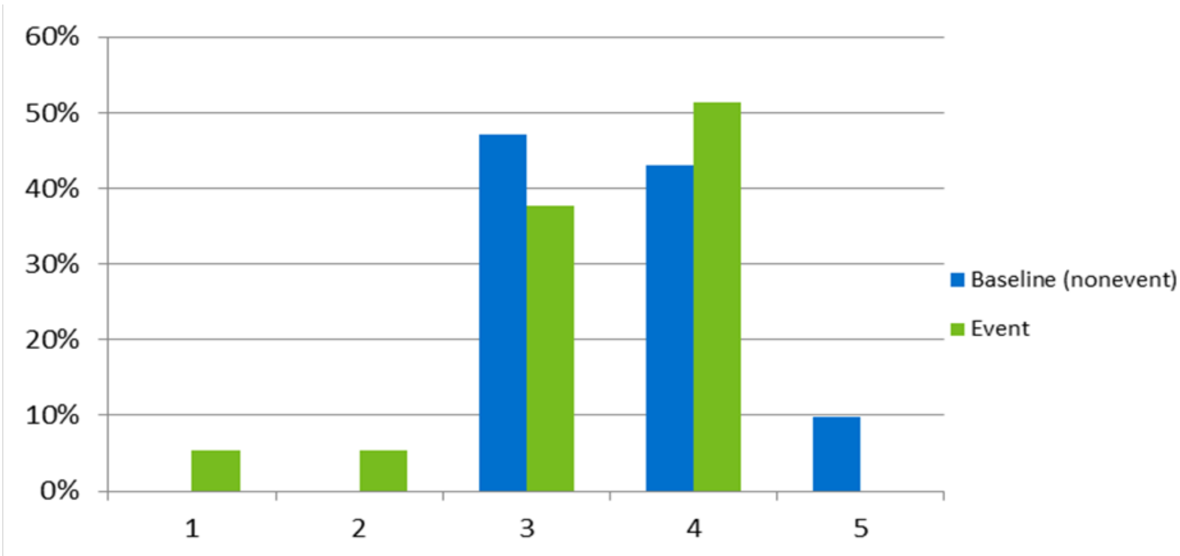
Table 7-2: "Was there any time today when the temperature in your home was uncomfortable?" Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73

Response	Event	Baseline (Nonevent)
Yes	18%	18%
No	72%	69%
Don't know	10%	13%

Of those relatively few customers (13 event and 11 baseline survey respondents) who reported that they were uncomfortable at some time during the day of the survey, almost half (11 respondents) reported becoming uncomfortable between 3:00 and 5:00 pm. The rest were distributed throughout the day, from 12:00 pm to 6:30 pm. Asked when the period of thermal discomfort in their home ended, there was a shift in responses towards later in the day, with 15 respondents reporting that their homes stopped feeling uncomfortable between 6:00 and 8:00 pm. Five respondents listed times earlier than 6:00 pm, and four respondents said their homes stopped being uncomfortable at 10:00 pm or later.

These customers who reported thermal discomfort were also asked to rate their discomfort using a five point scale, where 1 represents "not at all uncomfortable" and 5 represents "very uncomfortable." Frequencies of the responses are summarized in Figure 7-1; the chi-squared statistical test shows no discernable difference in the distributions of event and baseline survey responses (at the 90% level of confidence). In sum, there is no discernable difference in levels of thermal discomfort between the event group and the baseline group. The survey does not present evidence that Power Manager events led to more customers reporting discomfort in their homes, or to higher levels of discomfort.

Figure 7-1: Please rate your discomfort using a scale of one to five, where one means "not at all uncomfortable" and five means "very uncomfortable." Response Frequencies Weighted by Mode, N_t = 13 and N_c = 11



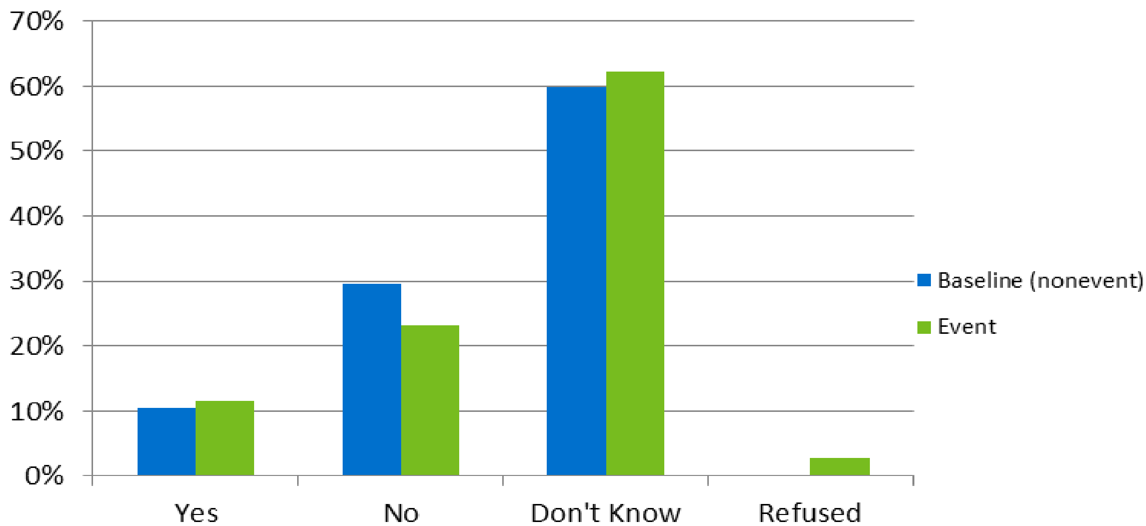
Those respondents who reported that their homes had been uncomfortably hot that day were asked to state in their own words what they think caused the discomfort. The most commonly reported rationale is that the discomfort in their home was due to the weather being hot; 63% of event respondents and 71% of nonevent respondents gave that reason. The second most common reason was that the air conditioner was not on: 10% of baseline and 5% of event respondents said this. Only 16% of event respondents ascribed their thermal discomfort to Duke Energy controlling their air conditioners; no baseline respondents thought that Duke Energy was controlling their air conditioners. Table 7-3 summarizes the responses given to this survey question.

Table 7-3: What do you think caused the temperature to be uncomfortable? Response Frequencies Weighted by Mode, N_t = 13 and N_c = 11

Reason	Event	Baseline (Nonevent)	All
It was a very hot day	63%	71%	67%
Air conditioner doesn't work properly	5%	10%	8%
Duke Energy was controlling air conditioner	16%	0%	8%
Air conditioner unit was not on	15%	0%	7%
Other	0%	19%	10%

All survey respondents were also asked directly whether or not they thought a Power Manager event had been called in the past few days. The most common response was "don't know," where 62% of event customers and 60% of baseline customers stated that they didn't know if there was a Power Manager event in the past few days. The prevalence of "don't know" responses here is not surprising in light of the fact that Duke Energy does not actively notify participants of load control events. Figure 7-2 presents response frequencies for event and nonevent respondents; the differences between event and nonevent responses to this question were not statistically significant. Across all respondents, 61% did not know if there was a Power Manager event recently, 11% thought that there was an event recently, and 27% did not think so.

Figure 7-2: "Do you think a Power Manager event occurred in the past few days?" Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73



The relatively few respondents (10 event and 8 nonevent) who thought there was a Power Manager event recently were asked a few questions about the event(s) that they perceived to have happened. First, when asked on what day they thought the event occurred, 59% of the event customers correctly identified the event day; for comparison, 33% of nonevent customers said there was an event that day.

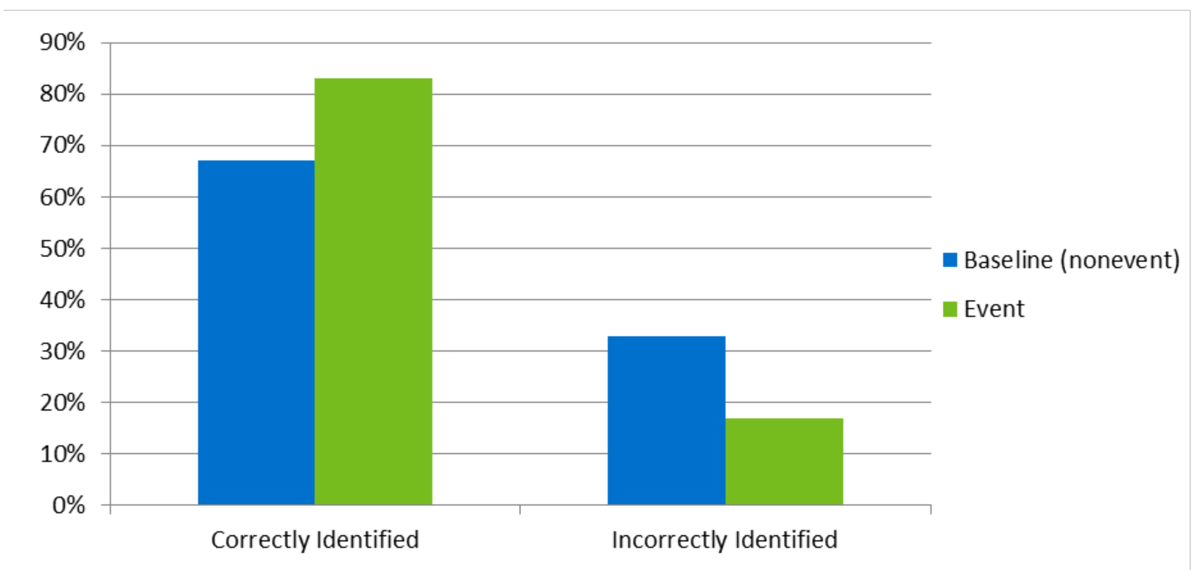
These customers who thought that there had been a Power Manager event recently were also asked to describe how they determined that the event was occurring, and the responses are summarized in Table 7-4. The most common response, given by 33% of respondents, is that they concluded an event was occurring because the temperature inside their home went up. The next most commonly reported rationale that an event occurred was due to it being a hot day outside, with 25% of respondents giving this reason.

Table 7-4: "How did you determine that an event was occurring?" Response Frequencies Weighted by Mode, N_t = 10 and N_c = 8

Reason	Event	Baseline (Nonevent)	All
It got warmer inside - the inside temperature went up	42%	24%	33%
It was a hot day – I knew from the temperature outside	41%	9%	25%
Did not hear the air conditioner running like I knew it should	8%	17%	13%
Some other way	8%	9%	9%
Heard about it on the news	0%	9%	4%
Don't know	0%	33%	16%

Customers were asked whether or not they were home during the event, and forty-eight percent of respondents who experienced an event were home, while 35% of non-event respondents were. These respondents were also asked what time they thought the event occurred, and were offered three response options: 12:00 pm – 2:59 pm, 3:00 pm – 4:59 pm, and 5:00 pm – 7pm. Because the event window (4:00 – 6:00 pm) spanned two time periods, those who had answered that they had thought an event occurred in either of the latter time periods were recognized as having correctly identified the time of the event. Rates of successful identification were calculated and are shown in Figure 7-3.

Figure 7-3: "About what time did you first notice this event?" Response Frequencies Weighted by Mode, N_t = 10 and N_c = 8



7.3 Program Experience

Aside from occasional program communications to program participants, the primary way that Duke Energy customers experience the Power Manager program is during load control events. A majority of survey respondents, 78%, stated that there is normally someone home between the hours of 12:00 pm and 6:00 pm on weekdays. Similarly, large proportions of respondents also reported that they are frequent users of their air conditioning systems. Table 7-5 shows the percentage of respondents who reported that they used their air conditioners every day for four different time periods and day type combinations. Generally, between 74% and 86% of Power Manager survey respondents reported using their air conditioners every day during weekday afternoon and evenings. During the weekend, the rates of customers who use their air conditioners every day increases; between 82% and 92% of customers stated that they run their units during weekend afternoons and evenings. Statistically significant differences in response patterns between the two groups of customers were not observed.

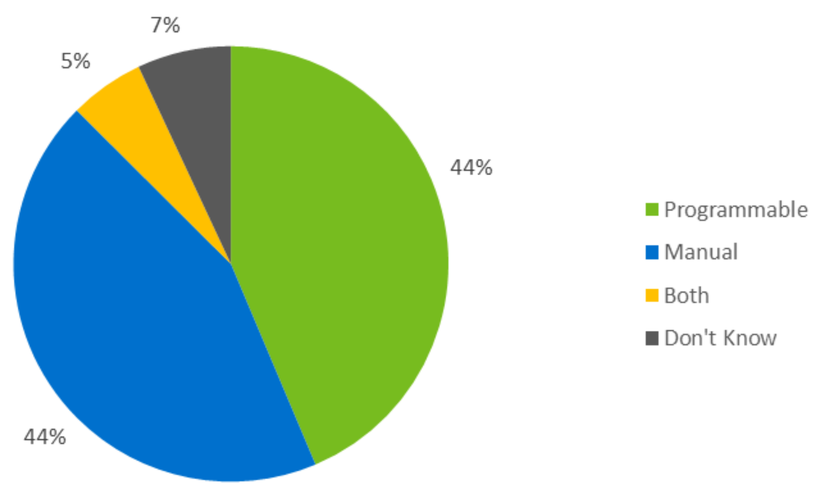
These survey responses confirm that Power Manager participants are in fact largely at home and using their air conditioners during the times that the program is likely to be launched when the need arises to use the program resource. As such, monitoring participant comfort levels is confirmed to be an important evaluation activity so that thermal comfort can be maintained at high enough levels to retain customer participation.

Table 7-5: "How frequently do you or someone else in your household use your air conditioning system?" Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73

Day and Time	% of Event Respondents Responding "every day"	% of Baseline Respondents Responding "every day"
...weekday afternoons (12-6 pm)	74%	83%
...weekend afternoons (12-6 pm)	82%	92%
…weekday evenings (6 pm-12 am)	77%	86%
…weekend evenings (6 pm-12 am)	89%	91%

In addition to occupancy patterns and frequency of air conditioning usage, Power Manager participants' experience with the program is affected by how they operate their air conditioning systems. Survey responses show that there is a mix of both manual and programmable thermostats installed in the homes of Power Manager participants. Figure 7-4 summarizes the types of thermostat(s) that survey respondents reported. Responses show that 44% of customers have a programmable thermostat. Another 44% of respondents said that they have a manual thermostat installed in their home; 5% of the remaining 13% have both a programmable and manual thermostat in their homes.

Figure 7-4: “What type of thermostat(s) do you have?” Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73



Among customers who have programmable thermostats, 42% reported using the programmability feature to allow the thermostat to cool to different temperatures at different times, and a further 47% of customers set their thermostat at a constant temperature. Among customers without programmable thermostats, 54% say that they keep their thermostat set at a constant temperature. This relatively high incidence of using a thermostat set point should increase thermal comfort associated with events. If during the course of an event, the home’s internal temperature rises by one or two degrees, when the event is over, the thermostat will reliably detect the higher temperature and automatically cool the home to the desired temperature, without relying on the customer to feel uncomfortable first and manually turn the air conditioning on themselves. These reported air conditioning usage behaviors are supportive of the earlier finding that, on the whole, Power Manager participants are not aware of events when they occur.

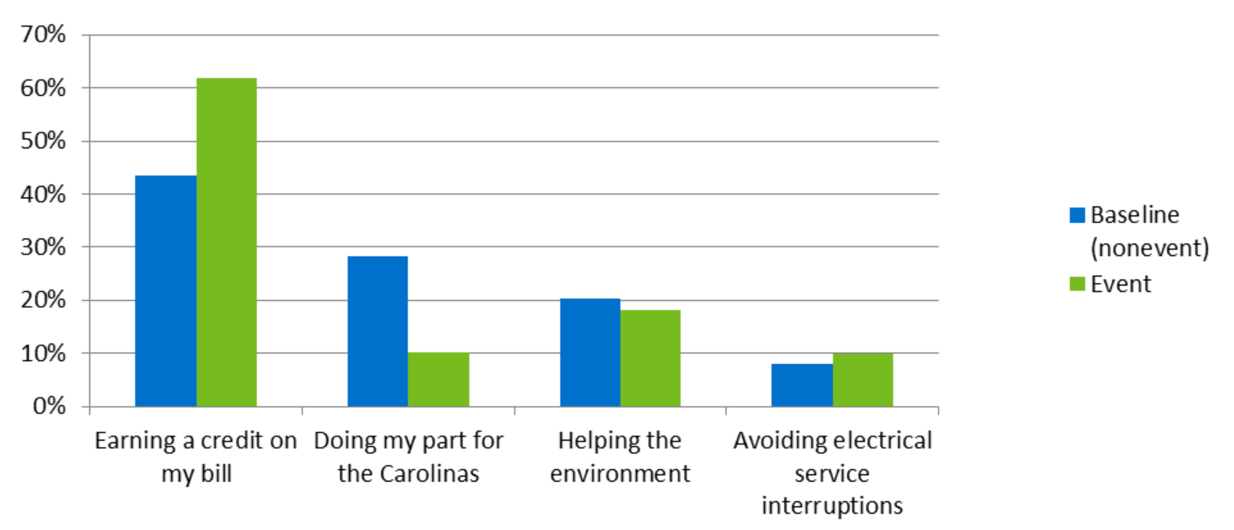
Similarly, Nexant asked customers who reported that they thought there was a Power Manager event recently whether or not they took any actions as a result of the perceived event. Only 5 customers (of 18 who said that they thought there was a Power Manager event) said they did something different in response to the perceived temperature change. The few responses to these questions were unpatterned, and provide further evidence that Power Manager events are not disruptive to participants

7.4 Motivation, Satisfaction, and Potential Barriers to Program Participation

Respondents were provided with a list of possible reasons for enrolling and asked which reason was most important to them. Survey responses reveal that Power Manager participants are motivated to be a part of the program by a diverse set of interests. The most frequently reported motivation is the bill credits, with 52% of respondents citing this as their most important motivator. The second-highest motivator was “doing my part for the Carolinas”, capturing 20%

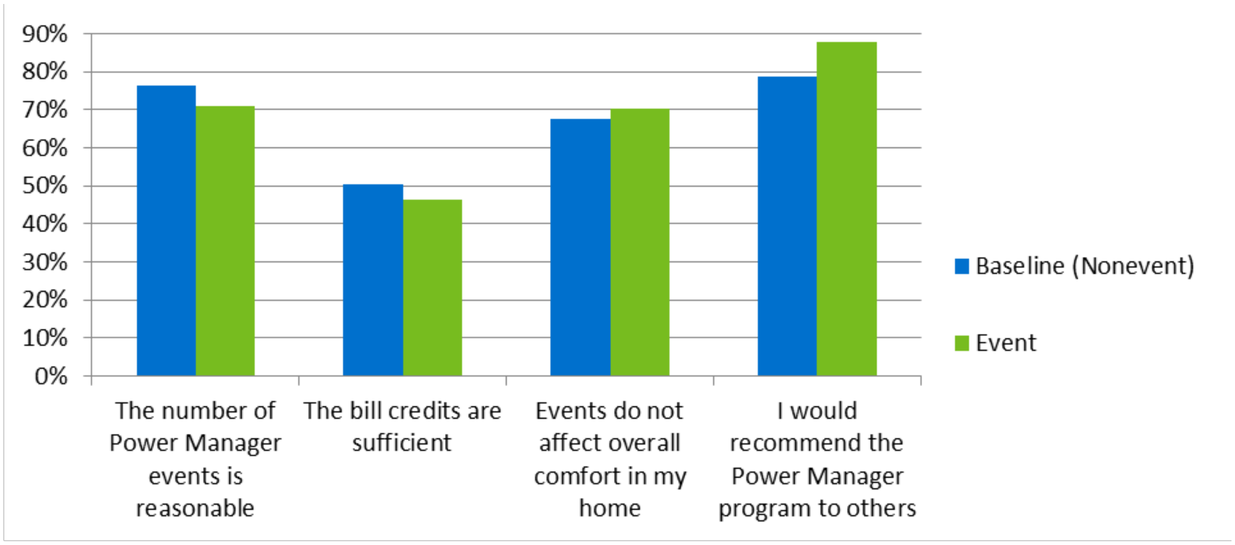
of responses; an additional of 19% of customers stated that their primary motivation was helping the environment. The remaining 9% of customers stated that their primary motivation for enrolling was avoiding electrical service interruptions. Figure 7-5 summarizes the survey responses, with customers who responded "Don't know", or refused to respond, excluded. Differences in response patterns between event and nonevent baseline groups are not statistically significant.

Figure 7-5: "Which of the following reasons was most important to you when enrolling?" Response Frequencies Weighted by Mode, N_t = 63 and N_c = 59



Customers were asked to rate on a scale of 1 to 5, where 1 means "strongly agree" and 5 means "strongly disagree", their agreement with various positive statements about Power Manager. Customers largely agreed with these statements; over 70% of both event and baseline customers agreed that the number of events is reasonable and that they would recommend the program to others. Customers were in slightly less agreement about events not affecting overall comfort in their homes; 70% of event and 68% of event customers agreed with this statement. Only 50% of event customers agreed that the bill credits were sufficient, and less than half of the event customers agreed with this statement. Crucially, 83% of all customer agreed that they would recommend the program to others. The distribution of responses for those who answered each question is shown in Figure 7-6. Differences in response patterns between event and nonevent baseline groups are not statistically significant.

Figure 7-6: "How would you rate the following statements about Power Manager?" Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73



The survey concluded with an opportunity for customers to provide suggestions on how they think the Power Manager program might be improved. Forty-two percent of respondents (61 of 145) offered responses to this question, and of those, 48 offered feedback (13 of the 61 customers stated that they had no suggestions for improving Power Manager). Among those offering suggestions for improvement, there were three common requests. The first, mentioned by 20 of 48 people, reflected a desire for better communication from Duke Energy about the Power Manager program, including increasing awareness of the program, and increased details on bills.

- "Just to make sure that I am more aware of the program."
- "Giving us more information or educating us about the program in the bill statement."

The second, mentioned by 12 people, expressed a desire for notification before or during an event:

- "For Duke Energy to send out and email for whenever an event has occurred."
- "I would like to know when they did it and outlining it on my bill."
- "Text me when you turn off the power. Send a text every month to show me my savings and credits from the program."

The third most common comment, reported by 11 people, was that customers were unsure or unaware of what the Power Manager program specifically entails:

- "I guess getting people more information about the program specifics, including what the power manager installation does."
- "Educate customers better, [so that they] understand what they are signing up for."
- "I kinda forgot it existed, so better information/reminders it exists and what it does."

Nine people expressed a desire for larger bill credits. Additionally, four people stated their desire to see the reach of – or services offered through – the Power Manager program expanded. Some of the comments in these areas include:

- "Giving more credits to people that have it/more incentives to sign up.
- "Increase the power manager credits to what it was when it first started and based on a per device [basis] like the water heater and AC unit."
- "Make it mandatory. There are some people who just want to be ice."

Table 7-6 summarizes categorizations of the free-form responses. Many responses fit into more than one coding category, thus the percentages add up to more than 100%.

Table 7-6: "What suggestions do you have for improving Power Manager?" n=48

Statement	Frequency
Better Communication	42%
Provide Notification of Events Occurring	25%
Unsure/unaware of program details; communicate them	23%
Increase Credits/Incentives	19%
Increase Awareness of Program	19%
Doesn't Impact Me (the customer)	10%
Clarity on Bill	10%
Increase Services/Reach of Program	10%
Unaware of Program	8%
Show Frustration	8%
Express Appreciation	6%
Miscellaneous	6%

Responses were positive when participants were asked to rate the likelihood of staying enrolled in Power Manager, with the large majority of respondents saying that they intend to stay in the program; 87% of all respondents said they are "somewhat likely" or "very likely" to remain enrolled. Responses are tabulated in Figure 7-7. The eight customers who said they were not at all likely to stay enrolled gave varying explanations. Their explanations are shown in Table 7-7.

Figure 7-7: "How likely is it that you will stay enrolled in Power Manager? Would you say…?" Response Frequencies Weighted by Mode, N_t = 72 and N_c = 73

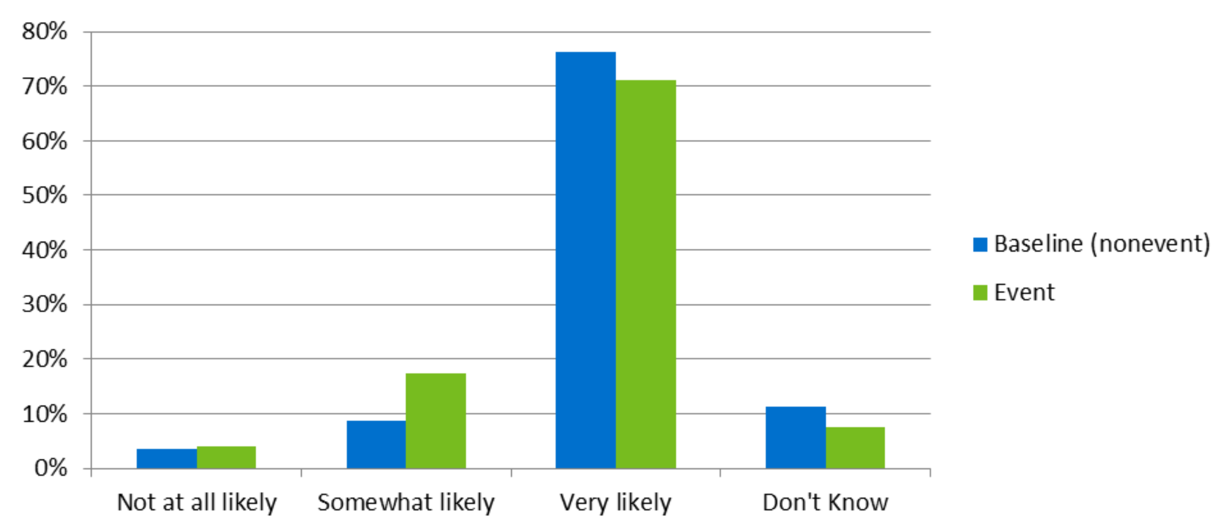


Table 7-7: "Why are you not at all likely to stay enrolled in Power Manager?" N_t = 4 and N_c = 4

Response	Group
If they provided more information on it, and let me know if I'm on it and also understand the terms and conditions of the program.	Nonevent
Doesn't see the benefits in it.	Event
I don't even know I am in it.	Event
Don't know.	Event
Refused.	Nonevent
I don't want them to have power to turn my power off.	Nonevent
Moving, because we are selling the house.	Event
If it lowered her bill it would be fine.	Nonevent

7.5 Interview Findings

Power Manager is a mature demand-side resource that is actively used in the course of operating Duke Energy Carolinas' electric system. The demand savings delivered by Power Manager are made possible through the teamwork of internal and external stakeholders that manage the program's budget and goals, communicate with participants, maintain the Yukon event dispatch software, and interact with the customer at every stage of the program lifecycle, from enrollment, to device installation, to device removal. Three primary stakeholder groups, the Duke Energy program management team, Eaton Power Systems, and Franklin Energy, work together to deliver Power Manager to customers. Nexant interviewed four individuals from these organizations.

Overall, through the course of our conversations, we observe that Power Manager maintains a customer-focused orientation and is currently engaged in a number of initiatives to improve program operations and customer service. The remainder of this section will describe the Power Manager offering in the Carolinas and what Duke Energy's activities are to bring in new program participants and support annual enrollment goals. A description of program operations follows, which is followed in turn by an outline of work that continues after each load control season concludes to ensure Power Manager's continued success. This section concludes with a review of the activities that are planned or currently underway to further improve program operations and participating customer experience.

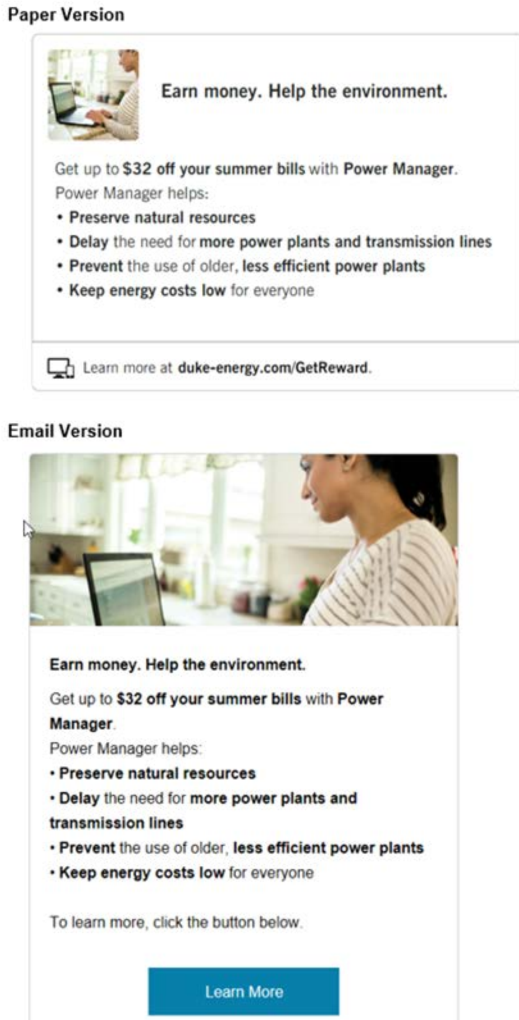
7.5.1 Program Offer and Enrollment Goals

Work to recruit new Duke Energy Carolinas participants into Power Manager takes place year-round. Duke Energy's 2019 enrollment goal for the Carolinas was 15,318 devices. This annual enrollment target is calculated using energy savings goals, and requires a year-round recruitment effort. In 2019, Duke Energy actually enrolled 17,727 devices. In part, this success was due to this year-round recruitment efforts—including increased "pre-season" installations—but also to the increase of recruitment targets for the third-party call center provider, CustomerLink. Though customers are sometimes recruited via other channels, this outbound calling channel is the predominant and most effective recruitment source for the Power Manager program. Additionally, Duke Energy has been providing CustomerLink with customer participation data for other programs. Having the ability to refer to this information during recruitment calls helps CustomerLink staff increase effectiveness of their communications and credibility with potential Power Manager participants.

As an outbound call center, CustomerLink is prepared to address common questions or concerns that Duke Energy customers who are not familiar with the program may have, in addition to describing the basic features of the program, many of which are friendly to the program participants. Outbound callers are ready to speak to the fact that Duke Energy's customer research has shown that the large majority of customers who are home during an event don't notice it, that there are generally only five to seven events each summer, and that events typically end by 6 pm, which is when many customers are just coming home from work. Another participant-friendly aspect of the program is that air conditioning units enrolled in the program are cycled rather than completely curtailed. Power Manager is also not called on weekends or weekday holidays, unless in the rare event of a system emergency. The load control devices used by the program—switches that directly control the air conditioner's compressor—are a proven technology that does no harm to the customer's air conditioner or the home's electric distribution system. In addition, because the device is installed on the compressor, which is typically located outside the home, as opposed to installed on fans or thermostats, the program design does not require a technician to enter the customer's home—preventing any possible problems and subsequent reductions in participant satisfaction.

The large majority of marketing efforts are focused on outbound calling by CustomerLink. However, both the electronic and paper versions of the March 2019 MyHER Home Energy Report featured The Power Manager program. Figure 7-8 depicts the copy present in each version.

Figure 7-8: Power Manager Outreach Material Featured in March 2019 MyHER Reports



The Duke Energy Carolinas program provides $8 credits on participating customers' July thru October bills. With only a modest financial incentive for participation, Duke Energy emphasizes messaging around community and environmental benefits to generate customer interest in the program. Duke Energy has found that these preferences are correlated with older, higher income, and higher education demographics.

Franklin Energy is a third party provider that manages Power Manager customer care and handles participants' inquiries about the programs and requests for customer service, in addition to all fieldwork. Power Manager fieldwork ranges from scheduling and routing load control device installations, training and managing a staff of device installers, responding to any device service calls, and fulfilling customer requests to remove load control devices. Franklin Energy also manages and staffs all quality assurance inspections and fieldwork. In the past, Duke Energy would provide Franklin Energy with a sample of residents to test for device operability problems. However, Duke Energy now uses AMI data to help pinpoint potentially malfunctioning or missing devices and passes a prioritized list of these devices to Franklin Energy. With this new "targeted" system, quality control trips have been reduced by about 60%, while tripling the proportion of devices that are reconnected, doubling installations (due to missing switches), while also significantly increasing replacements. This improvement has allowed for a much higher reconnection rate per quality control trip, while also dramatically reducing the number of necessary trips, as well as the length of time Franklin Energy staff need to be on-site at a participant's residence.

7.5.2 Power Manager Program Operations

In terms of maintaining Power Manager as a reliable system resource for the Duke Energy Carolinas system operators, Eaton Power Systems plays an important role as the provider of the switches and as a resource to assist Duke Energy program staff in maintaining the Yukon software system, managing firmware issues that can arise from time to time, addressing the switches for normal service and evaluation, measurement and verification (EM&V) activities and training Franklin Energy' switch installers. An annual all-hands Spring Training event hosted by Duke Energy brings all the Power Manager program stakeholders together to discuss the upcoming load control season's work.

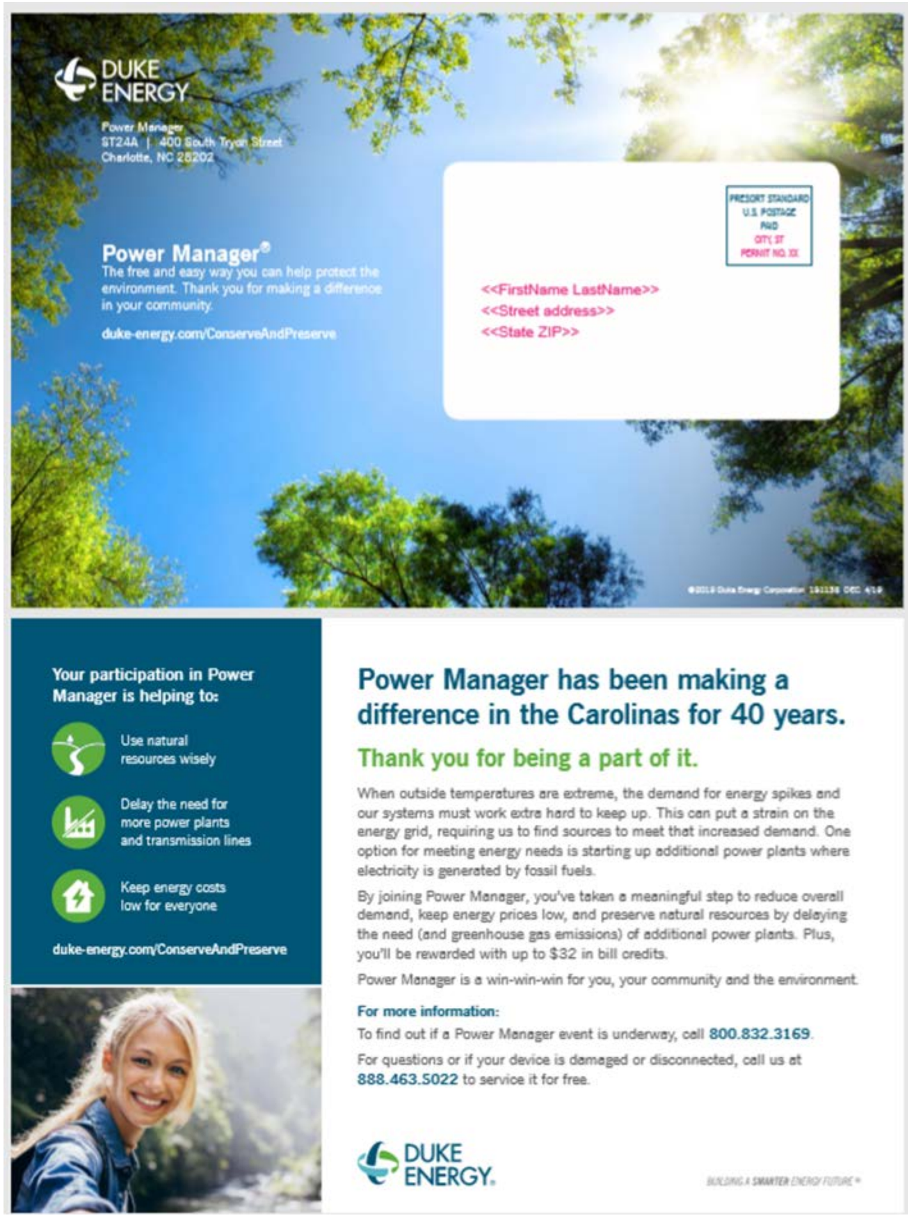
These events were cited by all stakeholders as a crucial aspect of program operations. Not only do these meetings allow for in-depth coverage of upcoming issues of relevance, but they are also critical in maintaining the overall collegiality and professionalism that facilitates free communication amongst the stakeholders that is crucial for the quick resolution of any emergent issues that arise during the program season. In this communicative environment, stakeholders are more keenly aware of each other's responsibilities, knowledge base, and workload, and are thus able to more efficiently troubleshoot and find the appropriate staff for solving any problems. Additionally, weekly meetings between Duke Energy Carolinas and Franklin Energy staff (which Eaton joins once a month), are another strategy that has been built in to head off any problems during the load control season.

Recent program operations improvements have been implemented by Eaton Systems, through the upgrade of their Yukon dispatch software with an "Assets" package. Yukon Assets ties Franklin Energy's program participation data to Duke Energy's customer information and program dispatch capabilities to provide greater flexibility in managing Power Manager events.

The TrueCycle algorithm in Yukon is used for normal Power Manager events. It uses each participants' actual AC usage patterns to achieve the 64% or 50% reduction of each AC unit's runtime during a cycling event. During emergency full-shed events, the cycling algorithm is replaced with a 100% shed.

Before the summer load control season begins, Duke Energy uses seasonal reminder/thank you cards that are sent near the start of the load control season to remind and thank customers for their participation in the program, provide tips for having a comfortable experience with the program, and recognize the benefits of the program in terms of reducing system load and providing environmental benefits. Additionally, the messaging used in 2019 included references to the Power Manager program's 40th anniversary. The 2019 reminder postcard is shown in Figure 7-9.

Figure 7-9: Spring Reminder and Thank-You Postcard



Beyond the monthly credits that are present on customer's bills during load control season, these cards are usually the only communication customers are provided with from the program each year. Duke Energy does not notify Power Manager participants either in advance or during event dispatches. However, Duke Energy maintains a toll-free hotline that program participants may call to get updates on the status of whether or not the program is planning to dispatch an event or whether an event is in progress.

At Duke Energy Carolinas, program managers make the final decision when load control events will be called on a day-of basis, mainly considering local system and weather conditions. Though this is the case, these managers are also in touch with other stakeholders in this system as they work to anticipate days where events are possible. Advance event discussion and preparation makes the day-of event calling process operate smoothly.

Duke Energy's Energy Control Center (ECC) (formerly, the System Operations Center (SOC)), also has access to dispatch Power Manager. The ECC has the responsibility of balancing the supply and demand of electricity on the grid for Duke Energy Carolinas. This requires planning for demand levels that fluctuate throughout the day which must be managed relative to Duke Energy's supply margins. Although Power Manager is rarely used in an emergency full-shed capacity, the ECC uses the cycling option on occasion. Because Power Manager provides a low-cost, reliable and quickly dispatchable asset for this group, it is often used as a "virtual power plant" and contributes to the system's operating reserve margins.

Under normal operations, the Demand Response Operations team includes staff in ECC and Fuel and Systems Optimization in event decision making. However, the Demand Response Operations staff maintains control of the decision to call nonemergency events. Power Manager is viewed as an important resource for the Duke Energy Carolinas system that depends on the participating customers' willingness to remain enrolled. Therefore, all events are called with a view towards whether or not it will be a detriment to the experience of the participants and their continued participation. Considerations taken in this area are the number of events that have already been called during the current summer, during that week, at what hours events are taking place, and at which level the participants' AC units will be cycled.

7.5.3 Program Monitoring and Postseason Program Maintenance

Duke Energy undertakes a number of activities both during the load control season and afterward to ensure that participants are satisfied with their Power Manager program experience and that the program is on track to provide an excellent customer experience going forward.

Franklin Energy, as the third party contractor that manages Power Manager customer contacts, has service level agreements in place with Duke Energy that outline service benchmarks, with both penalties for nonperformance and opportunities for incentives when benchmarks are exceeded. There are specific benchmarks in place to ensure that, during event days in particular, customer calls coming into Franklin Energy are handled quickly, efficiently, and that accurate information is provided to the customers calling in. Additionally, Duke Energy program managers monitor the number of calls coming in to the toll-free notification line, in addition to the number of calls coming into the Franklin Energy call center to detect any emerging issues associated with the program experience. Device removal requests are also tracked for this purpose.

7.5.4 Upcoming Program Changes and Initiatives

Duke Energy is also engaged in initiatives to change the program offering to make it more attractive to customers and to improve program performance. Duke Energy Carolinas is assessing using its website as an additional source of event notification, making it easier for customers to access information about Power Manager events.

As participation saturation becomes an increasingly salient issue for the Power Manager program, the upgrade of the Yukon software that allows for granular management of load control events can help address this issue. Program management is exploring the possibility of putting processes in place to control loads at the regional transmission level. Additionally, Duke Energy Carolinas is transitioning to winter-peaking operational characteristics. With that in mind, Power Manager staff have been preparing for this eventuality and have asked Eaton to begin developing load control switches for water heaters and heat pump strip heating, and work will continue to ensure the program's ability to manage system peaks.

7.6 Key Findings

Key findings from the process evaluation include:

- 145 Power Manager participants were surveyed within 24 hours of the program event that occurred on July 15, which had a high temperature of 92°F and a maximum heat index of 97°F.
- Of the 145 participants that completed the survey, 72 customers experienced the event and 73 customers did not experience the event. This nonevent group survey was used to establish a baseline for comfort, event awareness, and other key metrics.
- A majority of all respondents, 72%, reported that they are familiar with the Power Manager program.
- About 18% of both sets of survey respondents—those who had and those who had not experienced the event—reported that their homes were uncomfortable. There is no increase in customers' thermal discomfort due to Power Manager events.
- 52% of respondents reported that "Earning a credit on my bill" is the primary reason they are participating in Power Manager.
- Overall, 87% of survey respondents state that they are "very" or "somewhat" likely to remain in the program.
- 83% of respondents "strongly" or "somewhat" agreed that they would recommend the Power Manager program to others.
- New load control device installations and quality control reinstallations, reconnections and replacements substantially exceeded goals.
- The Power Manager staff and vendors are customer-focused and undertake a number of activities before, during, and after the load control season to ensure that the program administration and implementation runs smoothly, and that participants are satisfied with their Power Manager program experience.
- Yukon software system has been upgraded with the "Assets" package that provides increased functionality and granularity in calling Power Manager events.
- Effective communication strategies amongst stakeholders is an ongoing strength of the program.

8 2020 Impact Evaluation

Findings from the 2019 impact evaluation indicated that the impacts produced by the events in 2019 were likely affected by one or more issues arising from regional/locational dispatch signals, complexities stemming from the EM&V feeder group assignments, or possibly some other unidentifiable factor(s). Following the 2019 event season, Duke Energy undertook efforts to identify and address the possible issues and requested that Nexant complete a subsequent impact analysis on the 2020 event season. The 2020 analysis did not include a process evaluation component.

8.1 Summary of Results

In general, the magnitude and percent impacts produced by the 2020 events are comparable to those produced by the 2019 events. In 2020, a total of five events were called. Four of the events were emergency full-shed dispatch, while the remaining event was called by the ECC using the 64% cycling option. The four emergency events, all of which lasted less than 30 minutes in duration, averaged impacts of 1.04 kW per device, compared to 1.17 kW per device average impacts for the two emergency events called in 2019. While this shows a 0.13 kW drop in impacts, it is important to note that temperatures observed during the 2020 emergency events were significantly lower than the temperatures observed during the 2019 events, by 5°F on average. As demonstrated through previous evaluations, temperatures leading up to and during the event period are the primary driver of impacts. Events called at identical times for the same duration and population of customers, but under conditions 5°F cooler, will produce notably smaller load impacts compared to a similar event on a 5°F hotter day. This consequence of cooler temperatures appears to be the primary driver of the observed load reduction magnitudes produced in 2020.

Results of the 2020 DEC Power Manager impact analysis are summarized in Table 8-1.

Table 8-1: 2020 Event Impacts

Event Date	Shed Type	Event Period	Reference Load	Impact	90% Confidence		% Impact	90%Confidence		Max Event Temp
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
6/3/2020	Emergency	3:30PM - 3:45PM	2.93	-0.89	-0.72	-1.06	-30.5%	-24.6%	-36.3%	87.1
6/22/2020	Emergency	4:30PM - 4:45PM	3.14	-1.17	-0.88	-1.46	-37.2%	-27.9%	-46.5%	85.6
8/27/2020	Emergency	4:30PM - 4:45PM	3.30	-1.04	-0.77	-1.32	-31.5%	-23.2%	-39.9%	87.4
9/2/2020	Emergency	4:30PM - 4:57PM	3.47	-1.05	-0.89	-1.22	-30.4%	-25.7%	-35.1%	89.9
9/11/2020	Cycling	4:30PM - 5:12PM	3.02	-0.60	-0.41	-0.80	-20.0%	-13.5%	-26.4%	83.5

Key findings of the 2020 impact analysis are summarized as follows:

- Emergency shed event impacts ranged from 0.89 kW to 1.17 kW.
- The cycling event held on September 11 produced load reduction of 0.60 kW.
    - The magnitude of impacts observed during the September 11 event can be explained by relatively low temperatures observed on that day; the event was called by the Energy Control Center in order to maintain system integrity rather than in response to extreme weather.
- The 2020 event impacts are similar to those in 2019 when controlling for similar dispatch conditions.
- If emergency shed becomes necessary on a day where the event temperature is 100°F, Power Manager can deliver 1.59 kW of demand reductions per household during a one-hour event starting at 4:00PM.
- With an average ratio of 1.2 devices per household, the average demand reduction per device is 1.33 kW.
- Because there are approximately 238,000 Power Manager customers, the expected aggregate reductions total 380 MW under 100°F event period temperatures.

8.2 Methodology

The analysis methodology used to estimate impacts for the 2020 events differed from the analysis approach used in 2019 in a few fundamental ways. First, the 2020 impact analysis relied entirely on a within-subjects analysis framework rather than a RCT. This alternate approach was required in order to accommodate the simplified configuration of the program population, which removed the more complex feeder group assignments, and instead dispatched events at the full program level. Because the within-subjects methodology is described in detail in Section 3.4, it is not rehashed here. Second, the 2020 analysis utilized a small subset of customers from among the program's population who were discovered to have 15-minute interval meter data, rather than 30-minute interval data that is standard in the DEC territory. This group was particularly beneficial for assessing impacts achieved during events having durations that were not multiples of 30 minutes (i.e. events lasting 15 or 45 minutes). These methodological changes were detailed in the Impact Analysis Methodology Memo submitted to Duke Energy on February 2, 2021, and are described in additional detail below.

8.2.1 15-minute vs. 30-minute Interval Data

An assessment of the 2020 data revealed that a small portion of the Power Manager customer population (0.1%) has usage data in 15-minute intervals, rather than 30-minute intervals as expected. The presence of 15-minute interval usage data provides an opportunity to more accurately measure impacts for events that were 15 or 45 minutes in duration. Metered usage data in 30-minute intervals are unable to accurately depict load reductions achieved by dispatches sent for sub-30 minute periods of time because only a fraction of the interval is the true event period. To account for this, Nexant used the subset of customers having 15-minute interval data to inform our analysis based on the full population, resulting in more accurate impact estimates for event periods that are not multiples of 30 minutes. This process involved the following steps:

1) Conduct testing to ensure the sample of customers with 15-minute interval data is statistically similar to the full program population. Customers' load data from the two groups were compared to a set of non-event days to ensure similarity.
2) Use within-subjects methodology to develop impact estimates separately using both 15-minute interval data for the subset of customers with 15-minute data and 30-minute interval data for the general population. As part of this step, data from the customers with 15-minute intervals were collapsed to 30-minute intervals to produce a third set of impacts based on the collapsed data. This enabled two sets of impacts from the same population using both 15-minute and 30-minute data, and allowed for comparison with the general population's impacts based on 30-minute data.
3) Calculate an adjustment factor using the separate sets of impact estimates produced in #2. The adjustment factor was calculated as the ratio of the impacts produced by 15-minute data to the impacts produced by 30-minute data.
4) Apply the adjustment factor to event-level impacts produced by the full population of 30-minute interval data to generate the reported impact estimates for 2020 events.
5) If the event did not run for the full 15 minutes of a 15-minute interval, an additional adjustment factor was applied in order to account for the number of minutes in the interval that the event was dispatched.

8.3 Impact Analysis Findings

The load impact estimates for 2020 events are presented in Table 8-2. Load impacts and confidence intervals for each event are presented as the average per household changes in load during the indicated dispatch window.

Table 8-2: Per Customer Event Impacts

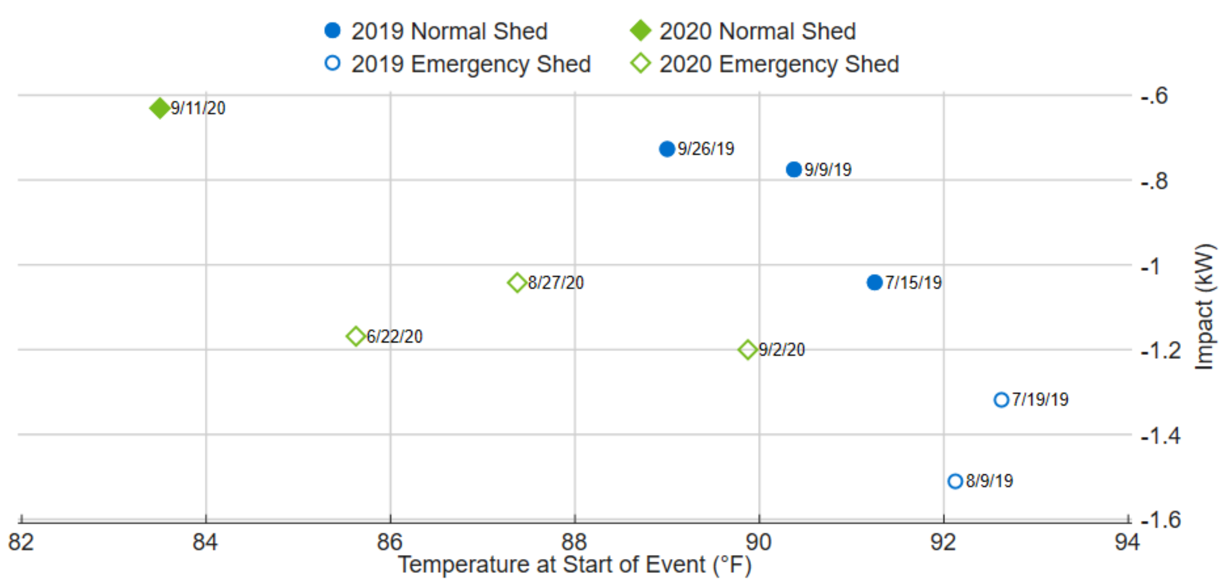
Event Date	Shed Type	Event Period	Reference Load	Impact	90% Confidence		% Impact	90%Confidence		Max Event Temp
					Lower Bound	Upper Bound		Lower Bound	Upper Bound	
6/3/2020	Emergency	3:30PM - 3:45PM	2.93	-0.89	-0.72	-1.06	-30.5%	-24.6%	-36.3%	87.1
6/22/2020	Emergency	4:30PM - 4:45PM	3.14	-1.17	-0.88	-1.46	-37.2%	-27.9%	-46.5%	85.6
8/27/2020	Emergency	4:30PM - 4:45PM	3.30	-1.04	-0.77	-1.32	-31.5%	-23.2%	-39.9%	87.4
9/2/2020	Emergency	4:30PM - 4:57PM	3.47	-1.05	-0.89	-1.22	-30.4%	-25.7%	-35.1%	89.9
9/11/2020	Cycling	4:30PM - 5:12PM	3.02	-0.60	-0.41	-0.80	-20.0%	-13.5%	-26.4%	83.5

Overall load impacts for the average customer ranged between 0.89 kW and 1.17 kW during the four emergency shed events. The lone cycling event, held on September 11, resulted in lower impacts than those for the emergency shed events, with load impacts of 0.60 kW for the average customer. The September 11 cycling event was called by the ECC for the purpose of maintaining system integrity, rather than by Duke Energy in response to extreme temperatures.

8.3.1 Comparison with 2019 Event Impacts

Several factors can affect the magnitude of event impacts, including: the event shed type (i.e. emergency vs. normal dispatch), time-of-day, the duration of the event, day-of-week, month-of-year, and temperature. The structure of the 2020 events, specifically with respect to timing and duration, was different in 2020 compared to 2019. All 2020 Power Manager events began between 3:30 PM and 4:30 PM and were less than one hour in duration. Meanwhile, the 2019 Power Manager events varied by their start times and duration. These differences, combined with cooler temperatures in 2020, led to some challenges in making a valid comparison between the 2019 and 2020 results. In order to draw a meaningful comparison that controls for as many of the differences in event conditions as possible, Nexant isolated the 2019 events that had similar start times to the 2020 events (i.e. dispatch sent between 3:30 PM and 4:30 PM), and then further isolated the impacts of those events to the first 30-minute interval. This enabled a comparison of impacts produced for similar durations and at similar times-of-day between the two years. The comparison of impacts in relation to event start temperature are presented in Figure 8-1.

Figure 8-1: Comparison of 2019 and 2020 Event Impacts



As shown in Figure 8-1, the 2019 events (blue markers) were consistently held on hotter days than the 2020 events. Looking at the emergency shed events (shown as the hollowed markers), temperatures were anywhere between 2°F and 7°F cooler at the start of the 2020 events compared to the emergency events held in 2019. Similarly, the lone cycling event in 2020 was 5°F to 8°F cooler than the normal shed events in 2019. Not surprisingly, the pattern of greater impacts being achieved on hotter days holds between the two years. However, considering the relative magnitude of the impacts observed in 2020 - under inferior temperature conditions - it stands to reason that the 2020 events would have produced equivalent, or higher, impacts as the 2019 events under those hotter weather conditions. These results support the premise that the 2020 impacts are consistent with, and perhaps show improvement over, what was achieved in 2019.

8.4 Demand Reduction Capability

In order to estimate the demand reduction capability, models were developed both for reference loads and event impacts based on a hot, one-hour emergency event starting at 4:00 PM. A 24-hour temperature profile was developed with a temperature of 100°F from 4:00 PM to 5:00 PM, which is also the maximum daily temperature. The analysis assumes that this temperature profile represents the conditions experienced by the average Power Manager customer. Therefore, temperatures from individual weather stations in the Carolinas jurisdiction were weighted based on the regional distribution of the program's population.

Due to lower observed temperatures in 2020 compared to 2019, data from both years were included in the models for reference load and event impacts. Additionally, because no emergency events in 2019 or 2020 exceeded 30 minutes in duration, a ratio was applied to adjust the half-hour impact to a full-hour impact using 2019 events that were at least one hour in duration.

Impacts and loads were modeled using the observed temperature and load data, and then applied to the hot weather temperature profile. A one-hour emergency event starting at 4:00 PM with an event temperature of 100°F is expected to deliver 1.59 kW of demand reduction capability per customer dispatched. Because there are approximately 238,000 customers enrolled in Power Manager, the expected aggregate reduction is 380 MW. In addition, because there is an average of 1.2 devices per household, the average per device load reduction is 1.33 kW.

Table 8-3: Estimated Per Household, Per Device, and Aggregate Impacts

Event	Per Household Impact	Per Device Impact	Aggregate Impact
Emergency Shed 4:00 PM Start 1-hour Duration 100°F Event Temperature	1.59 kW	1.33 kW	379.5 MW

Figure 8-2: Demand Reduction Capability – 100°F Event Period Temperature (2020)

Inputs	
Dispatch Type	Emergency Dispatch
Event Start Time	4 PM
Event Duration	1
Event Period Max Temp	100
# Customers	238,000

Event Window Average Impacts		
Load without DR	4.06	kW per customer
Load with DR	2.47	kW per customer
Impact per Customer	-1.59	kW per customer
Program Impact	-379.5	MW
% Impact	-39.3	%

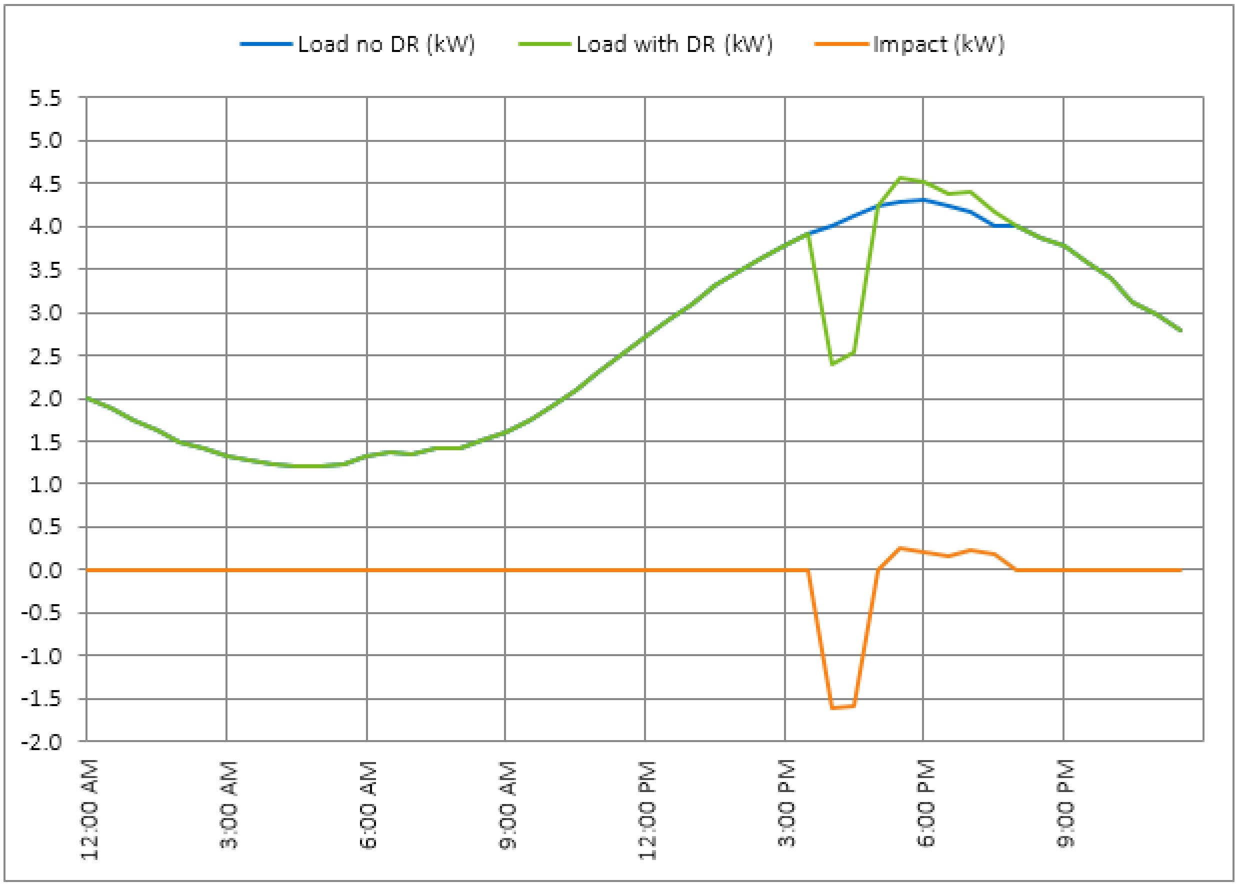


Table 8-3 displays the expected impacts for various event start times and maximum daily temperature conditions, given an emergency event with a one-hour duration. The estimates shown are derived from the time-temperature matrix, and are therefore reliant on the empirical data observed during the 2019 and 2020 program seasons. As such, the completion of Table 6-1 in its entirety requires the use of daily maximum temperatures, rather than event period temperatures, as the conditional input for estimating impacts. Because none of the 2019 or 2020 events experienced certain of the more extreme temperatures shown in Table 6-1, the time-temperature matrix is limited in its ability to predict loads under these conditions.

Table 8-4: Per Customer Impacts by Daily Maximum Temperature and Event Start Time (2020)

Daily Max Temperature	Event Start Time				
	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM
90°F	-0.62 kW	-0.74 kW	-0.85 kW	-0.95 kW	-1.06 kW
92°F	-0.70 kW	-0.84 kW	-0.98 kW	-1.08 kW	-1.19 kW
94°F	-0.78 kW	-0.95 kW	-1.11 kW	-1.22 kW	-1.34 kW
96°F	-0.88 kW	-1.07 kW	-1.24 kW	-1.37 kW	-1.51 kW
98°F	-0.97 kW	-1.19 kW	-1.38 kW	-1.52 kW	-1.68 kW
100°F	-0.98 kW	-1.22 kW	-1.43 kW	-1.59 kW	-1.87 kW
102°F	-1.04 kW	-1.35 kW	-1.65 kW	-1.88 kW	-2.14 kW

Impacts grow as temperatures increase and as the event starts later in the day. Impacts increase with a later event start time because reference loads are generally increasing from 1:00 PM to 5:00 PM during the summer. In practice, impacts may vary due to unique weather patterns or event day characteristics.

9 Conclusions and Recommendations

9.1 Impact Evaluation Conclusions and Recommendations

Conclusion: Overall, the Power Manager program produces significant results in reducing peak load demand for Duke Energy's residential customers. On average, 2019 events achieved greater than 20% load reduction per household for general population events.

> **Recommendation:** Continue to promote the Power Manager program to DEC residential customers who exhibit high peak load consumption. Customers with higher-than-average peak loads remain the best candidates for program participation and have the greatest potential to contribute to demand savings.

Conclusion: Complexities associated with feeder programming and event dispatch design for the M&V events led to a number of unanticipated ramifications with the impact analysis. M&V events designed to assess differences in shed type (i.e. side-by-side dispatches) and time-of-day dispatch (i.e. cascading events) only provided limited value due to the narrow range of event conditions.

> **Recommendation:** In the future, consider a simplified M&V design, whereby only a single control group is assigned and Duke Energy dispatches the Power Manager program as needed, and does not conduct M&V-specific events.

> **Update:** As of the time of this report submission following the 2020 impact analysis, Nexant and Duke have agreed to move to a simplified A/B group study design for subsequent program evaluations. This approach will be detailed in future project documentation.

Conclusion: The time-temperature matrix predicts demand reductions of 1.59 kW per household for a 1-hour event beginning at 4:00PM with an event period temperature of 100°F. However, the time-temperature matrix is limited by a narrow range of empirical data with a maximum observed event period temperature from the past season of 92.9 °F.

> **Recommendation:** Revisit the time-temperature matrix requirements and consider developing a model of program capabilities across a relatively modest band of temperatures, reflecting the current dispatch strategy. For example, reporting estimated impacts under a range of temperatures regularly observed during most event seasons for a 1-hour event starting at 4:00PM.

> **Recommendation:** If Duke Energy is interested in development of a TTM that reflects program capabilities under a broader range of scenarios, Nexant recommends collecting data to inform the TTM based on implementing end-use metering for a small sample of customers, rather than attempting the more complex RCT dispatches similar to the plans from the current evaluations.

9.2 Process Evaluation Conclusions and Recommendations

Conclusion: There were no differences in levels of agreement between event and non-event participants with statements about whether or not an event had occurred recently, about thermal discomfort, or about perceptions of the cause of any discomfort. In short, customers are not able to reliably perceive Power Manager curtailment events.

> **Recommendation:** Continue to prioritize participant comfort and satisfaction during curtailment events.

Conclusion: Eighty-three percent of Power Manager customers are likely to recommend the program to others, and 87% are likely to remain enrolled. There were no differences between event and non-event respondents for either question, nor for any other satisfaction questions. Therefore, Power Manager events do not affect customer satisfaction in either direction.

> **Recommendation:** Continue to prioritize practices that are focused on maximizing customer satisfaction in the design and implementation of the Power Manager program.

Conclusion: Seventy-two percent of all respondents are familiar with the Power Manager program. This represents a decrease of 13% from the previous evaluation of PY 2016. The majority of suggestions (28 of 48; 58%) for improvement from customers spoke to perceived communication gaps from Duke Energy.

> **Recommendation:** Evaluate each jurisdiction's communication strategy: before, during, and after load control seasons, and consider changes. Improved communication can improve customer satisfaction and increase positive word-of-mouth awareness. One possibility is to provide end of season "thank you" postcards, on which customers could be reminded of how much money they saved, or be informed about what the program has accomplished in that load control season and their role in that. For example, "Because of your participation this year, Duke Energy was able to keep expensive fuel-oil source electricity off of the grid on a hot summer day."

> **Recommendation:** Prioritize making Power Manager event notifications available on the program website.

Conclusion: "Targeted" QC protocols, using AMI data to identify switches that may be malfunctioning or missing, have yielded strong results. This allowed Franklin Energy to complete about 60% fewer QC site visits than were budgeted, while achieving a three-fold increase in the proportion of reconnects per site visit, as well as significant increases in replacements. Ultimately, this resulted in decreased costs and more switches being brought back online. The efficiency improvements here allowed for the reallocation of some resources to the recruitment budget, and this, along with increasing CustomerLink's recruitment goals, helped the program exceed enrollment and savings goals for 2019.

> **Recommendation:** Continue to leverage efficiency gains from the improved QC process into recruitment and communication efforts.

Conclusion: The current approach to communications amongst stakeholders has been effective in building professional collegiality and helps to make the program run smoothly, especially when problems arise.

> **Recommendation:** Continue to prioritize inter-organizational communications with "spring trainings", fall meetings (when needed), weekly and monthly calls, and other existing approaches.

Conclusion: As Duke Energy Carolinas transitions to winter-peaking operational conditions, the Power Manager program in the Carolinas will have to adapt to maintain viability. Eaton is currently developing a switch for water heaters.

> **Recommendation:** Continue preparations for this eventuality, as it will not only affect technological needs, but will also require new winter-specific marketing materials for new and existing customers, new guidelines for switch installation (because they will likely be inside homes), and new enrollment and savings goals.

Conclusion: The "Assets" module of the Yukon system offers opportunities to increase granularity of load control events. As customer saturation becomes an increasingly pertinent issue, "Assets" may offer a way to address it.

> **Recommendation:** Evaluate the feasibility and cost of utilizing this capability at different scales, as it offers the ability to localize load control events and thus maximize savings by targeting areas that offer the most savings.

Nexant

Headquarters

49 Stevenson, Suite 700

San Francisco CA 94105

Tel: (415) 369-1000

Fax: (415) 369-9700

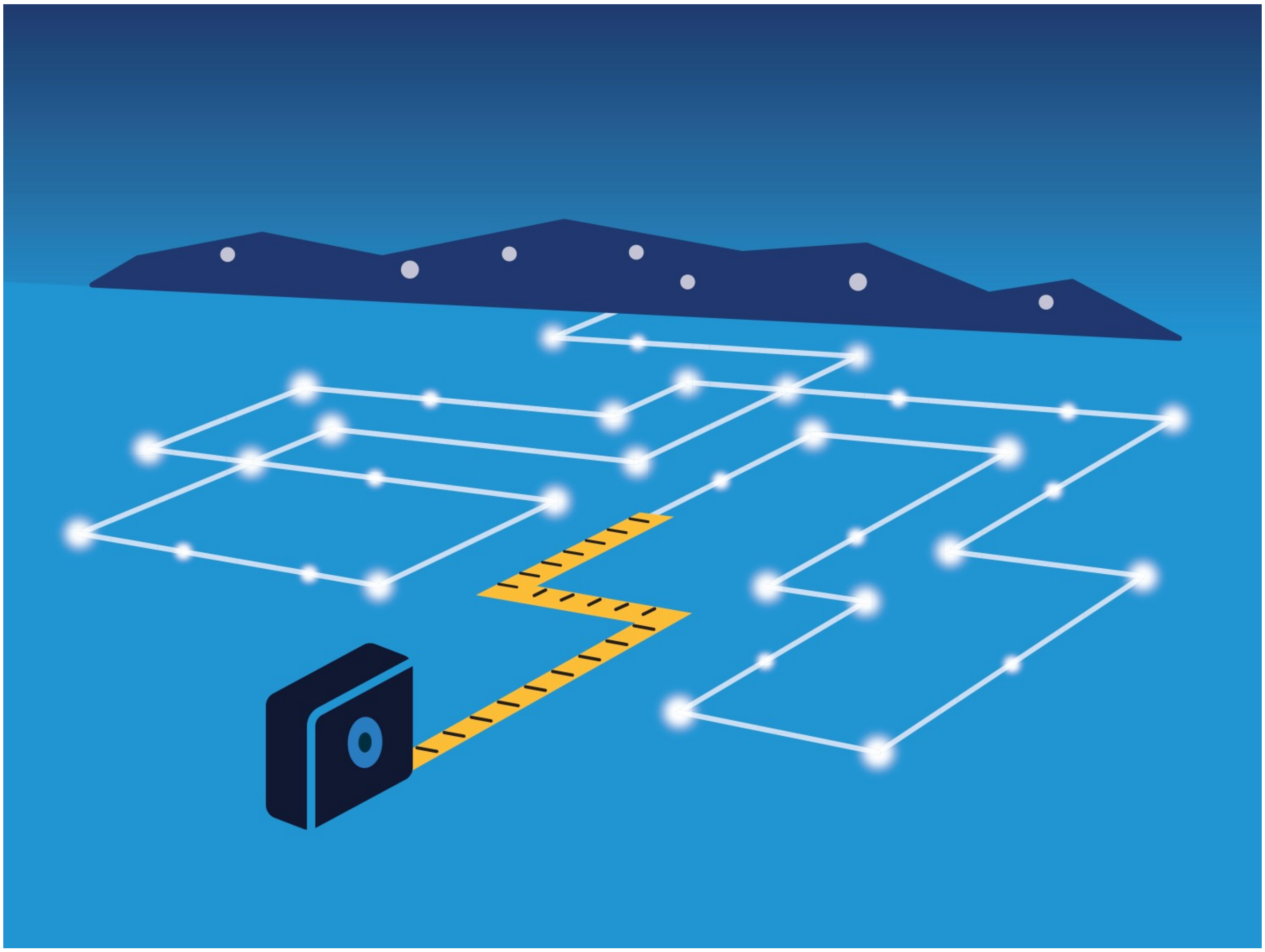
www.nexant.com

Opinion Dynamics

Boston | Headquarters

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

1000 Winter St
Waltham, MA 02451



Duke Energy Carolinas & Duke Energy Progress Online Savings Store Program

2021 Evaluation Report – Final

November 30, 2021

Table of Contents

1. Evaluation Summary ... 1
1.1 Program Summary ... 1
1.2 Evaluation Objectives ... 1
1.3 High Level Findings ... 2
1.3.1 Impact Evaluation ... 2
1.3.2 Process Evaluation ... 3
1.4 Evaluation Recommendations ... 4
2. Program Description ... 6
2.1 Program Design ... 6
2.2 Program Implementation ... 7
2.3 Program Performance ... 8
3. Overview of Evaluation Activities ... 9
3.1 Program Staff Interviews ... 9
3.2 Data and Deemed Savings Review ... 9
3.3 Participant Survey ... 9
3.4 Engineering Analysis ... 10
4. Gross Impact Evaluation ... 11
4.1 Methodology ... 11
4.1.1 Data and Deemed Savings Review ... 11
4.1.2 In-Service Rate ... 11
4.2 Gross Impact Results ... 14
4.2.1 Program Tracking Data Review ... 14
4.2.2 Per-Unit Deemed Savings ... 14
4.2.3 In-Service Rates ... 16
4.2.4 Total Ex Post Gross Savings ... 19
4.3 References ... 22
5. Net-to-Gross Analysis ... 23
5.1 Methodology ... 23
5.1.1 Free Ridership ... 23
5.1.2 Participant Spillover ... 24

5.2 NTG Results 25
5.2.1 Free Ridership 25
5.2.2 Participant Spillover 27
5.3 Net Impact Results 29
6. Process Evaluation 31
6.1 Research Questions 31
6.2 Methodology 31
6.3 Key Findings 32
6.3.1 Thermostat Usage Behavior 32
6.3.2 Program Marketing and Outreach 34
6.3.3 Value of Discounted Shipping 34
6.3.4 Program Delivery and Participant Satisfaction 35
6.3.5 Non-Energy Impacts 37
7. Conclusions and Recommendations 39
7.1 Conclusions 39
7.2 Recommendations 41
8. Summary Form 43
9. DSMore Table 44

Table of Tables

Table 1. Online Savings Store Program Performance by Jurisdiction 2
Table 2. Online Savings Store Program Performance by Jurisdiction 3
Table 3. NTGR Results 3
Table 4. Online Savings Store Program Performance by Jurisdiction 8
Table 5. Participant Survey Sample Summary 10
Table 6. Comparison of Per-Unit Deemed Savings (Net of ISR) for DEC 15
Table 7. Comparison of Per-Unit Deemed Savings (Net of ISR) for DEP 16
Table 8. LED Bulb First-Year ISR Development 16
Table 9. LED Bulb Cumulative Discounted ISR 17
Table 10. Non-Lighting First-Year ISR Development 17
Table 11. Final Effective ISR Summary 18
Table 12. Detailed Energy Savings Gross Impacts Results 19
Table 13. Detailed Summer Peak Demand Savings Gross Impacts Results 20
Table 14. Detailed Winter Peak Demand Savings Gross Impacts Results 20
Table 15. Per-Unit Savings Gross Impact Results 21
Table 16. NTGR Results 25
Table 17. FR Results 25
Table 18. Survey-Based PSO Savings 27
Table 19. Survey-Based PSO Results 28
Table 20. Non-Incented OSS Sales PSO Results 28
Table 21. Combined PSO Results 28
Table 22. Detailed Energy Savings Net Impact Results 29
Table 23. Detailed Summer Peak Demand Savings Net Impacts Results 29
Table 24. Detailed Winter Peak Demand Savings Net Impacts Results 30
Table 25. Impacts Reported by Participants 38
Table 26. Online Savings Store Program Performance by Jurisdiction 39
Table 27. Online Savings Store Program Performance by Jurisdiction 40

Table of Figures

Figure 1. LED Bulb Per-Unit Pricing 6
Figure 2. Non-Lighting and LED Fixture Per-Unit Pricing 7
Figure 3. LED Bulb First-Year ISR Development 12
Figure 4. Non-Lighting First-Year ISR Development 13
Figure 5. Portion of Program LEDs Participants Would Have Purchased Without Program Discount 26
Figure 6. Types of Bulbs Customers Would Have Purchased if Not Buying Program LEDs 27
Figure 7. Previous Thermostat Replacement 32
Figure 8. Thermostat Usage Behavior 33
Figure 9. Sources of Awareness 34
Figure 10. Discounted Shipping Breakdown 35
Figure 11. Influence of Shipping Discount 35
Figure 12. Participant Satisfaction with Program-Discounted Products 36
Figure 13. Participant Satisfaction with Key Program Elements 37

Table of Equations

Equation 1. Net Present Value Formula for Future LED Bulb Savings 13

1. Evaluation Summary

This report provides results of an impact and process evaluation of the Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) Online Savings Store (OSS) Program. The program period under evaluation is January 1, 2019 through March 31, 2021. We refer to this period as the evaluation period throughout the remainder of this report.

1.1 Program Summary

Duke Energy's OSS Program offers a wide range of point-of-sale (POS)-discounted LED lighting and advanced thermostats as well as several other consumer electronics and water-saving measures including advanced power strips, low-flow showerheads, thermostatic shower valves (TSV), dehumidifiers, and air purifiers. Incentivized LED lighting includes a variety of specialty bulb shapes and wattages as well as several types of fixtures, and advanced thermostats include a range of different models at different price points from leading brands. The non-lighting measures reflect an expansion of the OSS Program, which began exclusively distributing energy-efficient lighting in April 2013. Customers can purchase the discounted products online through a designated website operated by Energy Federation Inc. (EFI).

1.2 Evaluation Objectives

This evaluation included process and impact assessments and had several key objectives:

- Assess the program's performance and estimate gross and net annual energy (kWh) and peak summer and winter demand (kW) savings associated with program activity
  - Review program tracking data for completeness and accuracy, and discuss implications of any errors or inconsistencies for program savings estimates
  - Review deemed savings estimates used to track program performance, and provide recommendations for updates to assumptions, where necessary
  - Verify product installation and persistence, and estimate in-service rates (ISRs) by product category based on participant survey responses
  - Develop net-to-gross ratios (NTGRs) based on participant survey responses
  - Estimate ex post gross and net annual energy (kWh) and peak summer and winter demand (kW) savings and realization rates
- Gauge customer preferences as well as current and expected market trends to provide recommendations for how future implementation strategies can maximize customer engagement and minimize free ridership (FR)
- Assess the program's implementation processes and marketing strategies to identify key successes and opportunities for improvement

1.3 High Level Findings

From January 1, 2019 through March 31, 2021, Duke Energy's OSS Program sold 613,990 discounted energy-efficient products to DEC customers and 252,091 to DEP customers, achieving program-tracked ex ante energy savings of 32.1 GWh for DEC and 13.5 GWh for DEP. Table 1 provides a summary of program sales and ex ante energy savings.

Table 1. Online Savings Store Program Performance by Jurisdiction

Product Category	DEC				DEP			
	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings
Specialty LED	283,299	46%	9,444,683	29%	125,641	50%	4,212,587	31%
Reflector LED	217,718	35%	10,159,269	32%	80,792	32%	3,778,285	28%
Standard LED	74,703	12%	1,600,138	5%	25,679	10%	550,044	4%
LED Fixture	1,184	<1%	149,207	<1%	794	<1%	107,321	1%
Advanced Thermostat	27,828	5%	10,503,122	33%	15,427	6%	4,728,221	35%
Advanced Power Strip	8,663	1%	159,572	<1%	3,417	1%	62,941	<1%
Showerhead with TSV	387	<1%	82,040	<1%	230	<1%	63,059	<1%
Standalone TSV	197	<1%	10,991	<1%	102	<1%	7,359	<1%
Dehumidifier	10	<1%	1,530	<1%	9	<1%	1,377	<1%
Air Purifier	1	<1%	403	<1%	0	0%	0	0%
Total	**613,990**	**100%**	**32,110,956**	**100%**	**252,091**	**100%**	**13,511,195**	**100%**

Note: Specialty LEDs include globe, decorative, and three-way bulbs; reflector LEDs include both indoor and outdoor bulbs; LED fixtures include portable, direct wire, and photocell products.

1.3.1 Impact Evaluation

The DEC program realized 30.9 GWh in ex post gross energy savings, 6.5 MW in summer peak demand savings, and 4.5 MW in winter peak demand savings during the evaluation period. In the same period, the DEP program achieved 15.4 GWh in ex post gross energy savings, 3.3 MW in summer peak demand savings, and 2.8 MW in winter peak demand savings.

Gross realization rates for the DEC program are 96% for energy savings, 204% for summer peak demand savings, and 287% for winter peak demand savings, while the DEP program saw gross realization rates of 114% for energy savings, 259% for summer peak demand savings and 437% for winter peak demand savings. In both jurisdictions, realization rates are slightly below 100% for LED lighting, which accounts for more than half of ex post gross energy savings. For DEP energy savings, this is more than offset by a 138% realization rate for advanced thermostats, while for DEC energy savings, the advanced thermostat realization rate is also slightly below 100%. For demand savings, advanced thermostats are the primary driver of high overall realization rates, as these products were not assigned ex ante demand savings but account for more than half of ex post gross summer and winter demand savings.

After applying NTGRs established by the current evaluation, the DEC offering achieved 12.6 GWh in ex post net energy savings, 3.3 MW in summer peak demand savings, and 2.6 MW in winter peak demand ex post net savings. The DEP program meanwhile achieved 7.9 GWh in ex post net energy savings, 2.0 MW in summer peak demand savings, and 1.9 MW in winter peak demand ex post net savings.

Table 2 summarizes total ex ante, ex post gross, and ex post net savings for each jurisdiction.

Table 2. Online Savings Store Program Performance by Jurisdiction

Jurisdiction	Metric	Ex Ante	Gross RR	Ex Post Gross	Effective NTGR	Ex Post Net
DEC	Energy Savings (kWh)	32,110,956	96%	30,872,979	0.409	12,631,646
	Summer Peak Demand Savings (kW)	3,179	204%	6,493	0.507	3,293
	Winter Peak Demand Savings (kW)	1,569	287%	4,496	0.578	2,600
DEP	Energy Savings (kWh)	13,511,195	114%	15,359,753	0.513	7,882,578
	Summer Peak Demand Savings (kW)	1,291	259%	3,341	0.589	1,969
	Winter Peak Demand Savings (kW)	644	437%	2,814	0.659	1,854

Note: NTGR values were developed by product category and jurisdiction. While NTGRs do not vary across energy and demand savings, the effective NTGRs (estimated as jurisdiction level ex post net savings divided by ex post gross savings) do as a result of varying contributions of each product category to energy and summer and winter demand savings.

Table 3 provides NTGR results by product category and jurisdiction developed as part of the current evaluation. The evaluation team produced NTGR estimates that account for both FR and participant spillover (PSO). We estimated FR separately for each product category and jurisdiction and developed PSO estimates for the program population overall for each jurisdiction. The NTGR results shown here are applied to ex post gross savings to produce ex post net savings estimates.

Table 3. NTGR Results

Product Category	DEC			DEP		
	FR	PSO	NTGR	FR	PSO	NTGR
LED Lighting	0.777	0.002	0.225	0.695	0.007	0.312
Advanced Thermostats	0.263		0.739	0.257		0.750
Advanced Power Strips	0.031		0.971	0.013		0.994
Showerheads and TSVs	0.125		0.877	0.046		0.961
Dehumidifiers	0.140		0.862	0.105		0.902
Air Purifiers	0.140		0.862	0.105		0.902

1.3.2 Process Evaluation

The evaluation team identified the following high-level process findings based on research conducted as part of the current evaluation:

- Participants are highly satisfied with program-discounted products, key program elements, and the program overall, contributing to an image of a smoothly functioning program that consistently delivers on customer expectations.
- Around half of all participants first learned of the OSS offering from a bill insert or mailing (49% for DEC, 54% for DEP), and approximately one-third found out about the offering on the Duke Energy website (36% for DEC, 31% for DEP).

- Among participants who purchased non-lighting products, many had not been considering a comparable purchase prior to learning of the program's available discounts. This finding was particularly prominent among advanced power strip recipients (73% for DEC, 90% for DEP) and low-flow showerhead and TSV participants (63% for DEC, 79% for DEP) and suggests that other similar products may be especially good candidates for promotion through the program.
- As the market for LED lighting nears transformation, FR continues to rise, reflecting an increase in customer knowledge of and preference for LED bulbs paired with the increased availability and steadily decreasing prices of these products. Most of the remaining program influence (i.e., non-FR) identified by the current evaluation for these products is attributable to the program's role in motivating customers to replace still-working less efficient lighting with LEDs sooner than they otherwise would have.
- Many participants are unsure whether they had received free or reduced shipping, but among those who did, more than 80% considered it highly influential on their decision to purchase program-discounted products, suggesting it may be an especially valuable point of emphasis for future program marketing and an effective tool for encouraging energy-efficient purchases.
- Most advanced thermostat recipients purchased the new thermostat to replace a programmable thermostat (76% for DEC, 62% for DEP), while nearly all the others were replacing manual thermostats (20% for DEC, 38% for DEP). Although many customers reported having previously owned programmable thermostats, virtually all reported they primarily relied on manual adjustments or set the thermostat to a single temperature for entire seasons. Meanwhile, around two-thirds of participants reported they primarily use a programmed schedule and/or self-optimization features on their new thermostat (61% for DEC, 67% for DEP).
- First-year ISRs of less than 80% for advanced thermostats and advanced power strips indicate that substantive portions of participants are not installing their program-discounted products within several months of purchasing. Among respondents who did not have all of their new products installed, most indicated that they had not yet needed or had not yet gotten around to installing.
- Many advanced thermostat participants reported noticeable benefits of their new program-discounted products in terms of increased comfort and reduced electricity bills. Among LED lighting participants, more than half suggested the quality of light in their home had been improved.

1.4 Evaluation Recommendations

Based on the findings of this evaluation, the evaluation team identified the following opportunities for program improvement:

- Although there is a high rate of customer uncertainty regarding whether they received discounted shipping, those who did reported that it influenced their decision to purchase a program-discounted product. Therefore, we recommend that program marketing highlight discounted or free shipping, when available, both in outreach materials and on the program website.
- To support increases to first-year ISR, we recommend that the program continue to include collateral with orders encouraging customers to install their new energy-efficient products. The program could also consider additional outreach to recent participants encouraging them to install their new products, particularly for advanced thermostats. This has the potential to help the program maximize first-year savings.
- Program tracking data should include the necessary product infomation to enable application of appropriate savings assumptions for all product categories, as it did for all products sold during the

current evaluation period with the exception of air purifiers. For air purifiers, future program tracking data should include the product's size (i.e., clean air delivery rate) to ensure the accuracy of savings estimates.

- We recommend the program continue to explore possible expansions of the OSS Program and continue using the offering to promote less common energy-efficient products, some of which have already been introduced to the program (including advanced power strips, faucet aerators, air purifiers, dehumidifiers, or other household appliances). Our evaluation found that participants often purchase these products as a direct result of information made available by the OSS offering, as exhibited by their relatively low FR estimates.

2. Program Description

This section provides an overview of the design, implementation, and performance of the DEC and DEP Online Savings Store Program. The program period under evaluation is January 1, 2019 through March 31, 2021.

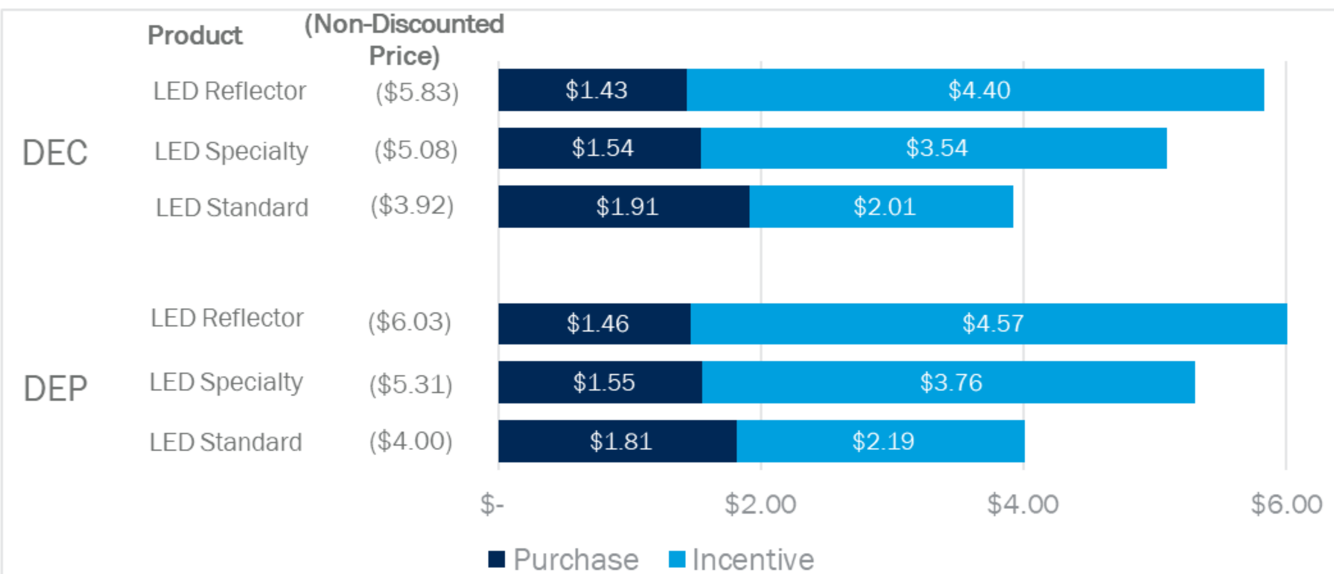
2.1 Program Design

Duke Energy's OSS Program offers a wide range of POS-discounted LED lighting and advanced thermostat products as well as several other consumer electronics and water-saving measures including advanced power strips, low-flow showerheads, TSVs, air purifiers, and dehumidifiers. Incentivized LED lighting includes a variety of specialty bulb shapes and wattages as well as several types of fixtures, and advanced thermostats include a range of different models at varying price points from leading brands.

The non-lighting measures reflect an expansion of the OSS Program, which began exclusively distributing energy-efficient lighting in April 2013. Customers can purchase the discounted products online through a designated website operated by EFI.

Program discounts varied considerably across products and throughout the evaluation period. Among incented LED bulbs for which program tracking data included pricing information,[1] average discounts amounted to more than 50% of non-discounted pricing for each category, with discounts averaging as high as 78% of non-discounted pricing for reflector bulbs. Figure 1 shows average per-unit pricing and incentive amounts for type of LED bulb sold through the program.

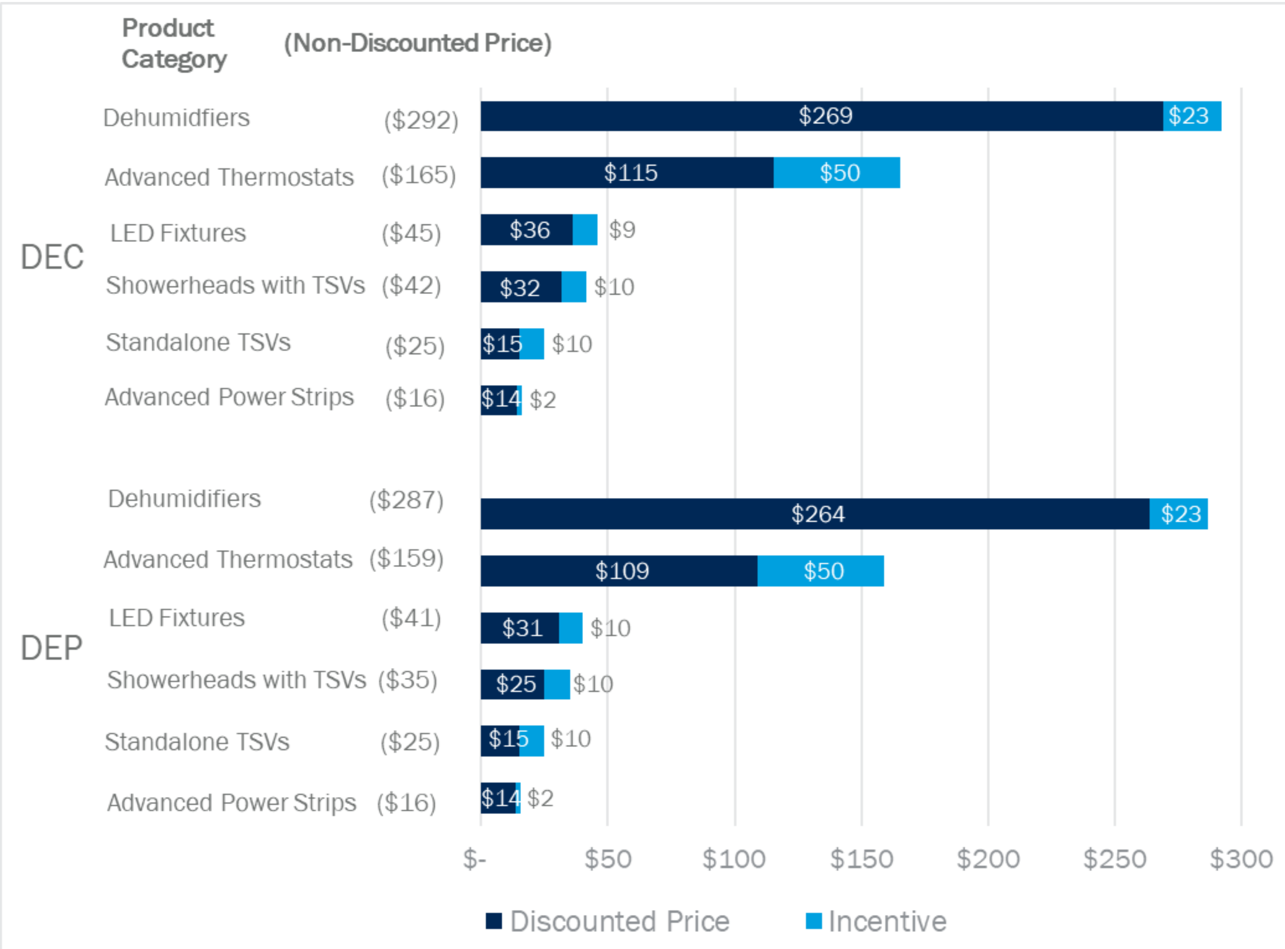
Figure 1. LED Bulb Per-Unit Pricing



[1] Pricing information was unavailable from program tracking data for most purchases made prior to mid-2020.

Figure 2 illustrates the average per-unit costs and program discounts associated with other higher-cost product categories among records for which program tracking data included pricing information. The program typically offered $50 incentives on advanced thermostats, $10 incentives on low-flow showerheads and TSVs, and $2 on advanced power strips. The small number of dehumidifiers sold during the evaluation period were each discounted by $23, amounting to 8% of their non-discounted price. LED fixture discounts ranged from $5 for lower-cost portable fixtures to $10 for photocell fixtures and $12 for direct wire fixtures, averaging $9 to $10 per-unit.

Figure 2. Non-Lighting and LED Fixture Per-Unit Pricing



2.2 Program Implementation

Duke Energy staff manage the OSS Program offerings and are responsible for overseeing program design, marketing, and operations. EFI has implemented the offering on behalf of Duke Energy since the program's inception. EFI is responsible for facilitating customer orders, warehousing products, maintaining inventory, handling order fulfillment and shipping logistics, and managing program invoicing and data tracking.

2.3 Program Performance

From January 1, 2019 through March 31, 2021, Duke Energy's OSS Program sold 613,990 discounted energy-efficient products to DEC customers and 252,091 to DEP customers, achieving ex ante gross energy savings of 32.1 GWh for DEC and 13.5 GWh for DEP. LED lighting dominated the OSS Program sales in both jurisdictions, representing more than 90% of total units sold and more than 50% of ex ante gross energy savings. Non-lighting measures were first distributed by the program in March 2019, shortly before standard LEDs were dropped from the list of available products. Advanced thermostats accounted for 5% of DEC and 6% of DEP sales but for 33% and 35% of savings, respectively. Other non-lighting products accounted for small shares of sales and savings (2% or less).

Table 4 provides a summary of program sales and ex ante energy savings.

Table 4. Online Savings Store Program Performance by Jurisdiction

Product Category	DEC				DEP			
	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings
Specialty LED	283,299	46%	9,444,683	29%	125,641	50%	4,212,587	31%
Reflector LED	217,718	35%	10,159,269	32%	80,792	32%	3,778,285	28%
Standard LED	74,703	12%	1,600,138	5%	25,679	10%	550,044	4%
LED Fixture	1,184	<1%	149,207	<1%	794	<1%	107,321	1%
Advanced Thermostat	27,828	5%	10,503,122	33%	15,427	6%	4,728,221	35%
Advanced Power Strip	8,663	1%	159,572	<1%	3,417	1%	62,941	<1%
Showerhead with TSV	387	<1%	82,040	<1%	230	<1%	63,059	<1%
Standalone TSV	197	<1%	10,991	<1%	102	<1%	7,359	<1%
Dehumidifier	10	<1%	1,530	<1%	9	<1%	1,377	<1%
Air Purifier	1	<1%	403	<1%	0	0%	0	0%
Total	**613,990**	**100%**	**32,110,956**	**100%**	**252,091**	**100%**	**13,511,195**	**100%**

Some OSS program participants also purchased non-incented LED lighting products from the OSS website in addition to program-discounted ones. Participants who reached the program's limit of 36 bulbs or fixtures were able to purchase additional LED products at non-discounted prices, amounting to 3,200 units for DEC and 650 units for DEP. These non-discounted OSS purchases are not included in program sales summaries or considered part of program ex ante or ex post gross savings, but are instead evaluated as potential PSO (see discussion in Sections 5.1.2 and 5.2.2).

3. Overview of Evaluation Activities

To answer the evaluation objectives outlined in Section 1.2, Opinion Dynamics performed a range of data collection and analytic activities, including the following:

- Program staff interviews
- Data and deemed savings review
- Participation survey
- Engineering analysis

3.1 Program Staff Interviews

The evaluation team conducted an in-depth qualitative telephone interview with Duke Energy program staff in April 2021 to (1) obtain a full understanding of the OSS Program, including implementation processes, eligibility requirements, and available program-tracked participant information; (2) obtain program staff's perspective on current and past program successes and challenges; and (3) identify program staff's priorities for the process evaluation, including researchable questions.

3.2 Data and Deemed Savings Review

As part of this evaluation, we reviewed program tracking data, assessed its completeness and accuracy, and identified errors or inconsistencies. We discuss our findings and their implications for program-tracked savings in Section 4.2 of this report. We also conducted a detailed review of deemed savings estimates used to track program performance, assumptions behind those values, and sources of those assumptions. We performed manual lookups of product specifications in a small number of cases where the necessary detail was unavailable from the tracking database or where information in the data appeared inconsistent and used those lookups to inform the application of savings assumptions. We delivered a memorandum presenting the findings of this review and recommended updates to per-unit savings, which is included in Appendix B.

3.3 Participant Survey

The evaluation team conducted an online survey with a sample of OSS participants to gauge installation and usage behavior with products purchased through the OSS offering, solicit feedback regarding experiences with the program, and collect information relevant to estimating gross and net savings not available from program tracking data or applicable secondary sources. This included key household characteristics, heating and cooling equipment, and information needed to develop estimates of ISR, FR, and PSO.

Sample Design and Fielding

We designed the survey sample to enable the development of robust ISR and FR estimates by product category for each jurisdiction, where possible. To avoid participant recall issues, we limited the sample frame for the survey to participants who made their purchase no more than twelve months prior to survey fielding.

We stratified the sample by product category and randomly selected up to 650 participants with purchases of each product category to include in the sample. For product categories with fewer than 650 participants who made their purchase within twelve months prior to survey fielding, which included advanced power strips and low-flow showerheads and TSVs, we attempted a census of all participants with available contact information. We excluded standard LEDs, dehumidifiers, and air purifiers given their very limited or non-existent participation during the twelve months preceding survey fielding. We reached out to each sampled participant up to three times via email inviting them to complete the online survey between July 30, 2021 and August 12, 2021.[2]

In total, 298 DEC participants and 172 DEP participants completed the survey. Table 5 summarizes the total count of participants and the number of survey respondents by product category for each jurisdiction.

Table 5. Participant Survey Sample Summary

Product Category	DEC		DEP	
	Participants in Population	Survey Completes	Participants in Population	Survey Completes
Specialty LEDs	3,646	68	1,716	41
Reflector LEDs	2,858	63	1,302	34
Advanced Thermostats	8,237	64	5,160	35
Advanced Power Strips[A]	439	88	205	48
Showerheads and TSVs[A]	73	15	59	14
Total	**15,473**	**298**	**8,491**	**172**

[A] We attempted a census of advanced power strip and low-flow showerhead and TSV participants.

3.4 Engineering Analysis

We estimated annual energy and demand savings for each product sold through the OSS Program by applying the outputs of our deemed savings review (i.e., product category-specific per-unit savings) and ISR analysis to product quantities in the program tracking database.

[2] We also conducted a truncated supplementary fielding effort from August 31, 2021 to September 10, 2021 to collect information from advanced power strip participants necessary for developing estimates of FR.

4. Gross Impact Evaluation

The gross impact evaluation of the DEC and DEP OSS Program consisted of two distinct steps: (1) review of per-unit deemed savings values for incented products; and (2) verification of product installation and continued operation. This section describes the methodologies and results of both steps.

It should be noted that this evaluation did not include a consumption analysis of advanced thermostats given the timing of evaluation activities relative to the measure's introduction to the program. We plan to conduct a consumption analysis as part of the next evaluation, when sufficient post-installation consumption data is available for participants who installed advanced thermostats.

4.1 Methodology

We employed the research methods described in this section to validate program tracking data, review and update deemed savings assumptions, verify product installation and persistence, and calculate ex post gross energy and demand savings for products sold through the DEC and DEP OSS Program.

4.1.1 Data and Deemed Savings Review

We began by reviewing all available program tracking data, assessing its completeness and accuracy, and identifying all available to inform estimation of per-unit savings. To develop per-unit savings, we used several resources. Since neither North Carolina nor South Carolina has a statewide TRM, we relied on the Mid-Atlantic TRM, where possible, and used other TRMs (including the Illinois and Indiana TRMs) and other secondary sources, as needed, for algorithms and assumptions. Where available, our engineering team used inputs from the program tracking data and from our survey of program participants. For more information on the algorithms and inputs used to develop deemed per-unit savings estimates for each product category, see Appendix B.

4.1.2 In-Service Rate

To develop first-year ISR estimates, we relied on responses to the participant survey that asked customers to verify receipt and installation of purchased products. For lighting purchases, most products not installed at the time of the survey are placed in storage and installed in future years, so the ISR analysis used a discounted savings approach to claim savings associated with those future installations. The following sections detail the methods employed to estimate first-year and effective ISRs for both lighting and non-lighting products sold through the DEC and DEP OSS Program.

LED Bulb First-Year ISRs

The evaluation team calculated ISRs for LED bulbs using responses to a series of survey questions that asked respondents to report the number of bulbs they received, the number of bulbs they installed, and the number of bulbs that were installed and then removed. We calculated the received rate as the number of bulbs received divided by the number of bulbs appearing in program tracking data, the installed rate as the number of bulbs installed divided by the number of bulbs received, and the persistence rate as the number of bulbs still installed divided by number of bulbs initially installed. The first-year ISR is a product of the receipt, installation, and persistence rates, as shown in Figure 3.

Figure 3. LED Bulb First-Year ISR Development

Reported	# of bulbs purchased according to program tracking data
%Received	# of bulbs confirmed received by customers / # reported
%Installed	# of bulbs confirmed installed by customers / # received
%Persisting	# of bulbs confirmed remaining installed / # initially installed
First-Year ISR	%Received x %Installed x %Persisting

LED Bulb Future Installations

Research studies across the country have found that residential customers often purchase more LED bulbs than immediately needed and continue to install these bulbs from storage in subsequent years. The two main approaches to claiming savings from these later installations are (1) staggering the savings over time and claiming some in later years, and (2) claiming the savings in the evaluation period the product was sold but discounting savings by a societal or utility discount rate. While the "staggered" approach allows program administrators to more accurately capture the timing of the realized savings, the "discounted savings" approach allows for the simplicity of claiming all costs and benefits during the evaluation period and eliminates the need to keep track of and claim savings from future installations.

The evaluation team used a discounted savings approach to account for savings from future installations. To allocate installations over time, we relied on the installation trajectory recommended by the Uniform Methods Project (UMP) whereby 24% of remaining bulbs are installed in each subsequent year, for a total of five years. For example, if the Year 1 ISR is 80%, an additional 4.8% of bulbs would be installed in Year 2 ([1 – 80%] x 24%; or 20% x 24%) and an additional 3.6% of bulbs would be installed in Year 3 ([1 – 80% - 4.8%] x 24%; 15.2% x 24%).

These future installations are then discounted using Equation 1 to derive the net present value (NPV) of savings associated with future installs of LED bulbs.

Equation 1. Net Present Value Formula for Future LED Bulb Savings

$$NPV = \frac{R_t}{(1+i)^t}$$

Where:

R = Savings
i = Discount rate
t = Number of years in the future that savings take place

Non-Lighting First-Year ISRs

The evaluation team developed ISRs for non-lighting products based on two sets of survey questions asking respondents to confirm the number of products received and to report the number of those products installed at the time of the survey. We calculated the receipt rate as the number of units received by the customer divided by the number appearing in program tracking data and the persistence rate as the number of units installed at the time of the survey divided by the number received. The first-year ISR is a product of the receipt and persistence rates, as shown in Figure 4.

Figure 4. Non-Lighting First-Year ISR Development

Reported	# of units purchased according to program tracking data
%Received	# of units confirmed received by customers / # reported
%Persisting	# of units confirmed currently installed by customers / # received
First-Year ISR	%Received x %Persisting

4.2 Gross Impact Results

This section provides gross energy and demand savings estimates for each product category offered by the DEC and DEP OSS Program and program-level savings, by jurisdiction, during the evaluation period.

4.2.1 Program Tracking Data Review

Opinion Dynamics received two types of program tracking data extracts for each jurisdiction. One type contained product and shipment information while the other contained customer contact information and product pricing. We combined the two sets of data extracts and analyzed the combined dataset for gaps and inconsistencies. As a part of the analysis, we performed the following steps:

- Checked core data fields for missing values
- Checked data for temporal gaps
- Checked key data fields for reasonableness and consistency

In reviewing the data, we found the data fields were clean and fully populated for the most part. Program tracking data included the necessary product specifications to inform TRM-based savings calculations for all product categories with the exception of air purifiers. Incorporating air purifier product size or clean air delivery rates into program tracking data would enable application of appropriate savings assumptions. Contact information and product pricing was included for all recent participation records but was mostly unavailable for purchases made prior to mid-2020. Among records where pricing information was provided, we did not observe any anomalous incentive amounts or total non-discounted pricing.

4.2.2 Per-Unit Deemed Savings

Duke Energy provided per-unit ex ante savings values in the form of spreadsheets containing DSMore outputs for each product category, jurisdiction, and state. Per-unit ex ante savings values are consistent for each product category across jurisdictions and states with the exception of advanced thermostats, low-flow showerheads, and TSVs, which vary by jurisdiction. Savings values were provided as energy, summer peak, and winter peak demand savings across six LED bulb types, three LED fixture types, and five non-lighting product categories.

Ex ante savings for LED lighting products are drawn directly from the most recent prior evaluation of the DEC OSS Program. These values reflect average per-unit ex post savings across the mix of products included in that product category during the prior evaluation period and incorporate ISRs from the prior evaluation. To allow for a better comparison of engineering assumptions, we backed out the prior LED lighting ISRs and developed ex post per-unit values that are also exclusive of ISRs.[3] For non-lighting products, exact parameters and sources used to develop ex ante per-unit savings were not readily available.

[3] The 2018 DEC OSS Program evaluation applied an effective ISR of 87.7% to develop ex-post savings, which were then provided by program staff as ex ante per-unit savings for LED bulbs in the current OSS Program. We therefore divided the ex ante values provided by program staff by 87.7% to produce the ex ante values shown here.

Differences between ex ante and ex post per-unit savings for LED lighting are primarily attributable to shifts in the mix of specific products and LED wattages within each category, with the exception of three-way bulbs, for which ex post savings reflect baseline wattage assumptions assigned based on mid-level lumen output rather than maximum lumen output. The product categories with the largest differences between ex ante and ex post gross per-unit savings are advanced power strips, where ex post savings are more than six times ex ante per-unit savings and advanced thermostats, for which ex ante demand savings were not claimed. In the absence of additional information on the sources of non-lighting ex ante assumptions, the reasons for differences between non-lighting ex ante and ex post per-unit savings estimates remain unknown.

Table 6 and Table 7 provide ex ante and ex post per-unit savings for all products sold through the DEC and DEP OSS Program. Additional detail on parameters and algorithms used to develop per-unit savings are provided in the deemed savings review memorandum included in Appendix B.

Table 6. Comparison of Per-Unit Deemed Savings (Net of ISR) for DEC

Product Category	Energy (kWh)		Summer Demand (kW)		Winter Demand (kW)	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
A-Line LED[A]	24.42	28.62	0.0036	0.0042	0.0017	0.0020
Recessed LED[A]	54.16	54.04	0.0080	0.0080	0.0039	0.0039
Recessed Outdoor LED[A]	47.67	48.85	0.0071	0.0072	0.0034	0.0035
Globe LED[A]	36.61	34.99	0.0054	0.0052	0.0026	0.0025
Decorative LED[A]	35.21	31.76	0.0052	0.0047	0.0025	0.0023
Three-Way LED[A]	83.01	54.19	0.0122	0.0080	0.0059	0.0039
LED Fixture – Direct Wire	39.62	48.37	0.0052	0.0071	0.0043	0.0035
LED Fixture – Portable	20.99	32.85	0.0027	0.0048	0.0023	0.0024
LED Fixture – Photocell	227.91	213.48	0.0000	0.0000	0.0050	0.0072
Advanced Thermostat	377.43	517.19	0.0000	0.1804	0.0000	0.1553
Advanced Power Strip	18.42	112.30	0.0015	0.0100	0.0023	0.0100
Showerhead with TSV	211.99	195.10	0.0683	0.0153	0.0683	0.0306
Standalone TSV	55.79	45.00	0.0180	0.0057	0.0180	0.0114
Dehumidifier	153.02	114.73	0.0347	0.0260	0.0000	0.0000
Air Purifier[B]	403.00	403.00	0.0462	0.0462	0.0462	0.0462

[A] Ex ante per-unit values shown here for LED bulbs have been adjusted to omit ISR, whereas original ex ante values provided by program staff and shown elsewhere in this report have ISRs embedded.

[B] Only one air purifier was sold during the evaluation period and tracking data did not provide sufficient detail to inform the deemed savings review. For the purposes of this evaluation, we set ex post values equal to ex ante values for air purifiers.

Table 7. Comparison of Per-Unit Deemed Savings (Net of ISR) for DEP

Product Category	Energy (kWh)		Summer Demand (kW)		Winter Demand (kW)	
	Ex Ante	Ex Post	Ex Ante	Ex Post	Ex Ante	Ex Post
A-Line LED[A]	24.42	28.81	0.0036	0.0043	0.0017	0.0021
Recessed LED[A]	54.16	54.62	0.0080	0.0081	0.0039	0.0039
Recessed Outdoor LED[A]	47.67	51.03	0.0071	0.0075	0.0034	0.0037
Globe LED[A]	36.61	35.01	0.0054	0.0052	0.0026	0.0025
Decorative LED[A]	35.21	31.70	0.0052	0.0047	0.0025	0.0023
Three-Way LED[A]	83.01	51.48	0.0122	0.0076	0.0059	0.0037
LED Fixture – Direct Wire	39.62	44.26	0.0052	0.0065	0.0043	0.0032
LED Fixture – Portable	20.99	32.95	0.0027	0.0049	0.0023	0.0024
LED Fixture – Photocell	227.91	210.15	0.0000	0.0000	0.0050	0.0071
Advanced Thermostat	306.49	594.55	0.0000	0.1886	0.0000	0.1983
Advanced Power Strip	18.42	112.30	0.0015	0.0100	0.0023	0.0100
Showerhead with TSV	274.17	213.60	0.0874	0.0177	0.0874	0.0355
Standalone TSV	72.15	49.26	0.0230	0.0066	0.0230	0.0132
Dehumidifier	153.02	113.94	0.0347	0.0258	0.0000	0.0000
Air Purifier[B]	403.00	403.00	0.0462	0.0462	0.0462	0.0462

[A] Ex ante per-unit values shown here for LED bulbs have been adjusted to omit ISR, whereas original ex ante values provided by program staff and shown elsewhere in this report have ISRs embedded.

[B] Only one air purifier was sold during the evaluation period, and tracking data did not provide sufficient detail to inform the deemed savings review. For the purposes of this evaluation, we set ex post values equal to ex ante values for air purifiers.

4.2.3 In-Service Rates

Table 8 summarizes survey-based first-year ISRs for LED bulbs. The first-year ISR is a product of the receipt, installation, and persistence rates, as detailed in Section 4.1.2. Analysis results show that participants confirmed receipt of almost all discounted LED purchases (99% of DEC, 98% for DEP) and that once installed, LED bulbs generally remained in place (92% for DEC, 99% for DEP). However, consistent with typical trends for this type of program, not all bulbs are installed within the first year, resulting in installation rates well below 100% (68% for DEC, 74% for DEP) and overall first-year ISRs of 62% for DEC and 72% for DEP.

Table 8. LED Bulb First-Year ISR Development

Rate	DEC (n=131)	DEP (n=75)
% Received	98.7%	98.1%
% Installed	68.0%	74.2%
% Persisting	92.2%	98.6%
First-Year ISR	**61.8%**	**71.7%**

Table 9 provides cumulative installations of LED bulbs by year using the discounted approach discussed above (i.e., incremental installations of 24% of bulbs that remain uninstalled for a total of five additional years). The values shown here are discounted to represent the net present value of installations that occur in each year. The resulting effective ISRs are 86.1% for DEC and 89.7% for DEP.

Table 9. LED Bulb Cumulative Discounted ISR

Year	Cumulative Discounted ISR	
	DEC	DEP
2021 (Year 1)	61.8%	71.7%
2022 (Year 2)	70.5%	78.3%
2023 (Year 3)	76.6%	82.7%
2024 (Year 4)	80.8%	85.9%
2025 (Year 5)	83.9%	88.1%
2026 (Year 6)	86.1%	89,7%
Total	**86.1%**	**89.7%**

Table 10 provides the survey-based values used to calculate first-year ISRs for advanced thermostats, advanced power strips, and low-flow showerheads and TSVs by jurisdiction. First-year ISRs for non-lighting products are calculated by multiplying the percent of the program-tracked quantity confirmed received by the percent of received bulbs confirmed installed at the time of the survey.

Table 10. Non-Lighting First-Year ISR Development

Rate	DEC			DEP		
	Advanced Thermostats (n=64)	Advanced Power Strips (n=84)	Showerheads and TSVs (n=12)	Advanced Thermostats (n=35)	Advanced Power Strips (n=48)	Showerheads and TSVs (n=14)
% Received	97.6%	99.3%	85.7%	100%	100%	100%
% Installed	70.7%	73.9%	100%	71.1%	79.1%	75.0%
First-Year ISR	**69.0%**	**73.4%**	**85.7%**	**71.1%**	**79.1%**	**75.0%**

Table 11 summarizes effective ISR values by product category and jurisdiction. The effective ISR for LED bulbs is reflective of the discounted savings approach detailed earlier in this report, while other values either reflect survey-based estimates of first-year ISR or are deemed at 100% (in cases where products are assumed to be installed or participation levels did not support survey sampling). Relative precision around the point estimates for product categories where sampling error applies range from 8.3% to 14.0% at 90% confidence.

Table 11. Final Effective ISR Summary

Product Category	DEC			DEP		
	ISR	n	Relative Precision	ISR	n	Relative Precision
LED Bulbs	86.1%	131	8.3%	89.7%	75	9.4%
LED Fixtures[A]	100.0%	N/A	N/A	100.0%	N/A	N/A
Advanced Thermostats	69.0%	64	10.7%	71.1%	35	14.0%
Advanced Power Strips[B]	73.4%	84	N/A	79.1%	48	N/A
Showerheads and TSVs[B]	85.7%	12	N/A	75.0%	14	N/A
Dehumidifiers[A]	100.0%	N/A	N/A	100.0%	N/A	N/A
Air Purifiers[A]	100.0%	N/A	N/A	100.0%	N/A	N/A

[A] ISR is assumed to be 100% for dehumidifiers, air purifiers, and LED fixtures.

[B] Because we attempted a census of advanced power strip and low-flow showerhead and TSV participants, the concept of sampling error does not apply for these product categories.

As expected, lighting participants who did not have all of their new LED products installed at the time of the survey (54% of DEC and 52% of DEP respondents) overwhelmingly reported that they had not yet needed them and were waiting for other bulbs to burn out (94% for both DEC and DEP). Most of the remaining 6% reported that the new LEDs had already burnt out, that they did not like the light quality, or that they were the wrong size for the intended socket.

Among surveyed advanced thermostat participants, around one-quarter (27% for DEC, 23% for DEP) had not installed their new thermostat(s) at the time of the survey. The most common reasons included having not yet gotten around to it (62%) and the item being incompatible with their current setup (23%). Just over one-quarter (29% for both DEC and DEP) of participants who purchased advanced power strips had not installed them all at the time of the survey. Most of these respondents similarly indicated that they had not yet needed or not yet gotten around to installing (53%), while another third of respondents indicated that the product was incompatible with their current setup (33%). Among the six respondents who had not installed their program-discounted low-flow showerhead or TSVs (19% of respondents who received these items), two had not gotten around to doing so, two reported they gave the product to a friend or family member, and two said that they did not like the product and therefore uninstalled.

These ISRs, especially for non-lighting products such as advanced thermostats and advanced power strips, indicate that a substantive portion of participants who purchase these products have yet to install or use them for several months after purchasing. Additional outreach or prompts to future participants may help encourage installation of these products and improve first-year ISRs and, subsequently, first-year savings from these products.

4.2.4 Total Ex Post Gross Savings

Table 12, Table 13, and Table 14 present total ex ante and ex post gross energy, summer peak demand, and winter peak demand savings and realization rates, by product category and jurisdiction. The DEC program realized 30.9 GWh in ex post gross energy savings, 6.5 MW in summer peak demand savings, and 4.5 MW in winter peak demand savings during the evaluation period. In the same period, the DEP program achieved 15.4 GWh in ex post gross energy savings, 3.3 MW in summer peak demand savings, and 2.8 MW in winter peak demand savings.

Gross realization rates for the DEC program are 96% for energy savings, 204% for summer peak demand savings, and 287% for winter peak demand savings, while the DEP program saw gross realization rates of 114% for energy savings, 259% for summer peak demand savings and 437%for winter peak demand savings. In both jurisdictions, realization rates are slightly below 100% for LED lighting, which accounts for more than half of ex post gross energy savings. For DEP energy savings, this is more than offset by a 138% realization rate for advanced thermostats, while for DEC energy savings, the advanced thermostat realization rate is also slightly below 100%. For demand savings, advanced thermostats are the primary driver of high overall realization rates, as these products were not assigned ex ante demand savings but account for more than half of ex post gross summer and winter demand savings.

Table 12. Detailed Energy Savings Gross Impacts Results

Product Category	DEC			DEP		
	Ex Ante kWh	Gross RR	Ex Post Gross kWh	Ex Ante kWh	Gross RR	Ex Post Gross kWh
Specialty LED	9,444,683	88%	8,282,108	4,212,587	91%	3,837,885
Reflector LED	10,159,269	98%	9,907,775	3,778,285	103%	3,900,243
Standard LED	1,600,138	115%	1,837,992	550,044	121%	662,946
LED Fixture	149,207	85%	126,444	107,321	86%	92,131
Advanced Thermostat	10,503,122	95%	9,930,731	4,728,221	138%	6,521,379
Advanced Power Strip	159,572	447%	714,075	62,941	482%	303,530
Showerhead with TSV	82,040	79%	64,707	63,059	58%	36,846
Standalone TSV	10,991	69%	7,597	7,359	51%	3,768
Dehumidifier	1,530	75%	1,147	1,377	74%	1,025
Air Purifier	403	100%	403	0	N/A	0
Total	**32,110,956**	**96%**	**30,872,979**	**13,511,195**	**114%**	**15,359,753**

Table 13. Detailed Summer Peak Demand Savings Gross Impacts Results

Product Category	DEC			DEP		
	Ex Ante kW	Gross RR	Ex Post Gross kW	Ex Ante kW	Gross RR	Ex Post Gross kW
Specialty LED	1,396	88%	1,222	622	91%	566
Reflector LED	1,498	98%	1,462	557	103%	576
Standard LED	239	113%	271	82	119%	98
LED Fixture	2	129%	3	1	130%	2
Advanced Thermostat	0	N/A	3,464	0	N/A	2,069
Advanced Power Strip	13	489%	64	5	527%	27
Showerhead with TSV	26	19%	5	20	15%	3
Standalone TSV	4	27%	1	2	22%	1
Dehumidifier	0	75%	0	0	74%	0
Air Purifier	0	100%	0	0	N/A	0
Total	**3,179**	**204%**	**6,493**	**1,291**	**259%**	**3,341**

Table 14. Detailed Winter Peak Demand Savings Gross Impacts Results

Product Category	DEC			DEP		
	Ex Ante kW	Gross RR	Ex Post Gross kW	Ex Ante kW	Gross RR	Ex Post Gross kW
Specialty LED	674	88%	593	301	91%	275
Reflector LED	727	97%	709	271	103%	279
Standard LED	112	117%	132	39	123%	47
LED Fixture	5	103%	5	3	108%	4
Advanced Thermostat	0	N/A	2,982	0	N/A	2,175
Advanced Power Strip	20	319%	64	8	344%	27
Showerhead with TSV	26	38%	10	20	30%	6
Standalone TSV	4	54%	2	2	43%	1
Dehumidifier	0	N/A	0	0	N/A	0
Air Purifier	0	100%	0	0	N/A	0
Total	**1,569**	**287%**	**4,496**	**644**	**437%**	**2,814**

Table 15 summarizes per-unit ex post gross energy, summer peak demand, and winter peak demand savings by product category and jurisdiction. These values are reflective of deemed per-unit savings presented in Section 4.2.2 adjusted to apply effective ISR values presented in Section 4.2.3.

Table 15. Per-Unit Savings Gross Impact Results

Product Category	DEC			DEP		
	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)	Energy (kWh)	Summer Demand (kW)	Winter Demand (kW)
A-Line LED	24.60	0.0036	0.0018	25.82	0.0038	0.0018
Recessed LED	46.43	0.0069	0.0033	48.93	0.0072	0.0035
Recessed Outdoor LED	41.98	0.0062	0.0030	45.72	0.0067	0.0033
Globe LED	30.06	0.0044	0.0022	31.37	0.0046	0.0022
Decorative LED	27.28	0.0040	0.0020	28.39	0.0042	0.0020
Three-Way LED	46.53	0.0069	0.0033	46.12	0.0068	0.0033
LED Fixture – Direct Wire	41.46	0.0061	0.0030	39.58	0.0058	0.0028
LED Fixture – Portable	28.13	0.0042	0.0020	29.53	0.0044	0.0021
LED Fixture – Photocell	183.47	0.0000	0.0062	188.03	0.0000	0.0063
Advanced Thermostat	356.86	0.1245	0.1072	422.73	0.1341	0.1410
Advanced Power Strip	82.43	0.0073	0.0073	88.83	0.0079	0.0079
Showerhead with TSV	167.20	0.0131	0.0262	160.20	0.0133	0.0266
Standalone TSV	38.56	0.0049	0.0098	36.95	0.0050	0.0099
Dehumidifier	114.73	0.0260	0.0000	113.94	0.0258	0.0000
Air Purifier [A]	403.00	0.0462	0.0462	N/A	N/A	N/A

[A] Only one air purifier was sold during the evaluation period and tracking data did not provide sufficient detail to inform the deemed savings review. For the purposes of this evaluation, we set ex post values equal to ex ante values for air purifiers.

4.3 References

Illinois Statewide Technical Reference Manual, Version 9.0.

Indiana Technical Reference Manual, Version 2.2, July 28, 2015.

Michigan Evaluation Working Group Showerhead and Faucet Aerator Meter Study Memorandum, June 2013.

Mid-Atlantic Technical Reference Manual, Version 10.0, May 2020.

National Renewable Energy Laboratory (NREL). *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 6: Residential Lighting Protocol.* October, 2017. https://www.nrel.gov/docs/fy17osti/68562.pdf.

Opinion Dynamics. *Duke Energy Progress & Duke Energy Carolinas Energy Efficient Lighting & Retail LED Programs.* Prepared for Duke Energy Progress and Duke Energy Carolinas. April 6, 2018.

TecMarket Works. *Process and Impact Evaluation of the Residential Energy Efficient Appliance and Devices: Lighting – Specialty Bulbs Program in the Carolina System.* Prepared for Duke Energy Carolinas. November 14, 2014.

Navigant Consulting, Inc. and Apex Analytics, LLC. *EM&V Report for the 2012 Energy Efficient Lighting Program.* Prepared for Duke Energy Progress. July 12, 2013.

National Renewable Energy Laboratory (NREL) Domestic Hot Water Event Generator, 2013.

US Energy Information Administration, 2015 Residential Energy Consumption Survey (RECS), Mid-Atlantic.

5. Net-to-Gross Analysis

This section describes our approach for estimating the net savings for the DEC and DEP OSS Program and presents the resulting NTGRs and net impacts.

5.1 Methodology

The NTGR represents the portion of the gross energy savings associated with a program-supported measure or behavior change that would not have been realized in the absence of the program. In other words, the NTGR represents the share of gross savings that can be considered program-induced or attributed to the program. The NTGR consists of FR and SO and is calculated as (1 – FR + SO).

FR is the proportion of the program-achieved verified gross savings that would have been realized absent the program. There are two types of SO: participant (PSO) and non-participant (NPSO). PSO occurs when participants take additional energy-saving actions that are influenced by program interventions but that did not receive program support. Non-participant SO is the result of energy-saving actions taken by customers who did not participate in the program but were somehow influenced by its existence. The scope of this evaluation included estimation of FR and PSO.[4]

Both FR and PSO components of the NTGR are derived from self-reported information from the participant web survey. The final NTGR is the percentage of gross program savings that can be attributed to the program. The following sections provide a general overview of the methods for developing FR and PSO estimates. Appendix C and Appendix D accompanying this report contain the participant survey instrument and additional detail behind FR algorithms and PSO estimation.

5.1.1 Free Ridership

As part of the participant survey, we asked a series of structured and open-ended questions about the influence of the program on customers' decisions to purchase and install program-discounted products. The survey questions gauged program influence in the following areas:

- Influence on efficiency: whether participants would have purchased comparably energy-efficient products without the program
- Influence on quantity: for relevant measures where participants purchased multiple units, whether participants would have purchased the same quantity without the program
- Influence on timing: whether participants would have delayed their purchase in the absence of the program-discounted products

We developed FR scores by jurisdiction and product category. All respondents who provided valid responses to FR questions were assigned a FR score ranging from 0 (non-free rider) to 1 (full free rider). In addition, we asked customers to provide an open-ended response summarizing how the program influenced their purchase decisions, which we reviewed to identify contradictory responses and adjust FR scores as needed. Appendix D provides additional detail on methods employed to develop FR estimates for both lighting and non-lighting products.

[4] Non-participant SO activities are challenging to quantify and identifying cases where they exist would warrant extensive additional research outside of the scope of this evaluation effort.

5.1.2 Participant Spillover

As a result of positive experience with program-discounted products or information from program marketing, some participants purchase additional energy-efficient products on their own. PSO represents energy savings from such additional energy-saving actions taken by participants (expressed as a percent of total program savings) that were influenced but not directly incentivized by the program. This evaluation quantified PSO savings from two different groups of spillover purchases:

1. **Additional energy-efficient products purchased outside the OSS offering.** The participant survey contained a series of questions designed to gauge the impact of the program on participants' subsequent purchases of energy-efficient products made outside of the OSS offering. Participants who reported a high level of program influence on non-discounted energy-efficient purchases made at other retailers were considered candidates for PSO. In these cases, the survey asked participants to provide additional detail on the non-discounted products they purchased and explain how their experience with the program influenced the purchase. Appendix D provides additional detail on survey-based methods employed to identify and quantify PSO.

2. **Non-discounted energy-efficient purchases made through the OSS offering.** Some OSS Program participants also purchased non-incented LED lighting products from the OSS website in addition to program-discounted ones. Participants who reached the program's limit of 36 bulbs or fixtures were able to purchase additional LED products at non-discounted prices. These non-discounted OSS purchases are not considered part of program gross savings but do represent a source of potential PSO. For these sales, we developed estimates of total ex post gross savings associated with the products and adjusted those savings based on lighting-specific FR estimates established by the current evalution to represent the portion of these sales attributable to the OSS Program.[5]

[5] Note that two survey respondents had additional, non-incented LED purchases through the OSS offering. These two respondents did not report their non-discounted OSS purchases as PSO; as such, there is no double-counting of PSO savings from the two types of spillover measures.

5.2 NTG Results

The evaluation team developed NTGR estimates that account for both FR and PSO. We estimated FR separately for each product category and jurisdiction and developed PSO estimates by jurisdiction. Table 16 summarizes NTGR results by product category and jurisdiction.

Table 16. NTGR Results

Product Category	DEC			DEP		
	FR	PSO	NTGR	FR	PSO	NTGR
LED Lighting	0.777	0.002	0.225	0.695	0.007	0.312
Advanced Thermostats	0.263		0.739	0.257		0.750
Advanced Power Strips	0.031		0.971	0.013		0.994
Low-Flow Showerheads and TSVs	0.125		0.877	0.046		0.961
Dehumidifiers	0.140		0.862	0.105		0.902
Air Purifiers	0.140		0.862	0.105		0.902

5.2.1 Free Ridership

Table 17 below summarizes FR results for each product category, which range from less than 5% for advanced power strips to 70% or more for LED lighting. With the exception of LED lighting, FR is less than 30% for each measure category. Relative precision around the point estimates for product categories where sampling error applies range from 8.0% to 12.9% at 90% confidence. In cases where participation levels were too low to support survey sampling, we apply FR results from other lighting or non-lighting product categories, respectively.

Table 17. FR Results

Product Category	DEC			DEP		
	Respondents	FR	Relative Precision	Respondents	FR	Relative Precision
LED Lighting[A]	76	0.777	8.0%	40	0.695	12.3%
Advanced Thermostats	64	0.263	11.7%	35	0.257	12.9%
Advanced Power Strips[B]	30	0.031	N/A	29	0.013	N/A
Low-Flow Showerhead and TSVs[B]	13	0.125	N/A	14	0.046	N/A
Dehumidifiers[A]	N/A	0.140	N/A	N/A	0.105	N/A
Air Purifiers[A]	N/A	0.140	N/A	N/A	0.105	N/A

[A] Due to limited participation, the survey did not include FR questions for standard LEDs, LED fixtures, dehumidifiers, or air purifiers. FR values for these measures represent the averages of other lighting and non-lighting product categories, respectively.

[B] Because we attempted a census of advanced power strip and low-flow showerhead and TSV participants, the concept of sampling error does not apply for these product categories.

The survey also asked LED lighting participants what they would have expected to purchase in the absence of discounts provided by the OSS offering. More than three-quarters of respondents claimed that without the program discounts they would have bought fewer LED bulbs than they did (78% for DEC, 88% for DEP). However, among these respondents, nearly 80% claimed they still would have purchased LEDs the next time they needed bulbs (78% for DEC, 79% for DEP). This represents a sharp increase from the corresponding results of the prior DEC OSS Program evaluation, where just 53% of respondents indicated they would have purchased LEDs the next time they needed bulbs.

Figure 5 summarizes participant responses regarding how many of the program-discounted bulbs they would have purchased at full price, and Figure 6 provides the type of bulbs they would have expected to buy instead.

Figure 5. Portion of Program LEDs Participants Would Have Purchased Without Program Discount

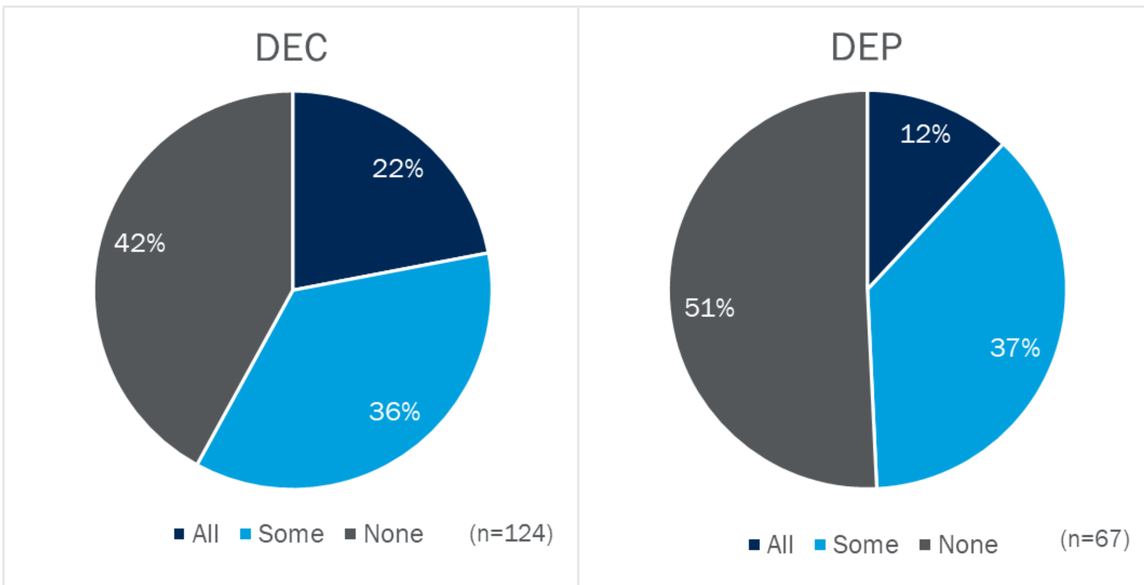
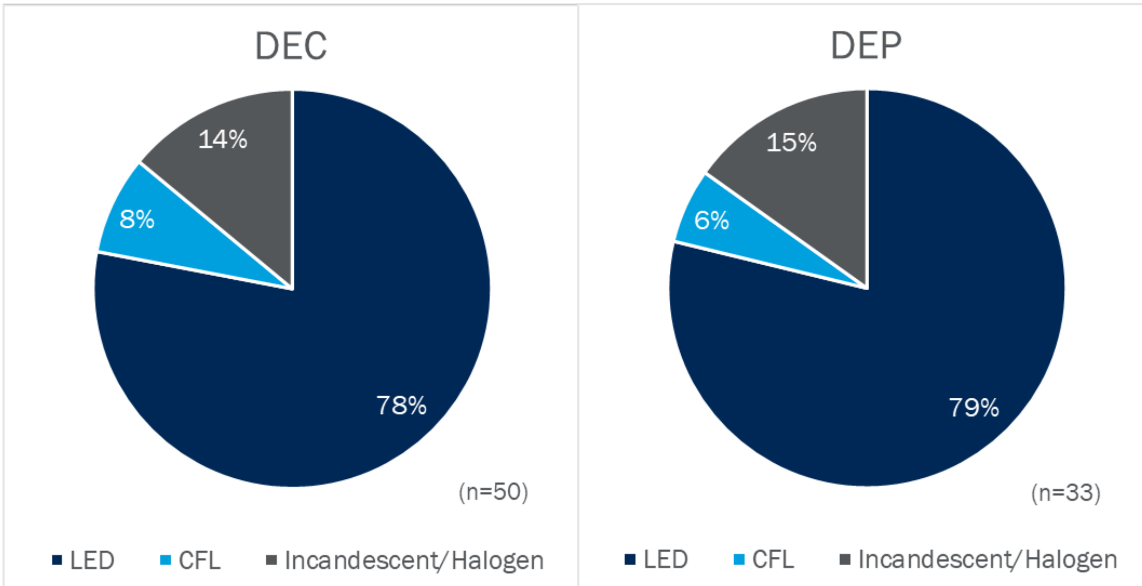


Figure 6. Types of Bulbs Customers Would Have Purchased if Not Buying Program LEDs



The survey also asked non-lighting participants whether they had been looking to purchase a comparable product prior to learning of the available Duke Energy discounts; if they had not previously considered such a purchase, they are assumed to be non-free riders. Sizeable portions of non-lighting participants indicated they had not been planning to purchase a similar product prior to learning about the Duke Energy discounts available, resulting in their being assigned a FR value of 0%. This finding was somewhat more pronounced among low-flow showerhead and TSV participants (62% for DEC, 79% for DEP) and advanced power strip participants (73% for DEC, 90% for DEP) compared to advanced thermostat participants (33% for DEC, 51% for DEP).

5.2.2 Participant Spillover

Two DEC and four DEP survey respondents qualified for PSO by purchasing additional energy-efficient products outside of the OSS since participating in the program and attributing these purchases to their experience with the OSS offering. Table 18 summarizes the products reported as spillover by participants responding to the survey, including the quantity purchased and the associated savings.

Table 18. Survey-Based PSO Savings

Product Type	DEC		DEP	
	Purchase Quantity	kWh	Purchase Quantity	kWh
LED Lighting	5	142.50	1	28.50
Refrigerator			1	51.10
Advanced Power Strip			2	224.60
Low-Flow Showerhead			1	185.50
Low-Flow Faucet Aerator			1	13.28
Total	**5**	**142.50**	**5**	**502.98**

Table 19 outlines the calculation of jurisdiction-level PSO rates based on self-reported qualifying purchases, where total spillover savings associated with purchases made outside of the OSS are divided by total savings associated with participants responding to the survey.

Table 19. Survey-Based PSO Results

Jurisdiction	Spillover Savings from Non-OSS Purchases (kWh)	Total Respondent Savings (Ex Post Gross kWh)[A]	Survey-Based PSO Rate
DEC	142.50	132,371	0.1%
DEP	502.98	79,071	0.6%

[A] Represents total ex post gross savings associated with respondents who provided valid participant survey responses, including those who did not report a spillover purchase.

Table 20 summarizes the calculation of PSO attributable to non-incented LED purchases made on the OSS website, where total program-attributable savings from non-discounted purchases are divided by total program-wide gross savings.[6]

Table 20. Non-Incented OSS Sales PSO Results

Jurisdiction	Spillover Savings from Non-Incented OSS Sales (kWh)	Total Program Savings (Ex Post Gross kWh)	Non-Incented OSS Sales PSO Rate
DEC	22,493.3	30,872,979	0.1%
DEP	6,542.1	15,359,753	<0.1%

The sum of the survey-based PSO rate and PSO rate associated with non-discounted OSS sales is 0.2% for DEC and 0.7% for DEP, as shown in Table 21.

Table 21. Combined PSO Results

Jurisdiction	Survey-Based PSO	Non-Incented OSS Sales PSO	Final PSO
DEC	0.1%	0.1%	0.2%
DEP	0.6%	<0.1%	0.7%

[6] Program-attributable savings from non-discounted OSS purchases reflect ex post gross savings assumptions, including deemed savings updates and ISR application, adjusted to account for program influence by excluding the portion of savings attributable to FR (77.7% for DEC and 69.5% for DEP).

5.3 Net Impact Results

Table 22, Table 23, and Table 24 present the ex post net impacts for energy, summer peak demand, and winter peak demand savings, respectively, that result from applying the evaluation NTGRs to ex post gross savings. The DEC program realized 12.6 GWh in net energy savings, 3.3 MW in net summer peak demand savings, and 2.6 MW in net winter peak demand during the evaluation period. In the same period, the DEP program achieved 7.9 GWh in net energy savings, 2.0 MW in net summer peak demand savings, and 1.9 MW in net winter peak demand.

Table 22. Detailed Energy Savings Net Impact Results

Product Category	DEC			DEP		
	Ex Post Gross kWh Savings	NTGR	Ex Post Net kWh Savings	Ex Post Gross kWh Savings	NTGR	Ex Post Net kWh Savings
Specialty LED	8,282,108	0.225	1,863,474	3,837,885	0.312	1,197,420
Reflector LED	9,907,775		2,229,249	3,900,243		1,216,876
Standard LED	1,837,992		413,548	662,946		206,839
LED Fixture	126,444		28,450	92,131		28,745
Advanced Thermostat	9,930,731	0.739	7,338,810	6,521,379	0.750	4,891,035
Advanced Power Strip	714,075	0.971	693,367	303,530	0.994	301,709
Showerhead with TSV	64,707	0.877	56,748	36,846	0.961	35,409
Standalone TSV	7,597		6,663	3,768		3,621
Dehumidifier	1,147	0.862	989	1,025	0.902	925
Air Purifier	403		347	0	N/A	0
Total	**30,872,979**	**0.409**	**12,631,646**	**15,359,753**	**0.513**	**7,882,578**

Note: Overall NTGRs are estimated as jurisdiction level ex post net savings divided by ex post gross savings.

Table 23. Detailed Summer Peak Demand Savings Net Impacts Results

Product Category	DEC			DEP		
	Ex Post Gross kW Savings	NTGR	Ex Post Net kW Savings	Ex Post Gross kW Savings	NTGR	Ex Post Net kW Savings
Specialty LED	1,222	0.225	275	566	0.311	177
Reflector LED	1,462		329	576		180
Standard LED	271		61	98		31
LED Fixture	3		1	2		1
Advanced Thermostat	3,464	0.739	2,560	2,069	0.749	1,552
Advanced Power Strip	64	0.971	62	27	0.993	27
Showerhead with TSV	5	0.877	4	3	0.960	3
Standalone TSV	1		1	<1		<1
Dehumidifier	<1	0.862	<1	<1	0.901	<1
Air Purifier	<1		<1	0	N/A	0
Total	**6,493**	**0.507**	**3,293**	**3,341**	**0.588**	**1,969**

Note: Overall NTGRs are estimated as jurisdiction level ex post net savings divided by ex post gross savings.

Table 24. Detailed Winter Peak Demand Savings Net Impacts Results

Product Category	DEC			DEP		
	Ex Post Gross kW Savings	NTGR	Ex Post Net kW Savings	Ex Post Gross kW Savings	NTGR	Ex Post Net kW Savings
Specialty LED	593	0.225	133	275	0.312	86
Reflector LED	709		160	279		87
Standard LED	132		30	47		15
LED Fixture	5		1	4		1
Advanced Thermostat	2,982	0.739	2,204	2,175	0.750	1,631
Advanced Power Strip	64	0.971	62	27	0.994	27
Showerhead with TSV	10	0.877	9	6	0.961	6
Standalone TSV	2		2	1		1
Dehumidifier	0	N/A	0	0	N/A	0
Air Purifier	<1	0.862	<1	0	N/A	0
Total	**4,496**	**0.578**	**2,600**	**2,814**	**0.659**	**1,854**

Note: Overall NTGRs are estimated as jurisdiction level ex post net savings divided by ex post gross savings.

6. Process Evaluation

This section details research questions, evaluation activities, and key findings from the process evaluation of the DEC and DEP OSS Program.

6.1 Research Questions

The evaluation team developed the following process-oriented research questions with input from OSS program staff.

- How effective are program implementation and data-tracking practices?
- How do participants learn about the program?
- Are participants satisfied with their program experience?
- What factors, if any, are preventing customers from installing program-discounted products or prompting their removal?
- How do customers use program-discounted products, and what are the implications for savings attributable to those measures, for advanced thermostats in particular?
- Which measures or customer segments can the program target to maximize its influence and minimize free ridership?
- What role does free or discounted shipping play in motivating customers to purchase program-discounted products?
- What information is currently collected from program participants, and what participant information or eligibility requirements would enable the program to maximize savings for measures where household characteristics are especially relevant?
- What other energy-efficient measures could the program consider offering?
- What are the program's strengths or key successes and in what areas are there potential opportunities for improvement?
- What non-energy impacts, if any, do OSS participants realize as a result of their participation?

6.2 Methodology

The process evaluation relied on the following data collection and analytic activities:

- In-depth interviews with program staff
- Analysis of program tracking data
- Participant survey (n=470)

6.3 Key Findings

The following sections present key findings regarding the evaluation's process-oriented research questions.

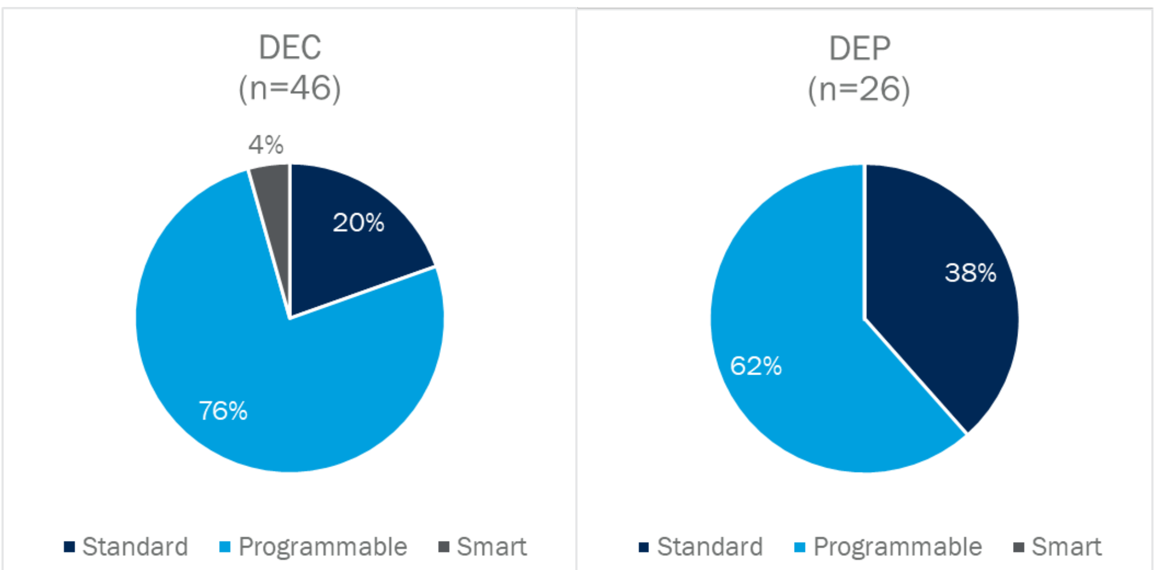
6.3.1 Thermostat Usage Behavior

Two key determinants of savings from advanced thermostats are (1) the type of thermostat participants used prior to the installation of their program-discounted thermostats and (2) how participants used their old thermostats and are using their new ones. The participant survey explored both topics.

Most respondents reported that their new smart thermostats replaced a programmable thermostat (76% for DEC, 62% for DEP), with the rest mostly replacing manual thermostats (20% for DEC, 38% for DEP). A small number of thermostat participants reported they were replacing a previously owned smart thermostat (4% for DEC, 0% for DEP). Ex post per-unit savings do not allow savings for advanced thermostats that replace other advanced thermostats, resulting in a small decrease to per-unit savings for DEC.

Figure 7 summarizes the types of thermostats being replaced by program-discounted advanced thermostats in each jurisdiction.

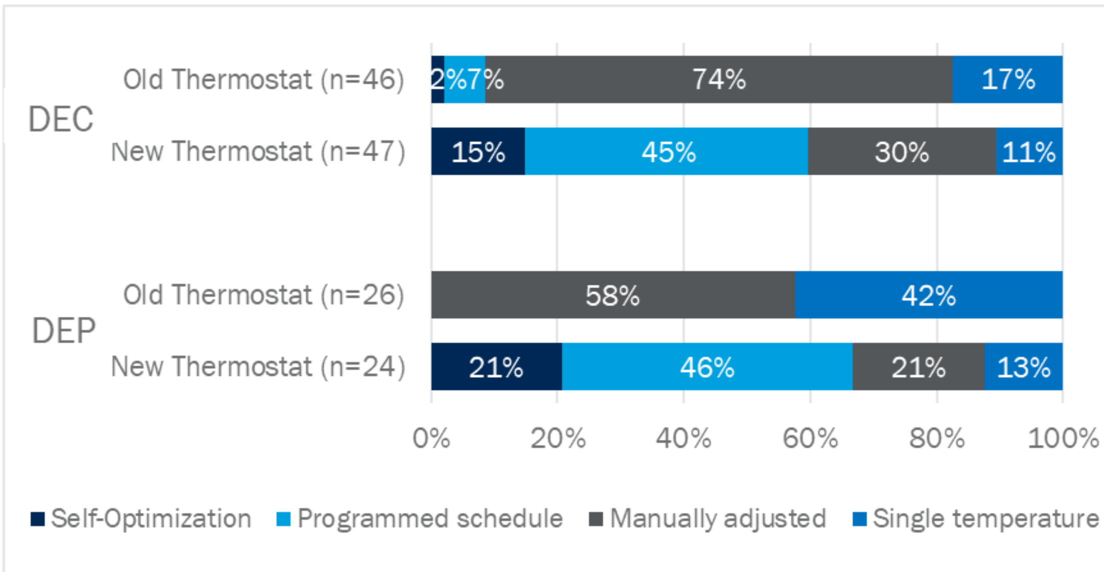
Figure 7. Previous Thermostat Replacement



Thermostat usage patterns are often varied and dependent on a variety of factors, making them challenging to gauge via survey self-report. The participant survey nevertheless explored how customers typically set the temperature on their previous and new thermostats in the summer months to get a sense of how their behavior may have changed. Although the engineering algorithm for advanced thermostats does not explicitly incorporate self-reported usage behaviors, understanding such tendencies can provide important insights into whether application of prior billing analysis results are justified and what savings might be expected from future billing analyses for this program.

Perhaps most notably, few to none of the participants in either jurisdiction typically had a programmed schedule set on their previous thermostat despite most of them having programmable thermostats installed. Conversely, more than half of these respondents claimed that they were either taking advantage of their new advanced thermostat's self-optimization function (15% for DEC, 21% for DEP) or programming their new thermostat on a schedule (45% for DEC, 46% for DEP). Figure 8 illustrates these findings regarding how thermostat participants most typically used their previous and program-discounted thermostats.

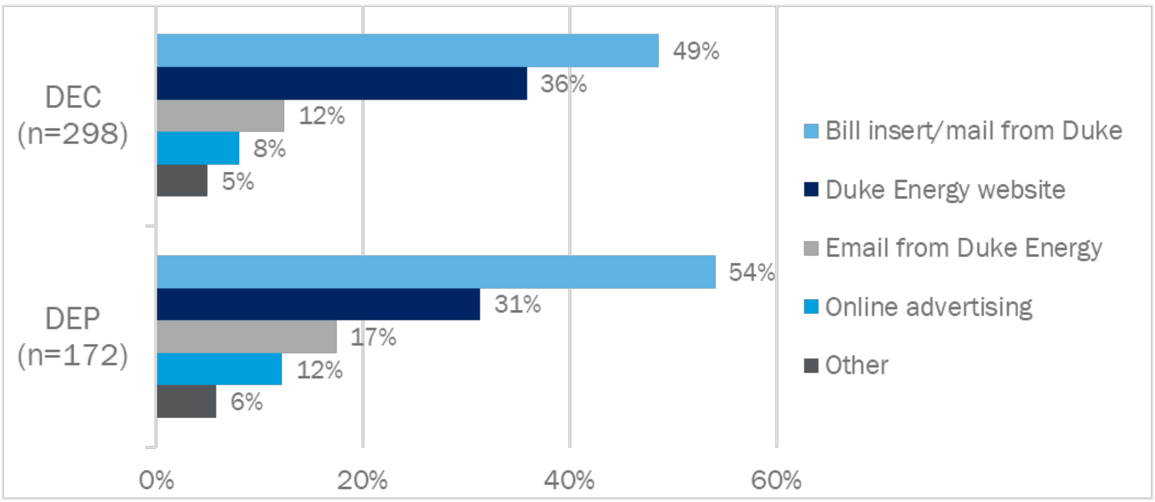
Figure 8. Thermostat Usage Behavior



6.3.2 Program Marketing and Outreach

We asked all participants how they first learned about the Online Savings Store offering. Around half of respondents in each jurisdiction reported they learned about the offering through a bill insert or physical mailing from Duke (49% for DEC, 54% for DEP). The Duke Energy website was the second most common source of program awareness (36% for DEC, 31% for DEP) and emails from Duke were third (12% for DEC, 17% for DEP). Other sources of information reported by participants included family and friends, social media, and hired contractors. Figure 9 summarizes how participants first heard about the OSS offering.

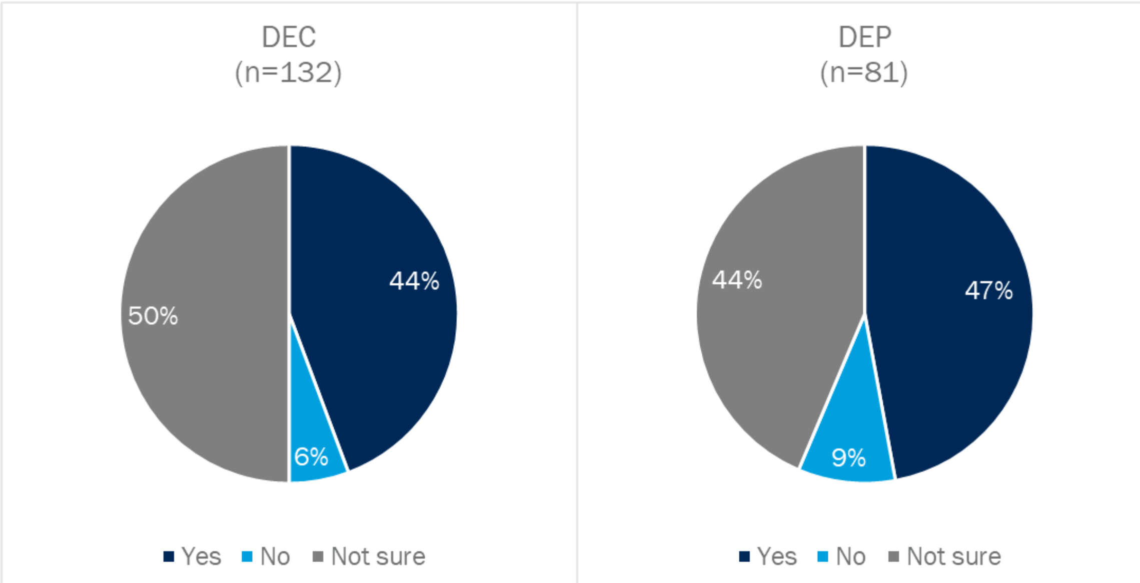
Figure 9. Sources of Awareness



6.3.3 Value of Discounted Shipping

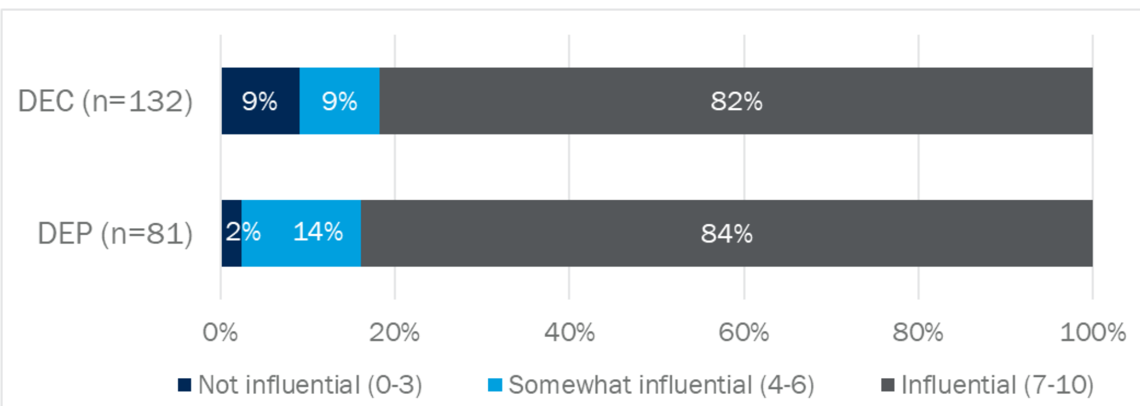
As part of the participant survey, the evaluation sought to gauge the importance of discounted shipping to respondents and better understand the role it plays in motivating customers to purchase program-discounted products. About half of survey respondents reported receiving discounted shipping for the OSS purchase (44% for DEC, 47% for DEP), but about as many indicated they were unsure whether they received free or discounted shipping (50% for DEC, 44% for DEP). Figure 10 illustrates these responses, highlighting a high degree of participant uncertainty as to whether they received free or reduced shipping.

Figure 10. Discounted Shipping Breakdown



Those who did recall receiving free or discounted shipping mostly indicated that it was highly influential in their decision to purchase a product through the program, with more than 80% rating the influence at least 7 on a zero to ten scale (where zero means "Not at all influential" and ten means "Extremely influential"). Figure 11 shows respondents' ratings of how influential discounted shipping was on their decision to make a purchase.

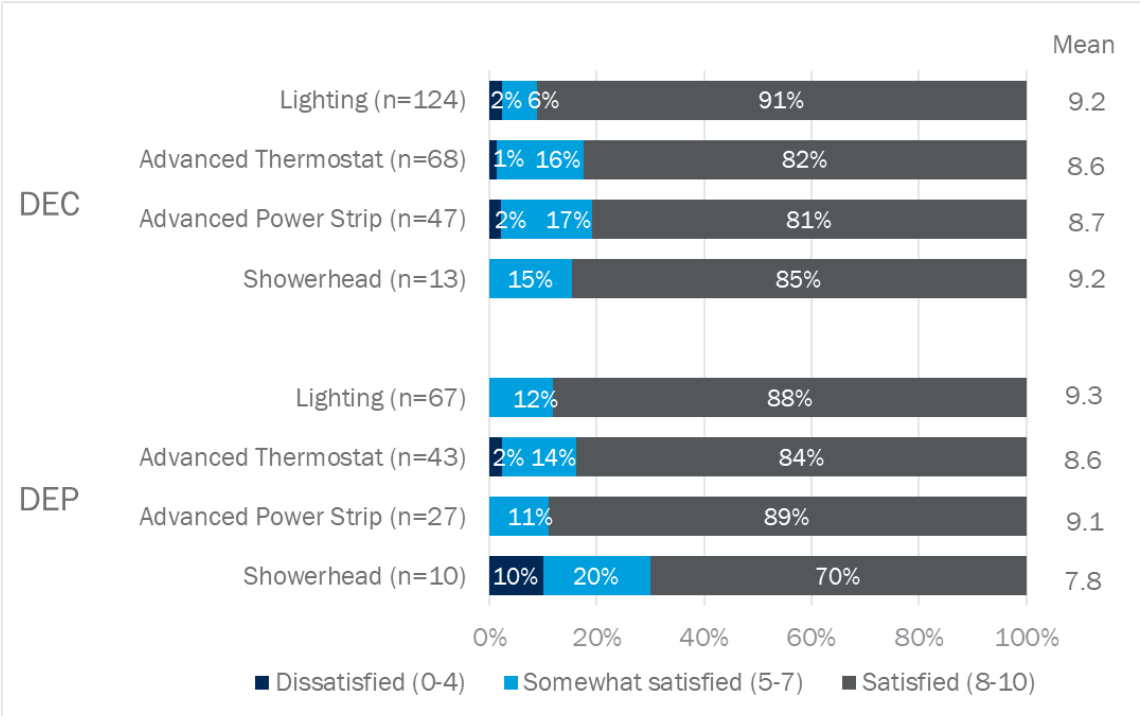
Figure 11. Influence of Shipping Discount



6.3.4 Program Delivery and Participant Satisfaction

Across the board, participants indicated high satisfaction with their discounted products, with average scores of eight or nine for nearly all products in both jurisdictions. The only specific complaints from respondents were two instances of defective advanced power strips and one participant who ordered an LED fixture thinking it was an LED bulb. These findings suggest that the program is effectively targeting high-quality products that customers enjoy using. Figure 12 summarizes participant satisfaction with each type of program-discounted product by jurisdiction.

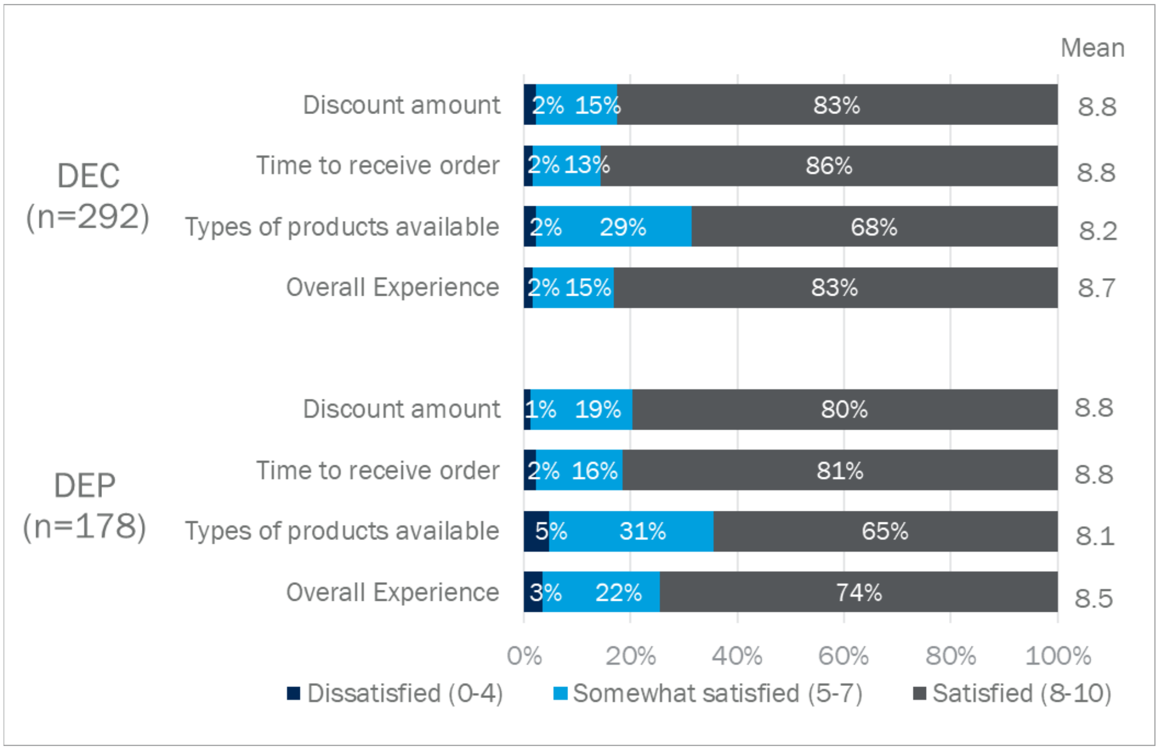
Figure 12. Participant Satisfaction with Program-Discounted Products



Satisfaction with various elements of the program's implementation was also exceptionally high with customers providing mean ratings of between eight and nine out of ten for each aspect of the program and for the program overall. The only suggested improvements offered by participants came from three respondents who indicated the website was difficult to navigate and three who indicated they would have appreciated a larger variety of LED bulbs to choose from. These high satisfaction ratings contribute to an image of a smoothly functioning program that consistently delivers on customer expectations.

Figure 13 provides participant satisfaction ratings associated with key program elements for each jurisdiction.

Figure 13. Participant Satisfaction with Key Program Elements



6.3.5 Non-Energy Impacts

NEIs include a range of occupant health, safety, and economic outcomes that participants may realize beyond the energy and cost savings of energy-efficient upgrades. NEIs can provide significant additional benefits to participants and can be a powerful motivator for program participation.

The participant survey included questions about changes in electricity bills and in different aspects of the home's comfort following program participation, and many participants reported both electric bill and non-energy benefits. Among those who purchased and installed new advanced thermostats, nearly half claimed their winter electricity bills were lower (44% for DEC, 45% for DEP) and at least one-third reported lower electricity bills in the summer (38% for DEC, 33% for DEP). Similarly, at least one-third of advanced thermostat participants reported their home was more comfortable during the winter months since installing the new thermostat (38% for DEC, 33% for DEP), and a similar pattern plays out for summer months with between a quarter and a third of customers reporting higher comfort (37% for DEC, 26% for DEP). Among respondents who purchased LED lighting, a majority reported that the quality of lighting in their homes had improved since installing the new products (55% for DEC, 59% for DEP).

Table 25 summarizes feedback from advanced thermostat and LED lighting participants regarding changes to their home's electricity bills, comfort, and lighting quality since installing program-discounted products.

Table 25. Impacts Reported by Participants

Jurisdiction	Impact	Positive Change	No Change	Negative Change
DEC	**Advanced Thermostat Participants**			
	Electricity bills in summer (n=34)	38% *Bills are lower*	59%	3% *Bills are higher*
	Electricity bills in winter (n=33)	44% *Bills are lower*	52%	4% *Bills are higher*
	Home comfort in summer (n=41)	37% *More comfortable*	61%	2% *Less comfortable*
	Home comfort in winter (n=29)	38% *More comfortable*	62%	0% *Less comfortable*
	LED Lighting Participants			
	Lighting quality (n=116)	55% *Better*	43%	2% *Worse*
DEP	**Advanced Thermostat Participants**			
	Electricity bills in summer (n=15)	33% *Bills are lower*	53%	13% *Bills are higher*
	Electricity bills in winter (n=11)	45% *Bills are lower*	45%	9% *Bills are higher*
	Home comfort in summer (n=23)	26% *More comfortable*	61%	13% *Less comfortable*
	Home comfort in winter (n=15)	33% *More comfortable*	53%	13% *Less comfortable*
	LED Lighting Participants			
	Lighting quality (n=64)	59% *Better*	39%	2% *Worse*

These findings suggest the OSS Program provides value to participants beyond energy savings. Increased home comfort relating to temperature control could be beneficial for customer health and safety. Improved lighting also provides a higher sense of safety in and around the home. Lower energy bills can also help alleviate energy burdens and allow customers to spend their money on essential items, such as food or medicine.

7. Conclusions and Recommendations

This section presents conclusions and recommendations resulting from the process and impact evaluations of the DEC and DEP OSS Program.

7.1 Conclusions

From January 1, 2019 through March 31, 2021, Duke Energy's OSS Program sold 613,990 discounted energy-efficient products to DEC customers and 252,091 to DEP customers, achieving ex ante gross energy savings of 32.1 GWh for DEC and 13.5 GWh for DEP. LED lighting dominated OSS Program sales in both jurisdictions, representing more than 90% of total units sold and more than 50% of ex ante gross energy savings. Non-lighting measures were first distributed by the program in March 2019, shortly before standard LEDs were dropped from the list of available products. Advanced thermostats accounted for 5% of DEC and 6% of DEP sales but for 33% and 35% of savings, respectively. Other non-lighting products accounted for small shares of sales and savings (2% or less). Table 26 provides a summary of program sales and ex ante energy savings.

Table 26. Online Savings Store Program Performance by Jurisdiction

Product Category	DEC				DEP			
	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings	Units Sold	% of Sales	Ex Ante Gross kWh Savings	% of Savings
Specialty LED	283,299	46%	9,444,683	29%	125,641	50%	4,212,587	31%
Reflector LED	217,718	35%	10,159,269	32%	80,792	32%	3,778,285	28%
Standard LED	74,703	12%	1,600,138	5%	25,679	10%	550,044	4%
LED Fixture	1,184	<1%	149,207	<1%	794	<1%	107,321	1%
Advanced Thermostat	27,828	5%	10,503,122	33%	15,427	6%	4,728,221	35%
Advanced Power Strip	8,663	1%	159,572	<1%	3,417	1%	62,941	<1%
Showerhead with TSV	387	<1%	82,040	<1%	230	<1%	63,059	<1%
Standalone TSV	197	<1%	10,991	<1%	102	<1%	7,359	<1%
Dehumidifier	10	<1%	1,530	<1%	9	<1%	1,377	<1%
Air Purifier	1	<1%	403	<1%	0	0%	0	0%
Total	**613,990**	**100%**	**32,110,956**	**100%**	**252,091**	**100%**	**13,511,195**	**100%**

The DEC program realized 30.9 GWh in ex post gross energy savings, 6.5 MW in summer peak demand savings, and 4.5 MW in winter peak demand savings during the evaluation period. In the same period, the DEP program achieved 15.4 GWh in ex post gross energy savings, 3.3 MW in summer peak demand savings, and 2.8 MW in winter peak demand savings.

Gross realization rates for the DEC program are 96% for energy savings, 204% for summer peak demand savings, and 287% for winter peak demand savings, while the DEP program saw gross realization rates of 114% for energy savings, 259% for summer peak demand savings and 437% for winter peak demand savings. In both jurisdictions, realization rates are slightly below 100% for LED lighting, which accounts for more than half of ex post gross energy savings. For DEP energy savings, this is more than offset by a 138% realization rate for advanced thermostats, while for DEC energy savings, the advanced thermostat realization rate is also slightly below 100%. For demand savings, advanced thermostats are the primary driver of high overall realization rates, as these products were not assigned ex ante demand savings but account for more than half of ex post gross summer and winter demand savings.

After applying NTGRs established by the current evaluation, the DEC offering achieved 12.6 GWh in ex post net energy savings, 3.3 MW in summer peak demand savings, and 2.6 MW in winter peak demand ex post net savings. The DEP program meanwhile achieved 7.9 GWh in ex post net energy savings, 2.0 MW in summer peak demand savings, and 1.9 MW in winter peak demand ex post net savings.

Table 27 summarizes total ex ante, ex post gross, and ex post net savings for each jurisdiction.

Table 27. Online Savings Store Program Performance by Jurisdiction

Jurisdiction	Metric	Ex Ante	Gross RR	Ex Post Gross	NTGR	Ex Post Net
DEC	Energy Savings (kWh)	32,110,956	96%	30,872,979	0.409	12,631,646
	Summer Peak Demand Savings (kW)	3,179	204%	6,493	0.507	3,293
	Winter Peak Demand Savings (kW)	1,569	287%	4,496	0.578	2,600
DEP	Energy Savings (kWh)	13,511,195	114%	15,359,753	0.513	7,882,578
	Summer Peak Demand Savings (kW)	1,291	259%	3,341	0.589	1,969
	Winter Peak Demand Savings (kW)	644	437%	2,814	0.659	1,854

Note: NTGR values were developed by product category and jurisdiction. While NTGRs do not vary across energy and demand savings, the effective NTGRs (estimated as jurisdiction level ex post net savings divided by ex post gross savings) do as a result of varying contributions of each product category to energy and summer and winter demand savings.

Implementation and Data Tracking

Program implementation processes appear to run smoothly and effectively, as evidenced by high levels of customer satisfaction with the products offered and the program overall. In particular, participants expressed high degrees of satisfaction with the size of discounts being offered, the speed with which they received purchased products, and the range of products the program allowed them to choose from.

Program tracking data was generally clean, accurate, fully populated, and included the necessary product specifications to inform TRM-based savings calculations for nearly all products with air purifiers being the notable exception.

Marketing and Outreach

Despite the OSS Program being implemented as an online platform, around half of participants learned about the offering through a bill insert or physical mailing from Duke, suggesting these outreach channels remain an effective method of communicating the program's availability.

Discounted shipping may be an especially valuable point of emphasis for program marketing and an effective tool for encouraging energy-efficient purchases. Many customers expressed uncertainty about whether their order received discounted shipping, but those who did recall receiving it often indicated that it was highly influential in their decision to purchase a product through the program.

Program Influence

The OSS Program provides an easily accessible platform for encouraging customers to consider adopting energy-efficient household items. Participant feedback suggests that many of those who purchased less widely popular measures such as low-flow showerheads or advanced power strips only considered purchasing such a product because of information they received about program offerings. This finding suggests that other less common products that have very recently or not yet been introduced to the program may be especially good candidates for promotion through the program, including faucet aerators, air purifiers, dehumidifiers, or other household appliances.

Conversely, the lighting market appears to be nearing transformation, and limited opportunity remains for program discounts to spur LED purchases that would not have occurred in their absence. Utility programs like this one have helped the lighting market near transformation with many customers indicating LEDs as their preferred product. As the market continues to shift, we expect LEDs will be an increasingly popular and affordable option, further limiting the power of program discounts to motivate LED purchases that would not have otherwise occurred.

Thermostat Usage

Nearly all advanced thermostat participants replaced previously installed programmable or manual thermostats, but the majority of previously installed thermostats were programmable, suggesting there may be limited potential for savings if customers are already conserving energy by way of programmed thermostat schedules. However, almost none of these participants reported primarily relying on a programmed schedule to set the temperature of their home with their previous thermostat. Meanwhile, a majority of respondents indicated that they do use a programmed schedule and/or advanced features of their new thermostat, which offers some support for savings assumptions being applied to these measures as part of the current evaluation.

Installation Behavior

First-year ISRs of less than 80% for advanced thermostats and advanced power strips indicate that substantive portions of participants are not installing their program-discounted products within twelve months of purchasing. Among those with uninstalled products, the vast majority report they have not yet gotten around to or have not yet needed to install their new products. The program may therefore be able to maximize savings by conducting additional outreach or providing materials to participants encouraging them or reminding them to install the new products, as discussed in the following section.

Non-Energy Impacts

In addition to the energy savings achieved by the OSS Program, many customers reported other benefits of their new program-discounted products. More than half of LED lighting participants reported the quality of lighting in their home had been improved and between one-third and half of advanced thermostat participants suggested their homes were more comfortable or their electricity bills were lower since installing their new thermostats.

7.2 Recommendations

Based on the findings of this evaluation, the evaluation team identified the following opportunities for program improvement:

- Although there is a high rate of customer uncertainty regarding whether they received discounted shipping, those who did reported that it influenced their decision to purchase a program-discounted product. Therefore, we recommend that program marketing highlight discounted or free shipping, when available, both in outreach materials and on the program website.
- To support increases to first-year ISR, we recommend that the program continue to include collateral with orders encouraging customers to install their new energy-efficient products. The program could

also consider additional outreach to recent participants encouraging them to install their new products, particularly for advanced thermostats. This has the potential to help the program maximize first-year savings.

- Program tracking data should include the necessary product infomation to enable application of appropriate savings assumptions for all product categories, as it did for all products sold during the current evaluation period with the exception of air purifiers. For air purifiers, future program tracking data should include the product's size (i.e., clean air delivery rate) to ensure the accuracy of savings estimates.
- We recommend the program continue to explore possible expansions of the OSS Program and continue using the offering to promote less common energy-efficient products, some of which have already been introduced to the program (including advanced power strips, faucet aerators, air purifiers, dehumidifiers, or other household appliances). Our evaluation found that participants often purchase these products as a direct result of information made available by the OSS offering, as exhibited by their relatively low FR estimates.

8. Summary Form

Duke Energy Carolinas and Duke Energy Progress Online Savings Store Program

Completed EM&V Fact Sheet

Program Description

Duke Energy's Online Savings Store (OSS) Program offers a wide range of point-of-sale-discounted specialty LED lighting and advanced thermostats as well as several other consumer electronics and water-saving measures including advanced power strips, low-flow showerheads, TSVs, dehumidifiers, and air purifiers. The non-lighting measures reflect an expansion of the OSS Program, which began exclusively distributing energy-efficient lighting in April 2013. Customers can purchase the discounted products online through a designated website operated by Energy Federation Inc. (EFI).

Date	November 30, 2021
Region(s)	Duke Energy Carolinas (DEC) Duke Energy Progress (DEP)
Evaluation Period	January 1, 2019– March 31, 2021
Annual kWh Savings (Ex Post Net)	DEC: 12,632 MWh DEP: 7,883 MWh
Coincident kW Impact (Ex Post Net)	DEC: 3.3 MW (Summer), 2.6 MW (Winter) DEP: 2.0 MW (Summer), 1.9 MW (Winter)
Measure Life	Not Evaluated
Net-to-Gross Ratio	DEC: 0.403 DEP: 0.513
Process Evaluation	Yes
Previous Evaluation(s)	DEC Online Savings Store Program Evaluation. October 4, 2018.

Evaluation Methodology

In support of the **gross impact evaluation**, we first reviewed program tracking data and ex ante per-unit deemed savings values for incented products. We then developed updated per-unit deemed savings based on review of secondary sources and results of a survey fielded with program participants. We also verified product installation and persistence based on participant survey responses. Based on these evaluated ex post per-unit deemed savings values and survey-based ISRs, we calculated ex post gross energy and demand savings for products sold through the DEC and DEP OSS Program.

The **net impact evaluation** relied on responses to the participant survey to quantify free ridership and participant spillover. We estimated free ridership by measure category and jurisdiction and developed jurisdiction-level participant spillover rates. The resulting net-to-gross ratios were multiplied by ex post gross savings to determine net program impacts.

We also conducted a **process evaluation** focused on participant experiences and satisfaction with the program, product usage behaviors, program marketing and outreach, and implications of participant-reported influence of key program elements on their decision to purchase program-discounted energy-efficient products.

9. DSMore Table

The Excel spreadsheet containing measure-level inputs for Duke Energy Analytics is provided below. Per-measure savings values in the spreadsheet are based on the gross and net impact analyses reported above. The evaluation scope did not include updates to measure life assumptions.

[DSMore Table provided as a separate file]

For more information, please contact:

Evan Tincknell
Managing Consultant

617-301-4648 tel
etincknell@opiniondynamics.com

1200 Prospect St. G100
La Jolla, CA 92037

Opinion Dynamics

Boston | Headquarters

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

1000 Winter Street
Waltham, MA 02451

San Francisco Bay

510 444 5050 tel
510 444 5222 fax

1 Kaiser Plaza
Suite 445
Oakland, CA 94612

San Diego

858 270 5010 tel
858 270 5211 fax

7590 Fay Avenue
Suite 406
La Jolla, CA 92037

Portland

503 287 9136 tel
503-281-7375 fax

3934 NE MLK Jr. Blvd.
Suite 300
Portland, OR 97212

Now a part of Resource Innovations

K12 Education Program 2019-2020 Evaluation Report

Submitted to Duke Energy Carolinas and Duke Energy Progress

December 2, 2021

Principal authors:

Jason Hinsey, Senior Consultant

Greg Sidorov, Consultant

Andrew Hauser, Project Analyst

Contents

1 Executive Summary 1
1.1 Program Summary 1
1.2 Evaluation Objectives and Results 1
1.2.1 Impact Evaluation 1
1.2.2 Process Evaluation 2
1.2.3 Conclusions and Recommendations 4

2 Introduction and Program Description 6
2.1 Program Description 6
2.1.1 Overview 6
2.1.2 Energy Efficiency Kit Measures 6
2.2 Program Implementation 7
2.2.1 Program Marketing and School Recruitment 7
2.2.2 NTC Performance 7
2.2.3 Kit Distribution 8
2.2.4 Energy Kit Eligibility 8
2.2.5 Participation 8
2.2.6 Program Changes 9
2.3 Key Research Objectives 9
2.3.1 Impact 9
2.3.2 Process 10
2.4 Evaluation Overview 10
2.4.1 Impact Evaluation 11
2.4.2 Process Evaluation 11

3 Impact Evaluation 13
3.1 Background 13
3.2 Methodology 13
3.3 Data Requirements 15
3.3.1 Program Participation 16
3.3.2 Cross-Program Participation 16

3.3.3 Participating Schools 16
3.3.4 Consumption Data 16
3.3.5 MyHER Customer Data 16

3.4 Data Cleaning and Validation 16

3.5 Analysis Limitations 17

3.6 Control Group Matching 19

3.7 Energy Savings Results 21

3.8 Demand Impacts Results 23

3.9 Summary & Key Findings 25

3.9.1 Summary of Program Savings 25
3.9.2 Key Findings 26

4 Net-to-Gross Methodology and Results 27

5 Process Evaluation 28

5.1 Summary of Data Collection Activities 28

5.1.1 Teacher Surveys and Follow-Up Interviews 28
5.1.2 Survey of Student Families Who Received the DEC/DEP Kit 29

5.2 Process Evaluation Findings 29

5.2.1 Awareness of DEC/DEP Sponsorship of the Program 29
5.2.2 Parent Awareness of DEC/DEP Kit Opportunity 30
5.2.3 Teacher Experience with the Program 31
5.2.4 Student Family Experience with the Program 36

5.3 Key Findings 43

6 Conclusions and Recommendations 45

Appendix A Summary Forms A-1

Appendix B Measure Impact Results B-1

Appendix C Program Process Flow Chart C-1

Appendix D Program Performance Metrics D-1

Appendix E Instruments E-1

Appendix F Survey Results F-1

List of Figures

Figure 2-1: NTC Recruitment Postcard for Elementary Students (K-5) 7
Figure 3-1: Results of False Experiments 14
Figure 3-2: Share of Program Participants with AMI Data, by Month 18
Figure 3-3: Group Matching Results 20
Figure 3-4: Monthly Energy Savings Profile, % 22
Figure 3-5: Estimated Peak Demand Impacts, by Season 24
Figure 5-1: DEC Age-Appropriateness of NTC Performance (n = 34) 32
Figure 5-2: DEP Age-Appropriateness of NTC Performance (n = 21) 32
Figure 5-3: DEC Teachers Use of Forms and Instructional Materials 34
Figure 5-4: DEP Teachers Use of Forms and Instructional Materials 34
Figure 5-5: DEC Kit Recipient Satisfaction with Installed Measures 38
Figure 5-6: DEP Kit Recipient Satisfaction with Installed Measures 38

List of Tables

Table 1-1: Ex Post Annual Energy and Peak Demand Savings Summary 2
Table 2-1: Kit Measures 6
Table 2-2: Summary of Process Evaluation Activities 12
Table 3-1: Average Daily Energy Savings Summary 21
Table 3-2: Monthly Energy Savings Results 23
Table 3-3: Peak Period Definitions 23
Table 3-4: Estimated Peak Demand Impacts, by Season 24
Table 3-5: Summary of Program Savings, 2017-2018 vs. 2019-2020 25
Table 5-1: Summary of Process Evaluation Data Collection Activities 28
Table 5-2: Survey Response Rates 29
Table 5-3: How Teachers Learned of Duke Energy's Sponsorship (Multiple Responses Allowed; DEC n = 33, DEP n = 20) 30

Table 5-4: Sources of Parental Awareness of Kits (Multiple Responses Allowed; DEC n = 300, DEP n = 215) 30
Table 5-5: New Behaviors Adopted by DEC Parents and Children since Receiving Kit.............40
Table 5-6: Additional Energy Saving Measures Purchased..42

Equations

Equation 3-1: Energy Savings Model Specification 15
Equation 3-2: Peak Load Demand Impacts Model Specification 15

1 Executive Summary

1.1 Program Summary

The Energy Efficiency Education in Schools (K12 Education) Program is a Duke Energy Carolinas and Duke Energy Progress (DEC/DEP) program offering implemented by the National Theatre for Children (NTC). The program provides age-appropriate school performances by NTC's professional actors that teach students about energy and energy conservation in a humorous, engaging, and entertaining format. NTC also provides participating schools with classroom curriculum to coincide with the performance, which includes energy efficiency kit request forms that student families can use to receive free energy efficiency measures to install in their home.

1.2 Evaluation Objectives and Results

This report presents the results and findings of evaluation activities for the DEC/DEP K12 Education Program conducted by Nexant (now a part of Resource Innovations) for the program year of August 2019 through July 2020.

1.2.1 Impact Evaluation

The primary objective of the impact evaluation is to estimate energy and demand savings attributable to the 2019-2020 DEC/DEP K12 Education Program. The 2019-2020 impact evaluation was based on an advanced metering infrastructure (AMI) consumption data analysis using a matched control group made up of non-participants. One of the benefits of using a matched control group in this approach is that it yields net savings estimates, and eliminates the need to address factors such as freeridership and spillover that are typically accounted for in a net-to-gross (NTG) adjustment.

The 2019-2020 EE Education program generated significant energy savings among participating households, but did not show meaningful load demand reductions during the peak periods.

Table 1-1 presents the summarized findings of the 2019-2020 impact evaluation.

Table 1-1: Ex Post Annual Energy and Peak Demand Savings Summary

		2019-2020 Per Houshold Savings	2019-2020 Program Savings
DEC		*Program Population = 20,852*	
	Energy Savings	475 kWh	9,905 MWh
	Summer Demand Impact	-0.081 kW	-1.689 MW
	Winter Demand Impact	0.003 kW	0.062 MW
DEP		*Program Population = 5,348*	
	Energy Savings	475 kWh	2,540 MWh
	Summer Demand Impact	-0.081 kW	-0.433 MW
	Winter Demand Impact	0.003 kW	0.016 MW

*Negative value denotes a load increase

1.2.2 Process Evaluation

The process evaluation assessed opportunities for improving the program's design and delivery in DEC and DEP's service territories. It specifically documented teacher, student, and parent experiences by investigating: 1) teachers' assessments of the NTC performance, quality of curriculum materials, and the kit request form distribution procedure; and 2) student families' responses to the energy efficiency kits and the extent to which the kits effectively motivate families to save energy.

The evaluation team reviewed program documents and web surveys with student families that received a kit (*DEC n*= 300, *DEP n*= 215) and teachers who attended the performance (*DEC n*= 34, *DEP n* = 21). The team also conducted in-depth interviews with utility staff, NTC staff, and eight teachers who completed the web survey.

Overall, the DEC/DEP K12 Education Program performed effectively during the 2019-2020 school year. Key findings from the process evaluation include:

Awareness:

- Both teachers and parents were aware of Duke Energy's sponsorship of the K12 Education Program; 97% of teachers and 88% of parents in DEC, and 95% of teachers and 91% of parents in DEP indicated that they were aware of this fact.
- Teachers in DEC primarily learned about Duke Energy's sponsorship of the program through material provided by NTC about the program, NTC staff or Duke marketing materials. Similarly, teachers in DEP learned about the sponsorship of the program most often through Duke marketing materials and materials provided by the NTC.
- Most parents in both DEC and DEP reported that they learned of Duke's involvement in the program through informational material provided in the kit, followed by educational material provided by NTC and brought home from school by their child.

- Parents are largely unaware of the NTC performances and program related classroom activities with 25% of them in DEC and 18% of them in DEP reporting knowledge of these activities.
- Awareness of digital materials, performances, and the Kilowatt Krush app is inconsistent for teachers.
- Kilowatt Krush app usage by students is increasing, though still relatively low; elementary students are most likely to have used it.
- While 19 of 34 teachers in DEC reported that NTC staff or materials mentioned the Kilowatt Krush app, 7 reported that their students were using it. In DEP more teachers reported that their students were using it than not; 12 of 21 teachers stated that NTC staff or materials mentioned the app, and 9 teachers said that their students were using it.
- In DEC, 275 of 300 student families reported that either the student had not downloaded the Kilowatt Krush app, or that they were not sure if they had or not. In DEP, 194 of 215 families stated that their child had not downloaded the app or they were unsure.

Program Experience and Satisfaction:

- Teacher satisfaction with the performances and interactions with NTC staff was very high with 32 of 34 DEC teachers and 20 of 21 DEP teachers rating the performance a 4 or a 5, or “highly satisfied”.
- Parents reported high levels of satisfaction with the measures provided in the efficiency kits. Measure satisfaction was highest amongst parents who installed LED bulbs; 81% of DEC and 91% of DEP respondents said that they were “highly satisfied” with the measure. Satisfaction measures were lowest with bathroom faucet aerators; 71% of parents in DEC and 74% of parents in DEP reported that they were “highly satisfied” with this measure.

In-Service Rates:

- An average of 3.2 measures from the kit were installed per household in DEC, and an average of 3.4 measures were installed in DEP. Nineteen respondents (6%) in DEC installed all of the items, and 42 respondents (14%) installed none of the items. In DEP, 21 respondents (10%) installed all items and 19 respondents (9%) installed none of the items.
- The lighting measures provided in the kit were installed more often than the water saving measures. When asked why they did not install water saving measures, respondents most frequently reported low water pressure or that the measures didn’t fit or match their fixture. Concerns about lighting measures were minimal and limited to night lights, where most of the respondents who didn’t install the measure reported that they did not need it.
- Large majorities of parents (79% and 81% in DEC and DEP) and children (DEC: 74%, DEP: 67%) changed their behaviors after receiving the kit or seeing the performance. The most commonly changed behavior was turning off lights when not

in the room and was shared amongst parents and children in both territories. Almost as many parents in DEC stated that they changed their thermostat settings as said turned lights off when leaving a room.

1.2.3 Conclusions and Recommendations

Based on evaluation findings, the evaluation team concluded the following and provides several recommendations for program improvement:

Conclusion: The use of AMI meter data as the primary input in the impact analysis was effective in reliably estimating savings attributable to the program.

> **Recommendation:** When proven to be feasible, continue to use an AMI-based consumption analysis approach in future EE Education program evaluations.

Conclusion: Teachers are highly satisfied with NTC performances and materials, although many teachers are unable to effectively utilize the materials within their curriculum due to timing issues. Some teachers additionally reported that they were unaware of the availability of online resources.

> **Recommendation:** Though the amount of online content has increased, it is important to prioritize making teachers aware of the availability of these online resources, including assuring these resources are prominently included in performances, instructional materials, and promotional materials. This may help address any problems stemming from the misalignment of these lessons. Additionally, ensuring that teachers are aware of any online content will be of particular importance in cases of remote learning, when traditional materials cannot be distributed as effectively.

Conclusion: A majority of parents who received energy efficiency kits installed at least one measure. Light bulbs and night lights were much more popular than water saving measures and were widely cited as items that respondents would like to receive more of. Parents primarily indicated that they would prefer to request additional kit items via the internet.

> **Recommendation:** Consider including additional lightbulbs in the efficiency kits, as they are relatively inexpensive and can enhance savings rates.

Conclusion: Large numbers of parents and students adopted energy saving behaviors as a result of tips and materials included in the kit.

> **Recommendation:** Expand behavioral guidance in both student and parent materials to maximize effects of the program. Parents in particular indicated that the primary reason for not finding energy saving tips useful was previous knowledge of those tips, suggesting that more advanced behavioral guidance (e.g. utilizing the scheduling feature of their thermostat to cool or heat the house in off peak periods) may be beneficial.

Conclusion: Teachers at smaller schools noted that reaching the 100 kit request threshold that qualifies for the $250 enrollment bonus is difficult. The program is also highly reliant on engaged teachers to drive performances and distribution of kits/student materials.

> **Recommendation:** Consider adjusting the award structure to encourage more teachers to become “champions” at unenrolled schools and drive more sign-ups. In addition, consider altering the incentive framework for schools that reach 100 kit requests and receive the $250 enrollment bonus to a proportion-based system, using quantity of received kit requests and student enrollment. This will make it easier for smaller schools to receive the enrollment bonus, and thus be more likely to be motivated to join and remain in the program. It is the evaluator’s understanding that an adjustment to the incentive structure was implemented for the 2021-2022 School Year that rewards teachers with $50 that reach 20 kit requests.

Conclusion: It is not clear how many teachers are attending performances, which makes estimating population parameters of evaluation and tracking data for this group difficult.

> **Recommendation:** Evaluate data gathering and tracking protocols to ensure that accurate teacher and student attendance is gathered at each school. This might include teacher sign-in sheets.

2 Introduction and Program Description

2.1 Program Description

2.1.1 Overview

The K12 Education Program is an energy efficiency program sponsored by Duke Energy Carolinas and Duke Energy Progress (DEC/DEP). The program provides free in-school performances by the National Theatre for Children (NTC) that teach elementary, middle, and high school students about energy and conservation concepts in a humorous and engaging format.

In addition to the NTC performance, NTC provides teachers with: 1) student workbooks that reinforce topics taught in the NTC performance, including a take-home form that students and parents can complete to receive an energy efficiency starter kit from Duke Energy; and 2) lesson plans associated with the content in the student workbooks. All workbooks, assignments and activities meet state curriculum requirements. The NTC performers encourage students to have their parents request the kits.

The program can achieve energy savings in two ways:

1. Through the installation of specific energy efficiency measures provided in the kit.

2. By increasing students' and their families' awareness about energy conservation and engaging them to change behaviors to reduce energy consumption.

2.1.2 Energy Efficiency Kit Measures

Table 2-1 lists the kit's contents included in the impact evaluation scope.

Table 2-1: Kit Measures

Measures	Details
9 Watt LED*	2 bulbs
Nightlight	1 LED plug-in nightlight
Showerhead	1 low-flow showerhead
Bathroom Faucet Aerator	1 low-flow faucet aerator
Kitchen Faucet Aerator	1 low-flow kitchen aerator
Water Temperature Gauge Card	1 temperature card indicating water heater temperature
Outlet Insulating Gaskets	8 outlet and 4 light switch gaskets
Behavioral Changes	Informational materials provided in the kit offer energy savings opportunities by changing patterns of energy consumption

*In January 2020 the program transitioned from offering two 9W LEDs to two 5W LEDs.

2.2 Program Implementation

2.2.1 Program Marketing and School Recruitment

Duke Energy sends NTC a list of approved schools in each utility territory, which NTC's communications staff uses to contact schools to schedule NTC performances. These communications include phone calls, emails, and postcards describing the program. An example of one of these postcards distributed to elementary school students can be seen in Figure 2-1. Once a school has agreed to participate, NTC ships curriculum materials to participating schools approximately two weeks prior to the performance date, at the request of the teacher. These teachers are often the contact at the school who organizes the involvement of other teachers.

Figure 2-1: NTC Recruitment Postcard for Elementary Students (K-5)

2.2.2 NTC Performance

NTC has four age-appropriate shows: two for elementary age students (Kindergarten through 2nd grade, and 3rd through 5th grade), one for middle school age students (6th through 8th grade), and one for high school students (9th through 12th grade). Two actors perform in each show, where they use an entertaining, humorous, and interactive format to educate students on four general areas:

- Sources of energy
- How energy is used
- How energy is wasted
- Energy efficiency and conservation

Performers also discuss how DEC and DEP offers students and their families free energy efficiency starter kits, how the items in the kit can save energy in their homes, and will hand out collateral to remind students of these tips, and ways to sign up for the kit.

Due to the emergence of the COVID-19 pandemic, NTC ceased live performances in mid-March, 2020. After about a month of subsequent preparation, NTC was able to provide elementary schools access to an educational video that included topics covered in the live performance. Due to this, the program was not able to meet pre-established kit sign-up goals.

In the performance, the actors explain to students that they must fill out the kit request form to receive their kit. Following the performance, teachers give their students the NTC workbooks that – in addition to educational activities to reinforce the concepts from the NTC performance – include a detachable postage-prepaid postcard kit request form. Students take the form home to their parents or guardians, who complete and mail the form. Parents or guardians may also request a kit via a toll-free telephone number or by signing up at MyEnergyKit.org, the program website administered by Relationship1, with content provided by NTC. The latter mode of sign up was the most popular in 2019-2020. To encourage participation, for every 100 parents to sign up, their childrens' school receives $250, and the six schools whose student's families' request the most kits each semester earn prizes ranging from $1,000-$2,500. In addition, student families who request a kit are entered into a drawing for a $1,000 cash prize.

2.2.3 Kit Distribution

Duke Energy uses two vendors to fulfill kit requests: R1 and AM Conservation. The participant's eligibility is confirmed by the firm R1 who manages and processes kit requests (both paper and online), removes non-Duke customers from the eligibility list, and sends this to Duke Energy, who also cleans this data and verifies the participant's eligibility and contact information. Once this is complete, the cleaned participation list is sent back to R1, as well as AM Conservation. A fulfillment request is then sent to AM Conservation who has 9 business days to ship the kits. Customers are told to expect 4-6 weeks for delivery of their energy kit, though this will generally happen much more quickly.

2.2.4 Energy Kit Eligibility

Student families can only receive a kit once every 36 months, and must be Duke Energy customers. The schools where the performances occur must also be a Duke Energy customer. These eligibility requirements present challenges in finding and motivating new schools, as well as new student families, to participate.

2.2.5 Participation

For the defined evaluation period of August 2019 through July 2020, the program recorded a total of 26,200 kit recipients. Customers in DEC accounted for 20,852 of the total, and the remaining 5,348 kit recipients were in DEP.

2.2.6 Program Changes

In January of 2020, the program changed out the general service LEDs that had historically been part of the kit, to candelabra-style LEDs, due to internal research indicating the former were too close to nearing saturation to legitimize their inclusion.

Duke Energy designed and launched a smart phone app called "Kilowatt Krush" in 2018. This app is geared toward students, and was designed to increase kit signups by 4%, and increase engagement and energy saving behaviors. Due to unanticipated data privacy issues, kit signups via Kilowatt Krush were not available in PY 2018-2019. However, this issue was resolved in 2019-2020, and student families were able to sign up with the app, as the verification codes were sent to the parents' emails so the student or family member could complete the signup process.

Lastly, starting in October 2018, high school performances piloted in other jurisdictions were added to the DEC/DEP program.

2.3 Key Research Objectives

The over-arching project goals will follow the definition of impact evaluation established in the "Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency," November 2007:

> "Evaluation is the process of determining and documenting the results, benefits, and lessons learned from an energy-efficiency program. Evaluation results can be used in planning future programs and determining the value and potential of a portfolio of energy-efficiency programs in an integrated resource planning process. It can also be used in retrospectively determining the performance (and resulting payments, incentives, or penalties) of contractors and administrators responsible for implementing efficiency programs."

Evaluation has two key objectives:

1) To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.
2) To help understand why those effects occurred and identify ways to improve the program.

2.3.1 Impact

As part of evaluation planning, the evaluation team outlined the following activities to assess the impacts of the DEC/DEP K12 Education Program:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for energy efficient measures implemented in participants' homes;

- If necessary, assess the rate of free riders from the participants' perspective and determine spillover effects;
- Benchmark verified measure-level energy impacts to applicable technical reference manual(s) and similar Duke programs in other jurisdictions.

2.3.2 Process

The process evaluation assessed opportunities for improving the design and delivery of the program in DEC/DEP service territory. It specifically documented teacher, student, and parent experiences by investigating: 1) teachers' assessments of the NTC performance, program materials, and curriculum in terms of quality of content, and ability to engage and motivate students to save energy; and 2) student families' responses to the energy efficiency kits and the extent to which the kits effectively motivate families to save energy.

The evaluation team assessed several elements of the program delivery and customer experience, including:

- **Awareness:**
  - How aware are teachers and student families of DEC/DEP's sponsorship of the program?
  - How did they become aware?
- **Program experience and satisfaction:**
  - How satisfied are teachers with the NTC performance and program curriculum in terms of ease of use, ability to engage, and motivate students to conserve energy at home?
  - How satisfied are student families with the measures in the kit and to what extent do the kits motivate families to save energy?
- **Challenges and opportunities for improvement:**
  - Are there any inefficiencies or challenges associated with program delivery?
  - How engaged are teachers in implementing the curriculum and motivating student families to request program kits?
  - What are teachers' assessments of the NTC performance, program information, and curriculum?
- **Student family characteristics:**
  - What are the demographic characteristics of kit recipients?

2.4 Evaluation Overview

The evaluation team divided its approach into key tasks to meet the outlined goals:

- **Task 1 –** Develop and manage an evaluation work plan to describe the processes that were followed to complete the evaluation tasks outlined in this report;

- **Task 2 –** Verify gross and net energy and peak demand savings resulting from the K12 Education Program through verification activities of a sample of 2019 - 2020 program participants;
- **Task 3 –** Conduct a process review to determine how successfully the program is being delivered to participants and to identify opportunities for improvement.

2.4.1 Impact Evaluation

The impact evaluation utilized a consumption data-based approach using AMI meter data. This methodology differs from the approach used in the previous evaluation, which calculated program savings based on engineering algorithms. While a consumption analysis was attempted as part of the previous evaluation, the evaluation team ultimately determined that it was not feasible at the time. At the time of the previous evaluation, AMI meters had not been fully deployed in DEC and DEP territories and only monthly billed consumption data was available for analysis. Since then, Duke Energy has deployed AMI meters to virtually all of its residential customers in the DEC and DEP territories, which offer more comprehensive usage data. With AMI data now accessible, a consumption analysis offers enhanced analytical capabilities to estimate household-level energy and demand savings.

A consumption analysis allows for accurate measurement of household (or equipment-level) electric usage before and after a program intervention is introduced. Unlike an engineering algorithm, consumption analysis is able to capture behavioral effects of the program, in addition to the effects of the equipment measures installed.

The impact evaluation involved the following steps:

1) Conduct a series of false experiments to test the feasibility of directly estimating energy savings using customers' AMI consumption data.
2) Having verified that consumption analysis is effective, apply a difference-in-differences regression modeling approach to estimate average household-level energy savings at the annual and monthly intervals.
3) Utilizing hourly load data, apply a similar regression modeling approach to estimate summer and winter peak demand impacts.

2.4.2 Process Evaluation

The process evaluation examined and documented:

- Program operations
- Stakeholder satisfaction
- Opportunities to improve the efficiency and effectiveness of program delivery

To satisfy the EM&V objectives for this research effort, the evaluation team reviewed program documents and conducted web surveys with participating student families and teachers who attended the performance. These surveys served both the process and impact evaluation work.

The team also held in-depth interviews (IDI) with utility staff, implementation staff, and teachers. Table 2-2 provides a summary of the evaluation team activities.

Table 2-2: Summary of Process Evaluation Activities

Target Group	Method	Sample Size	Population	Confidence / Precision
Duke Energy program staff	Phone in-depth interview	1	n/a	n/a
Implementation staff: NTC	Phone in-depth interview	1	n/a	n/a
Implementation staff: R1	Phone in-depth interview	1	n/a	n/a
Teachers who attended NTC performance	Web survey	72 (DEC:43, DEP: 29)	unknown	90% ± 9.7%
Participating teacher follow-up interviews	Phone in-depth interview	8	unknown	n/a
Student families who received DEC/DEP kit and are customers of DEC/DEP	Web survey	515 (DEC: 300, DEP: 215)	25,982	90% ± 3.6%

3 Impact Evaluation

3.1 Background

Prior to 2020, impact evaluation was based on an engineering approach, where estimated energy and demand savings were derived using a combination of customer survey responses and measure-specific assumptions that were applied to savings algorithms found in region-specific technical reference manuals.

Energy and demand savings are ideally estimated using empirical household consumption data. A consumption analysis allows for accurate measurement of household (or equipment-level) electric usage before and after a program intervention is introduced. Unlike an engineering algorithm, consumption analysis is able to capture behavioral effects of the program, in addition to the impacts of equipment measures installed.

The 2017-2018 impact evaluation of Duke's Energy Efficiency Education Program attempted a consumption analysis based on customers' monthly billing data. However, due to a range of factors, billing analysis was found to be an ineffective tool for estimating savings. One of the primary contributing factors was the inability of monthly data to detect small program savings of 2% to 3%. As a result, the 2017-2018 analysis applied an engineering approach to calculate estimated savings.

As of mid-2019, Duke Energy had fully deployed advanced meters to virtually all of its residential customers in the DEC territory, as well as to a portion of its customers in the DEP territory. AMI data offer more granular information about customers' electric usage at daily or hourly intervals and enables enhanced analysis methodologies beyond the capability of monthly billed usage data. Specifically, the more robust datasets granted by AMI data result in more precise savings estimates and enables the analysis to better detect small effect sizes. In addition, having hourly AMI load data allows for the estimation of load reduction during the system's summer and winter peak periods.

3.2 Methodology

The 2019-2020 impact evaluation was based on a consumption analysis using AMI consumption data. This approach differs from the engineering approach used in 2017-2018 in a few key aspects:

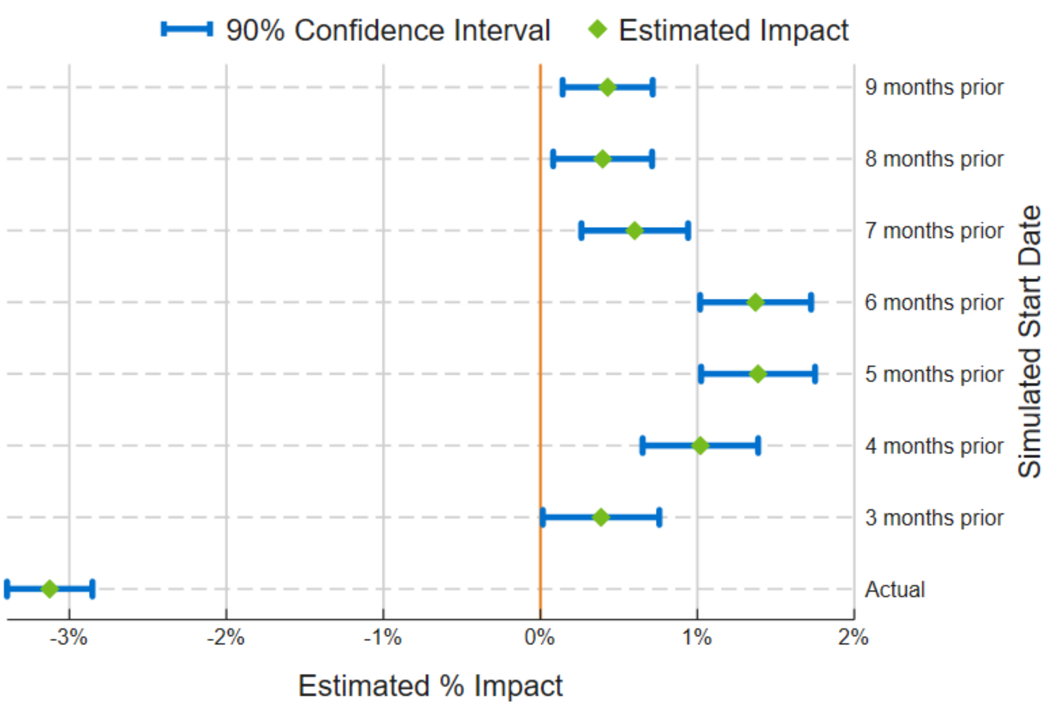
1) As mentioned previously, consumption analysis accounts for the behavioral component of the program by capturing program effects at the whole-house level, rather than at the equipment level. The savings estimates are comprehensive and comprise both the behavioral effects stemming from the educational component of the program, as well as savings derived from the kit equipment.

2) Consumption analysis is unable to disaggregate savings to the measure-level.
3) The savings estimates are not subject to assumptions gathered from a sample of customer surveys and/or taken from secondary sources such as TRMs.

The first step of the impact analysis was to verify the feasibility of an AMI-based consumption analysis approach for estimating energy savings. This involved conducting a series of false experiments where fake enrollment dates were simulated for program participants, and savings were estimated for fake post-treatment periods. The premise of these false experiments is that, because enrollment dates are fictitious and actual post-enrollment data are excluded, the savings are known to be zero.

The results of the false experiments, shown in Figure 3-1, provide assurance that the estimation approach is effective in detecting program effects. Specifically, when customers' enrollment start dates are simulated and fake treatment periods are used, the model correctly estimates near-zero savings when none are expected.

Figure 3-1: Results of False Experiments



We know that the true effects resulting from the false experiments are zero. However, the model estimates slight changes in the range of 0.5% to 1.5%, as indicated by the green markers to the right of the orange line in Figure 3-1. These changes, which we know are not program-related, are presumed to be due to natural increases in consumption over time among participating households that are not netted out by the matched control group. This concept is discussed in further detail in Section 3.6.

Having demonstrated that the consumption analysis modeling approach is effective via the false experiments, the next step of the impact evaluation was to apply the same modeling technique to the actual data in order to estimate annual savings attributable to the program. The model specification used to estimate energy savings is shown below.

Equation 3-1: Energy Savings Model Specification

$$kWh = \beta_0 + \beta_1(month) + \beta_2(partpost) + \varepsilon$$

The key output of the model is β_2, the coefficient on the *partpost* term. This coefficient represents the estimated change in average daily consumption among EE Education participants in the post-enrollment period. Because the modeling approach applies a difference-in-differences methodology, the estimated savings are considered net savings since any changes not related to the program are accounted for by the matched control group.

In addition to estimating annual energy savings, Nexant also assessed savings at the monthly level in order to determine any trends in savings achieved over time. This is often particularly helpful for gauging the savings from equipment measures that are expected to be seasonal or weather-dependent. The model specification used to estimate monthly savings is shown in Equation 3-2.

Equation 3-2: Monthly Energy Savings Model Specification

$$kWh = \beta_0 + \beta_1(moyr) + \beta_2(partpost) + \beta_3(moyr \times partpost) + \varepsilon$$

The monthly model specification includes an independent variable for month-year and interacts it with the *partpost* variable. The individual coefficients determined for each of those interactions, expressed by β_3 *in Equation 3-2,* represent the estimated change in average daily consumption in each month of the post period.

The final step of the impact evaluation was to estimate hourly load impacts during the summer and winter peak periods. This was done by applying a similar difference-in-differences regression modeling approach that was used to estimate energy savings, and based on the same set of customers making up the treatment and control groups. The model specification used to estimate hourly peak load impacts is shown below.

Equation 3-3: Peak Load Demand Impacts Model Specification

$$kW = \beta_0 + \beta_1(post) + \beta_2(partpost) + \varepsilon$$

The demand model controls for unobserved changes in usage over time through the addition of the *post* term. Similar to the energy model, the key output of the model is β_2, the coefficient on the *partpost* term, which represents the estimated change in hourly load among program participants.

3.3 Data Requirements

The impact evaluation utilized five primary data components.

3.3.1 Program Participation

An extract of 2019-2020 EE Education program participants was provided by Duke Energy. The dataset included key customer information and household characteristics, including unique account identifier, jurisdiction (DEC vs. DEP), premise type, heating type, school assignment, and enrollment date (i.e., date kit was sent).

3.3.2 Cross-Program Participation

In addition to EE Education program participation, Duke Energy provided records of customers' participation in other energy efficiency programs offered by Duke Energy during or prior to the 2019-2020 program year. This is important for isolating savings that are directly attributable to the EE Education program, and not due to efficiency measures introduced as part of other programs.

3.3.3 Participating Schools

In addition to a record of participating households, Duke Energy provided a list of schools that participated in the EE Education program during the 2019-2020 school year. The dataset included school identifers (i.e., account number, name, identification number), school characteristics (e.g., public vs. private, grades, number of students, etc), and performance date.

3.3.4 Consumption Data

The primary data input used in the impact analysis is customers' AMI data at either daily or hourly intervals. Data were obtained both for the population of EE Education program participants and for a matched control group made up of MyHER customers. Daily data were applied for the annual energy (kWh) savings analysis while the peak demand impact analysis utilized hourly load data. The data covered the date range from January 2018 through January 2021.

3.3.5 MyHER Customer Data

Nexant used existing customers from Duke Energy's MyHER program to populate the matched control group. The primary reason for using MyHER participants for the control group is the prevalence of the MyHER program among Duke Energy's residential customer population. Normally, the analysis would be restricted to customers who participated in EE Education and no other programs, in order to properly isolate the program's effects. However, because so many EE Education program participants also participate in MyHER, the integrity of the analysis would have been compromised had MyHER customers been excluded. Using MyHER accounts as control customers, and performing the group matching appropriately, assures a net savings result that is directly attributable to participating in the EE Education program.

3.4 Data Cleaning and Validation

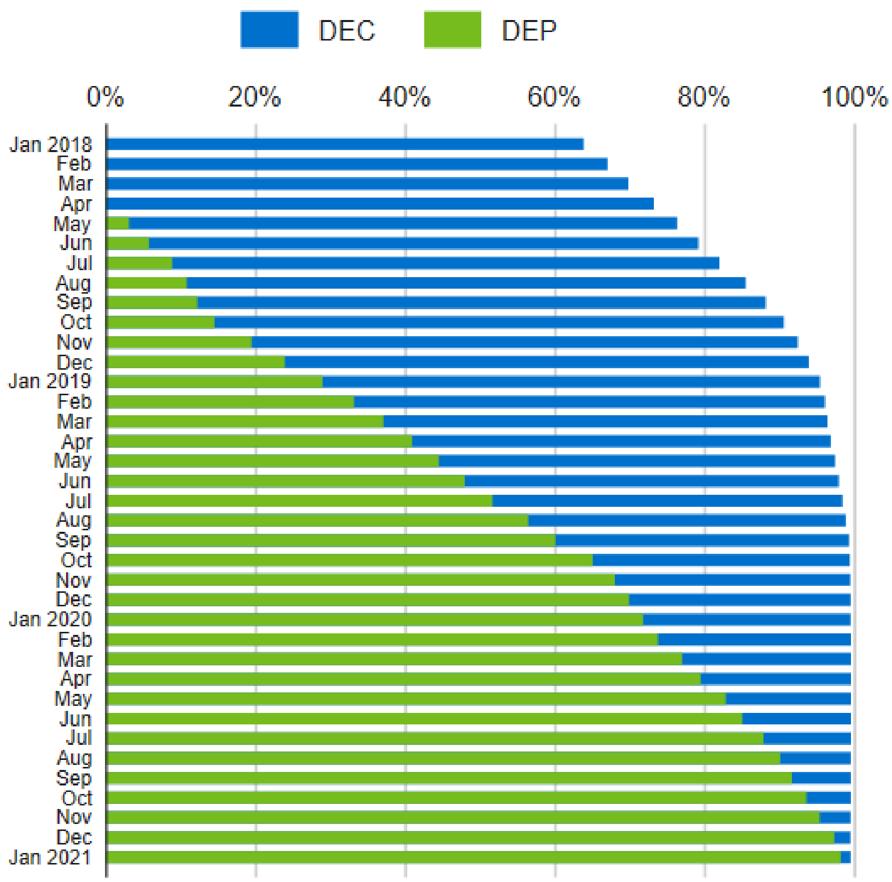
After all raw data sources were compiled and organized, steps were taken to ensure that the refined datasets used in the analysis excluded any spurious, duplicate, and/or unneeded data. The evaluation team applied a rigorous data cleaning process that involved initial, detailed assessments of each data file, followed by a system of checks and filters designed to detect and eliminate any observations not integral to the analysis.

- **Cross-program participants.** The evaluation team removed approximately 7,000 customers from the EE Education participant population who also participated in other Duke Energy efficiency program(s) during the period of consumption data used in the analysis (2018-2021). Removing these accounts ensures that any change in consumption found by the analysis is categorically attributable to the EE Education program, and not due to interventions introduced by other program(s).
- **Accounts with missing or insufficient consumption data.** Customers who did not have at least 12 consecutive months of consumption data prior to the program's enrollment period were removed from the analysis. These customers could not be used in the control group matching process, which was designed to require a complete year of pre-program data in order to establish a stable and representative baseline period.
- **Duplicates and outliers.** Any duplicated data observations were removed. In addition, the evaluation team identified and removed all negative and large outlier usage records. Outliers were defined as usage observations greater than three standard deviations above the mean value.
- **Control group cleaning.** A similar set of checks and filters was applied to the control group (MyHER) datasets.

3.5 Analysis Limitations

The impact evaluation faced a few limitations related to data availability and program design. First, while AMI meters had been deployed to a majority of households in the DEC territory by mid-2018, they were only partially deployed by that point in the DEP territory. Because the consumption analysis requires at least 12 months of pre-enrollment usage data, only households having valid AMI meter data as of August 2018 are able to be included in the analysis.

Figure 3-2: Share of Program Participants with AMI Data, by Month



By August 2018, roughly 85% of participating households in the DEC territory had active AMI meter data, while only 10% of households in DEP had active data. As a result, the set of customers available for analysis is heavily weighted with households from the DEC territory. The most affecting consequence of having such a lopsided analysis population is that savings estimates could not be determined for the DEC and DEP jurisdictions separately. Only 3% of the analyzed program participants came from the DEP jurisdiction, which is too few to produce valid, DEP-specific savings results. For this reason, the evaluation team applied the singular DEC-DEP combined savings results to both jurisdictions uniformly.

A second limitation of the evaluation has to do with forming a dependable baseline against which to measure post-enrollment consumption. Normally, one of the analysis methodologies tested would be an approach known as within-subjects. This approach involves a comparison of weather-normalized consumption prior to enrollment to consumption after enrollment for program participants only (i.e., no control group). In this case, the baseline is defined by the pre-enrollment consumption patterns among program particpants.

There are two specific aspects that compromise the baseline of a within-subjects analysis. First, the post-enrollment period for 2019-2020 program participants contains a substantial period of time affected by the COVID-19 pandemic. The effects of the pandemic have included significant and persistent changes to household occupancy and energy use patterns, particularly resulting from stay-at-home orders, telecommuting, and school closures. These external, non-weather circumstances were introduced during the evaluation period and present significant differences between the pre-enrollment and post-enrollment periods that influence household energy consumption. In other words, even absent the program, consumption still would have differed among participants due to the effects of COVID-19.

Second, households participating in the EE Education program are known to be families with school-aged children and are likely to experience inherent growth in energy usage over time. As family size, household occupancy, and ages of children grow, so does the household's energy needs. This again leads to a natural change in household consumption that is not related to the program.

3.6 Control Group Matching

The first step of the impact analysis is to develop a matched control group consisting of non-participating customers that resemble the participant population in pre-enrollment consumption patterns. To perform the match, each participant is paired with the non-participant whose pattern of electric usage during the 12 months prior to enrollment in the program is most similar. Comparing participants to matched non-participants helps to ensure there are no exogenous differences between the participants and matched control customers that would cause changes in consumption, other than the program's effects.

A difference-in-differences methodology that uses a matched control group has advantages over the within-subjects approach which is applied to program participants only. First, it establishes a reliable baseline for estimating savings attributable to the program. The non-participating customers serve as the baseline for a "no program" alternative. By assuring the control group's consumption is closely similar to that of the program's participants, we are able to assume that their usage in the post-enrollment period represents what would have happened absent the program. The estimated savings attributable to the program, therefore, is calculated as the average difference between the post-treatment consumption among participants and non-participants.

As described earlier, the control group was made up of existing MyHER customers due to the prevalence of the program in the DEC and DEP territories. The MyHER program, which is implemented as a randomized control trial (RCT) program, contains both treatment accounts (those who receive MyHER reports) and control accounts (those who do not receive reports). Furthermore, among the MyHER treatment customers, there are a total of 13 separate cohorts, each with a different release date that defines the time at which customers within that cohort started receiving MyHER reports. Meanwhile, the population of EE Education participants also includes a significant share of MyHER participants from among the 13 treatment cohorts, as well as a number of MyHER control customers and customers who have not participated in MyHER. In order to ensure a well-balanced match, where similarities between treatment and matched control groups are optimized, Nexant performed a segmented match using a number of key characteristics data points, including jurisdiction, premise type, and MyHER cohort.

Households participating in the EE Education program, who are also treatment customers in MyHER, were matched to similar households from among the MyHER control pool in the same cohort. Likewise, EE Education participants who did not participate in MyHER or were MyHER control customers were matched to non-participants from the MyHER control group. This system of targeted matching helps to maximize the homogeneity between groups in ways unobserved through household consumption data.

Groups were matched using monthly consumption data during the 12-month period prior to the start of program enrollment, or the period August 2018 through July 2019. An examination of the matching results indicates that treatment and control groups are highly similar in terms of household consumption during this period.

Figure 3-3: Group Matching Results

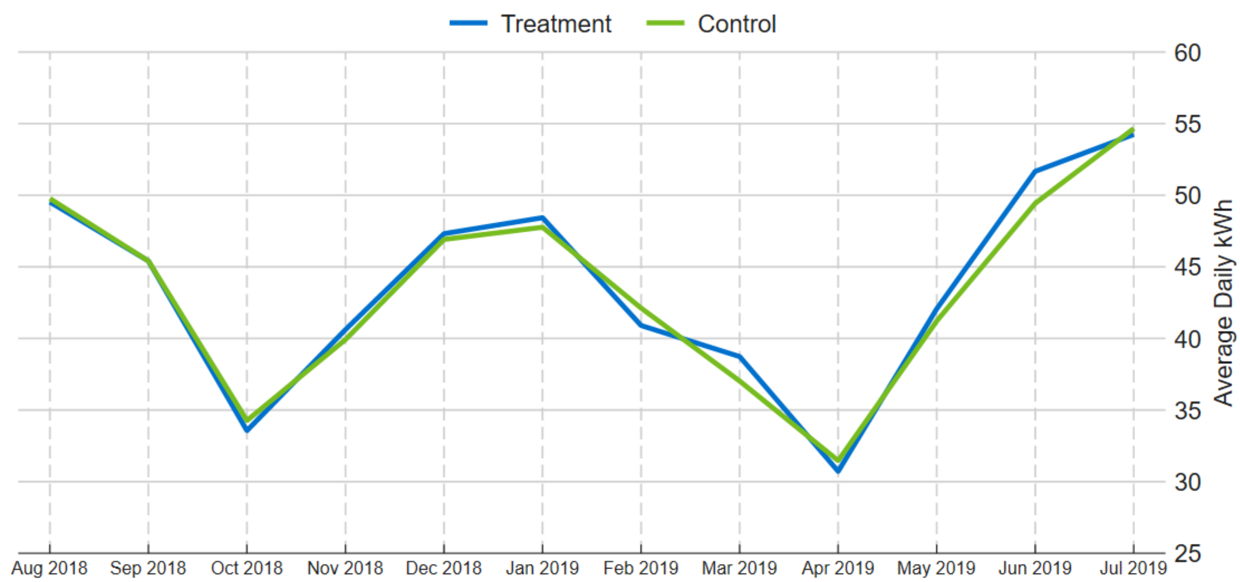


Figure 3-3 shows a strong correlation between groups in terms of pre period consumption patterns; however, three of the months (February, March, and June) show a small disparity between the groups' usage. These slight inconsistencies are not wholly unexpected given they are matched on monthly consumption values, which can fluctuate within the population.

3.7 Energy Savings Results

Energy savings estimates for the 2019-2020 EE Education program in the DEC and DEP territories are presented in Table 3-1. Results are presented as average daily kWh savings per household. Throughout this section, negative values refer to savings.

Table 3-1: Average Daily Energy Savings Summary

Program	Base kWh	Impact (kWh)	Std. Err.	Lower Bound	Upper Bound	Percent Impact	% Lower Bound	% Upper Bound
EE Education	41.65	-1.30	0.07	-1.42	-1.12	-3.13%	-3.40%	-2.85%

The impact analysis shows that the program generates an average of 1.3 kWh per day per household. This translates to approximately 475 kWh annual savings, or 3.13%. These results are statistically significant at the 90% confidence level.

A monthly regression analysis reveals the trends in savings observed over the extended duration of the post period. The results indicate that program savings occur predominantly during the first six to seven months of the school year (August 2019 through February 2020). The timing of the savings generally coincides with program enrollments (defined by the kit sent dates), where a large portion of the program's participation, roughly 70% of enrollments, occurred during the first half of the school year.

Figure 3-4 presents the estimated monthly percent energy savings profile for the time period August 2019 through December 2020. The trend shown in Figure 3-4 suggests that program effects diminish over time, perhaps due to customer fatigue and/or lack of interest.

Figure 3-4: Monthly Energy Savings Profile, %

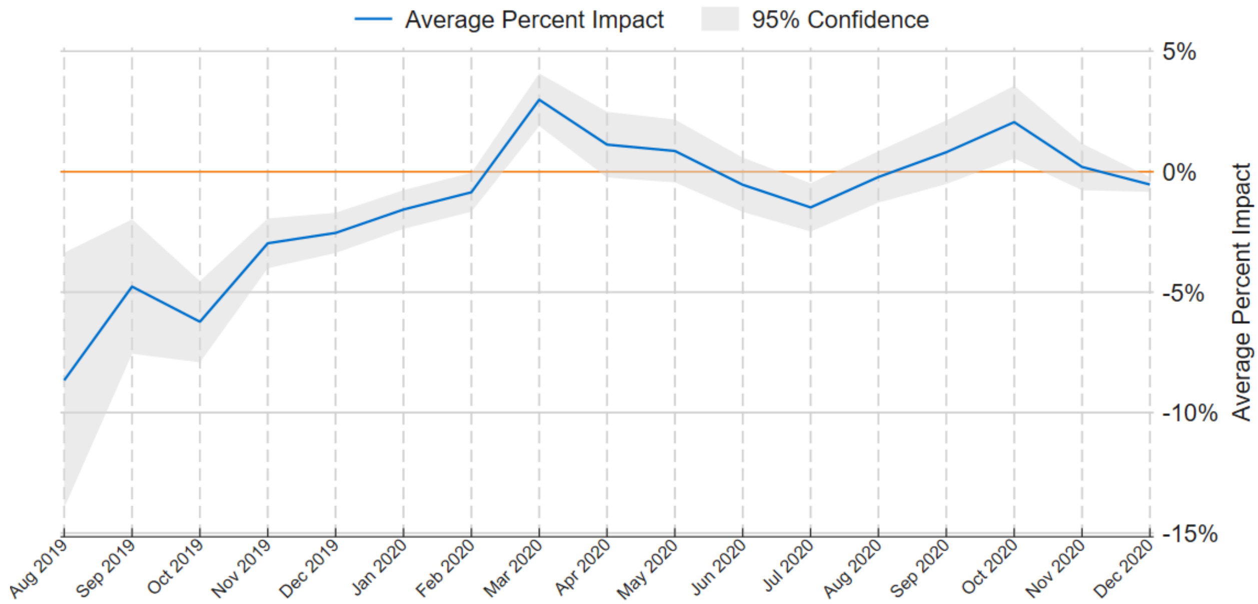


Table 3-2 shows kWh and percent savings by month for the period August 2019 through December 2020. The average percent savings over the first six months of the program year (August 2019 through January 2020) is 4.7%.

Table 3-2: Monthly Energy Savings Results

Month	Impact (kWh)	Lower Bound	Upper Bound	% Impact	% Lower Bound	% Upper Bound
Aug 2019	**-3.58**	-5.71	-1.45	**-8.9%**	-14.1%	-3.6%
Sep 2019	**-2.13**	-3.33	-0.94	**-5.0%**	-7.7%	-2.2%
Oct 2019	**-1.90**	-2.39	-1.41	**-6.6%**	-8.3%	-4.9%
Nov 2019	**-1.22**	-1.62	-0.82	**-3.2%**	-4.3%	-2.2%
Dec 2019	**-1.14**	-1.50	-0.78	**-2.7%**	-3.5%	-1.8%
Jan 2020	**-0.72**	-1.07	-0.37	**-1.7%**	-2.5%	-0.9%
Feb 2020	**-0.42**	-0.76	-0.08	**-1.0%**	-1.9%	-0.2%
Mar 2020	**0.98**	0.61	1.36	**2.9%**	1.8%	4.0%
Apr 2020	**0.31**	-0.12	0.73	**1.0%**	-0.4%	2.4%
May 2020	**0.26**	-0.19	0.72	**0.8%**	-0.5%	2.1%
Jun 2020	**-0.27**	-0.79	0.26	**-0.6%**	-1.7%	0.6%
Jul 2020	**-0.85**	-1.42	-0.28	**-1.5%**	-2.5%	-0.5%
Aug 2020	**-0.09**	-0.63	0.45	**-0.2%**	-1.3%	0.9%
Sep 2020	**0.28**	-0.21	0.77	**0.7%**	-0.6%	2.1%
Oct 2020	**0.58**	0.14	1.02	**2.0%**	0.5%	3.5%
Nov 2020	**0.06**	-0.26	0.39	**0.2%**	-0.8%	1.2%
Dec 2020	**-0.25**	-0.40	-0.10	**-0.5%**	-0.8%	-0.2%

3.8 Demand Impacts Results

A key benefit of AMI meter deployment in the DEC and DEP territories is the availability of hourly load data for residential customers. Accessibility of hourly data enables the analysis to measure changes in load during specific periods of interest, such as when system demand is greatest. These times when system load is greatest, known as peak periods, occur at different times of day during the summer and winter seasons.

Table 3-3: Peak Period Definitions

Season	Peak Period Definition
Summer	July Weekdays 4:00 PM to 5:00 PM
Winter	January Weekdays 7:00 AM to 8:00 AM

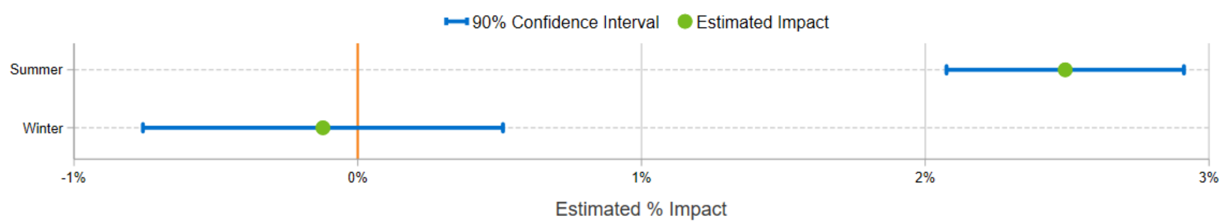
In DEC and DEP territories, summer peak occurs during the one-hour period from 4:00 PM to 5:00 PM on non-holiday weekdays in July. Winter peak occurs between 7:00 AM and 8:00 AM on non-holiday weekdays in January.To estimate the per household load reduction during these defined peak periods, Nexant applied a similar difference-in-differences regression modeling approach based on the same sets of customers used to make up the treatment and control groups for the energy savings analysis.

Results of the demand analysis are shown in Table 3-4 and Figure 3-5.

Table 3-4: Estimated Peak Demand Impacts, by Season

Season	Base kW	Impact (kW)	Std. Err.	Lower Bound	Upper Bound	% Impact	% Lower Bound	% Upper Bound
Summer	3.239	0.081	0.008	0.067	0.094	2.4%	2.1%	2.9%
Winter	2.189	-0.003	0.008	-0.017	-0.011	-0.1%	-0.8%	0.5%

Figure 3-5: Estimated Peak Demand Impacts, by Season



The results show that the EE Education program does not generate notable load reductions during peak periods. The estimated change in load during the summer peak hour is an increase of 0.081 kW, or a 2.4% load growth. The estimated winter peak impact is a load decrease of 0.003 kW, or 0.1% load reduction.

The lack of significant peak load impacts, specifically during the summer season, can be explained by a few possible factors:

- The types of measures included in the efficiency kit are not measures that are typically associated with generating meaningful peak load reduction. Specifically, the water-related measures contained in the kits (low-flow showerheads, faucet aerators, temperature gauge) have very little effect on summertime peak loads.
- The Duke-defined peak periods occur at times when household load is predominantly space heating/cooling. Equipment measures contained in the kit are not designed to reduce space conditioning load.
- The summer peak period occurs in July, generally six to nine months after customers enroll in the program (i.e., view the performance, receive their kits, etc). By the time summer occurs, customer fatigue may have set in and participants may not be as motivated to conserve energy.
- Household loads are likely to be larger during summer months, when children are home from school and energy needs are greater.

3.9 Summary & Key Findings

The 2019-2020 EE Education program generated significant energy savings among participating households, but did not show meaningful load demand reductions during the peak periods. The gains in energy savings shown compared to the previous evaluation were enough to offset the reduced program participation levels in DEC; however, the aggregate program-level savings dropped in DEP due to the decline in participation in 2019-2020.

3.9.1 Summary of Program Savings

The total estimated savings generated by the EE Education Program for the 2019-2020 program year is 9,905 MWh for the DEC jurisdiction and 2,540 MWh for the DEP jurisdiction. The aggregate, program-level load change during summer peak demand period is an increase of 1.69 MW in DEC and 0.43 MW in DEP. The program's winter peak demand impact is a decrease of 0.06 MW in DEP and 0.02 MW in DEP.

Table 3-5: Summary of Program Savings, 2017-2018 vs. 2019-2020

		2017-2018 Engineering Analysis	2017-2018 Program Savings	2019-2020 AMI Data Analysis	2019-2020 Program Savings
DEC		*Program Population = 23,161*		*Program Population = 20,852*	
	Energy Savings	254 kWh	5,884 MWh	475 kWh	9,905 MWh
	Summer Demand Impact	0.031 kW	0.723 MW	-0.081 kW	-1.689 MW
	Winter Demand Impact	0.045 kW	1.036 MW	0.003 kW	0.062 MW
DEP		*Program Population = 9,025*		*Program Population = 5,348*	
	Energy Savings	317 kWh	2,866 MWh	475 kWh	2,540 MWh
	Summer Demand Impact	0.038 kW	0.343 MW	-0.081 kW	-0.433 MW
	Winter Demand Impact	0.059 kW	0.534 MW	0.003 kW	0.016 MW

Table 3-5 provides a summary comparison of the current 2019-2020 AMI-based impact evaluation results to the previous 2017-2018 engineering analysis results. In both jurisdictions, the annual per household energy savings increased significantly from the previous findings. These differences are judged to be primarily due to the differences in the methodologies used to produce them. Specifically, the prior estimates relied on a set of assumptions needed to estimate savings via an engineering approach, while the current estimates utilized empirical measurements. Whereas an engineering approach relies on algorithm input variables that may be estimated or assumed based on secondary sources, an AMI data analysis approach is able to take advantage of requiring only measured and/or observed data. Because there was insufficient AMI data available for the DEP jurisdiction, results of the energy and demand consumption analyses are applied uniformly across both DEC and DEP.

3.9.2 Key Findings

Key findings from the impact evaluation include:

- The program produced significant energy savings. Annual per household energy savings increased by 87% and 50% in the DEC and DEP jurisdictions, respectively, from the 2017-2018 savings estimates.
- The program did not generate any meaningful load demand reductions during summer or winter peak periods.
- The lack of demand impacts may be due to a combination of factors, including the type of measures included in the kit and the timing of observed summer peak periods relative to the start of the program year.

4 Net-to-Gross Methodology and Results

The impacts of the K12 Education Program on energy consumption and demand were measured by comparing the energy consumption and demand of customers who received the kits with that of customers who did not (the matched control group). Naturally occurring energy consumption or demand changes that happen during the period of study are reflected in the energy consumption and demand observed for the control group. The impact of the K12 Education Program is measured as the difference in differences between the treatment and control groups before, during, and after exposure to the program. This difference is net of any naturally occurring changes, so there is no need to perform a net-to-gross adjustment.

5 Process Evaluation

5.1 Summary of Data Collection Activities

The process evaluation is based on telephone interviews with Duke Energy program staff, and implementer staff, and teachers who had attended an NTC performance. The process evaluation is also based on web surveys with teachers who had attended an NTC performance and student families who received a kit during the program evaluation year (Table 5-1).

Table 5-1: Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size	Population	Confidence / Precision
Duke Energy program staff	Phone in-depth interview	1	n/a	n/a
Implementation staff: NTC	Phone in-depth interview	1	n/a	n/a
Implementation staff: R1	Phone in-depth interview	1	n/a	n/a
Teachers who attended NTC performance	Web survey	72 (DEC:43, DEP: 29)	unknown	90% ± 9.7%
Participating teacher follow-up interviews	Phone in-depth interview	8	unknown	n/a
Student families who received efficiency kit and are customers of DEC or DEP	Web survey	515 (DEC: 300, DEP: 215)	25,982	90% ± 3.6%

5.1.1 Teacher Surveys and Follow-Up Interviews

The evaluation team surveyed and interviewed teachers who attended NTC performances to better understand program success and delivery and to gather an educator perspective on what could be improved.

In April and May 2021, the evaluation team contacted a total of 752 teachers who attended NTC performances via email (547 in DEC and 205 in DEP) and ultimately surveyed 55 teachers who saw performances between September 10, 2020 and April 30, 2021. Thirty-four of the 55 teacher respondents taught at schools within DEC's service territory; 11 were elementary school teachers, 14 taught middle school and 9 taught high school. The remaining 21 respondents within DEP's territory were comprised of 6 elementary and 14 middle school teachers, and one high school teacher. We report grade level findings together unless a meaningful difference emerged between school types. Response rates are reported in Table 5-2.

In June 2021 the evaluation team contacted teachers who completed the web survey and indicated interest in being interviewed about their experience. The evaluation team requested their participation in a follow-up in-depth interview (IDI) about their experience with the performance, curriculum materials, and kit request forms. These IDIs allowed the evaluation team to get a deeper understanding of topics uncovered in the web survey and to provide additional details about the teacher's experience with the program. The evaluation team completed interviews with eight of these teachers.

Table 5-2: Survey Response Rates

Survey Group	Population Size	Sample Frame Size	Completed Surveys	Completion Rate	Confidence/ Precision
Teachers	Unknown	752	55	7.3%	n/a
Student Parents	25,982	11,517	515	4.5%	90/4

5.1.2 Survey of Student Families Who Received the DEC/DEP Kit

In April and May 2021 the evaluation team surveyed 515 families who received energy efficiency kits from DEC or DEP between August 2019 and July 2020 (Table 5-2). During that period, DEC and DEP distributed a total of 26,200 kits to families who completed the kit request form their child brought home from school. Through email survey invitations, the evaluation team attempted to contact a random sample of 11,534 households for which program records provided an email address. Ultimately, the data collection effort achieved an 8.8% response rate and a 4.5% completion rate, providing a sample with 90/4 confidence/precision. Comparisons with census data demonstrate that the sample is largely representative of ownership status for the region, with rates in both DEC (70%) and DEP (72%) falling slightly above the regional average of 68%. However, respondents in both DEP and DEC noted higher educational attainment and larger-sized households than typical of the region. Income levels were slightly higher in DEC than what is typical of the region, and slightly lower in DEP.[1]

5.2 Process Evaluation Findings

5.2.1 Awareness of DEC/DEP Sponsorship of the Program

Teachers and student families were largely aware of Duke Energy's sponsorship of the program. Almost all teachers in both DEC and DEP reported they were aware of Duke Energy's sponsorship (DEC = 97%, DEP = 95%). The 33 teachers who knew of DEC's sponsorship most often learned about it through NTC materials (13), NTC staff (12) or DEC marketing materials (12); Table 5-3 provides a full breakdown of teacher awareness. DEP teachers also stated DEP marketing materials (7 of 20 teachers) and NTC materials (7 of 20 teachers) were the most common way of learning about Duke Energy's sponsorship.

[1] Region comparisons come from and average of 2019 American Community Survey (Census) 1-year period estimates data for North Carolina and South Carolina.

Table 5-3: How Teachers Learned of Duke Energy's Sponsorship (Multiple Responses Allowed; DEC n = 33, DEP n = 20)

Source	Number of Teachers	
	DEC	DEP
The National Theatre for Children Materials	13	7
Duke Energy Marketing Materials	12	7
The National Theatre for Children Staff	12	4
Another teacher	5	1
Other	4	4
Duke Energy Staff	1	0
Don't Know	1	0

Awareness of Duke Energy sponsorship among student families was also high, with 88% of DEC parents and 91% of DEP parents stating they knew the kit was sponsored by Duke Energy. Parents indicated they learned about Duke's sponsorship most frequently via information included in or on the kit (DEC: 53%, DEP: 53%). Other common ways that families learned about Duke Energy sponsorship were classroom materials their child brought home (DEC: 51%, DEP: 47%), and communications from their child's teacher or school (DEC: 25%, DEP: 28%).

About one-quarter (26%) of DEC and just under one in five (18%) of DEP student family respondents said they knew about the energy-related classroom activities and NTC performance at their child's school. A majority of the DEC parents who were aware of the performance (60%) said they found out about the NTC activities from their child; a similar proportion (56%) of DEP parents also found out through their child. Of the remaining parents, most stated that they found out about NTC activities from a teacher or school administrator (DEC: 28%, DEP: 33%) or on Duke Energy's website (DEC: 8%, DEP: 8%).

5.2.2 Parent Awareness of DEC/DEP Kit Opportunity

Classroom materials sent home with students were the key source of awareness of kits for families, with about half of student families in both DEC (49%) and DEP (47%) hearing about the opportunity to receive a Duke Energy kit via this medium. Other respondents learned about the kits through various communications from the school (Table 5-4).

Table 5-4: Sources of Parental Awareness of Kits (Multiple Responses Allowed; DEC n = 300, DEP n = 215)

Source of Kit Awareness	Rate (Percent)	
	DEC	DEP
Classroom materials	49%	48%
Email from teacher/school	16%	14%
School newsletter	11%	10%

Source of Kit Awareness	Rate (Percent)	
	DEC	DEP
School website or web portal	8%	10%
Other	5%	8%
Poster at school	1%	1%
Conversations with teacher	1%	1%
After hour event at school	1%	1%
Don't know	7%	8%

5.2.3 Teacher Experience with the Program

NTC Performance

Overall, teachers were largely satisfied with the performance, with 32 of 34 DEC teachers and 20 of 21 DEP teachers surveyed rating their satisfaction as a "4" or "5" on a one-to-five scale. Notably, 71% of DEC teachers and 68% of DEP teachers rated the performance as a "5". When asked about the content of the performances, the response from the majority of teachers was also positive. Interviewed teachers all noted the skill with which the performers engaged the students, by asking them to participate, and generally making the material humorous and accessible to students.

In addition, a large majority of the surveyed teachers (DEC: 82%, DEP: 86%) said the explanation of energy-related concepts was "about right" for most of their students. The remaining teachers in DEC (6) and DEP (3) all stated that the content was slightly too basic for their students. Two of the six DEC teachers and all three remaining teachers in DEP taught middle school. Of the final three DEC teachers, two taught high school and one taught elementary school. Teachers who thought the concepts were too basic for their students commented that the material seemed to be more geared towards younger audiences, and that the middle and high school students weren't as engaged.

Figure 5-1: DEC Age-Appropriateness of NTC Performance (n = 34)

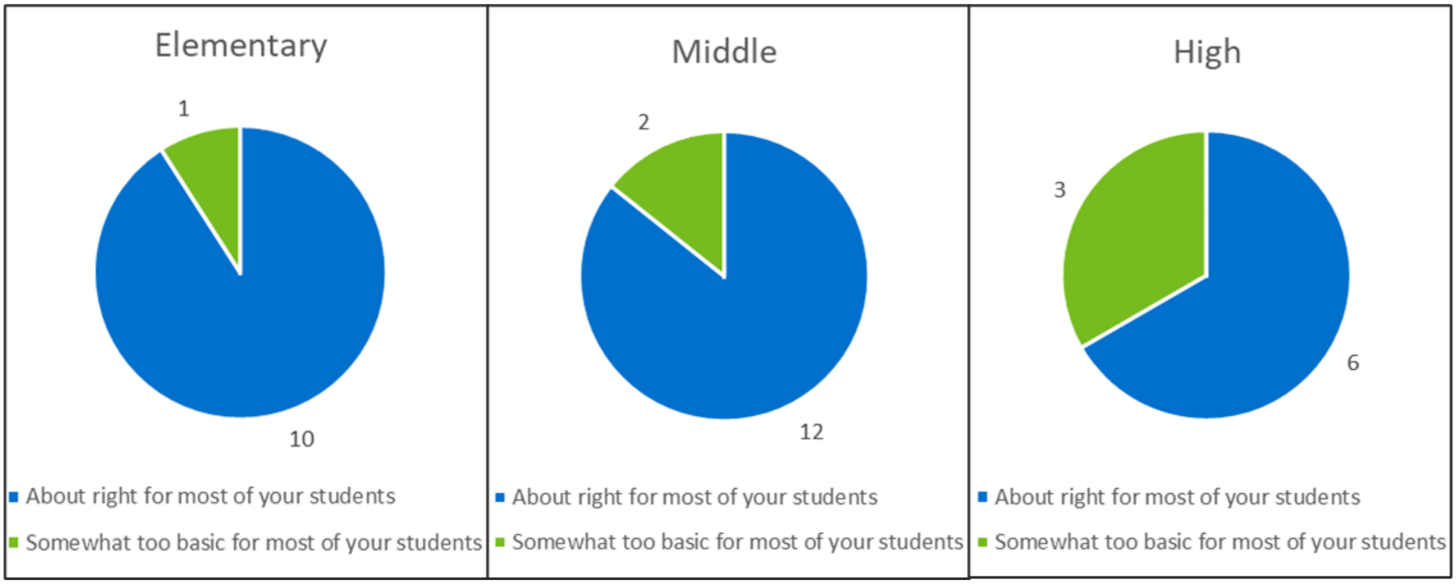
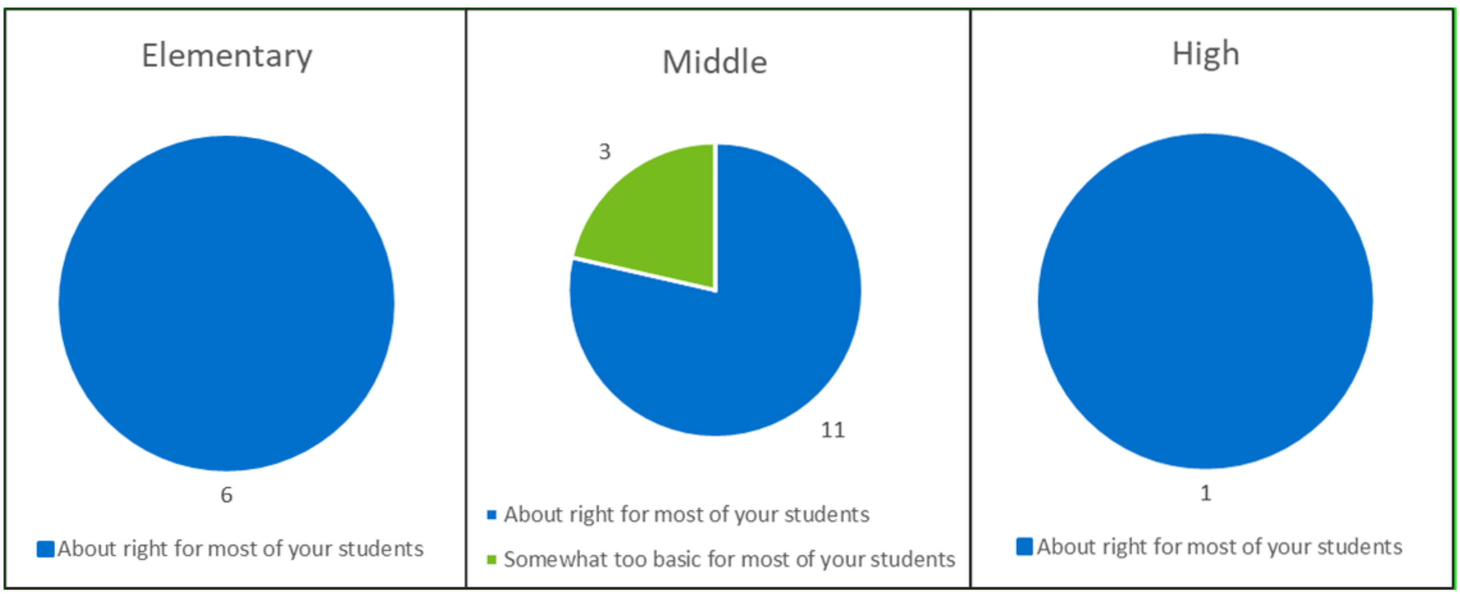


Figure 5-2: DEP Age-Appropriateness of NTC Performance (n = 21)



Regarding age appropriateness, the comments from the interviewed teachers echoed the findings from the online survey. All interviewed teachers said the performance was age appropriate and kept their students' attention, save one teacher that reported the performance for middle school students appeared to be a little juvenile for their age.

The interviewed teachers commented on the quality of the performance, specifically that the performance was engaging, humorous, and informative. When asked how performances might be improved, teachers generally did not offer suggestions, though one urged the performers to be sure they were finishing up the performance in the alloted time.

Curriculum and Instructional Materials

About two-thirds of teachers in both DEC and DEP reported receiving or using the materials, in addition to most reporting that they distributed kit request forms to their students (see Kit Request Forms section below). Sixty-eight percent of surveyed teachers (23 of 34) in DEC reported receiving the curriculum and instructional materials (Figure 5-3), and 62% (13 of 21) of teachers in DEP stated the same (Figure 5-4). Of the eleven remaining teachers in DEC, nine had not received the materials and the final two teachers didn't know if they had received them or not. All eight DEP teachers who reported not using the materials had not received them. All of the 23 DEC teachers who reported receiving the materials used them to some degree, but 10 of these teachers (44%) only used the materials "a little". DEP teachers were split along similar lines, with 46% (6 of 13) teachers stating that they used the materials "a little" and the remainder using the materials a moderate amount.

Teachers who stated that they used the educational material infrequently were asked to describe why; the most common responses were that teachers did not receive the educational material at the right time in the school year. In DEC and DEP, five teachers from each territory stated that the timing of receiving the materials was the main reason for not using materials more. To a lesser degree, teachers commented on the challenges of utilizing the materials effectively within the context of virtual learning; two teachers in DEC and an additional teacher in DEP referenced this as their main challenge to disseminating materials. Both of these response groups highlight that the educational material is regularly not used in conjunction with the presentation and their lessons as intended. It's important to note that while the transition to remote learning was due to external factors, it has exacerbated an existing issue and as such should not be discounted.

Figure 5-3: DEC Teachers Use of Forms and Instructional Materials

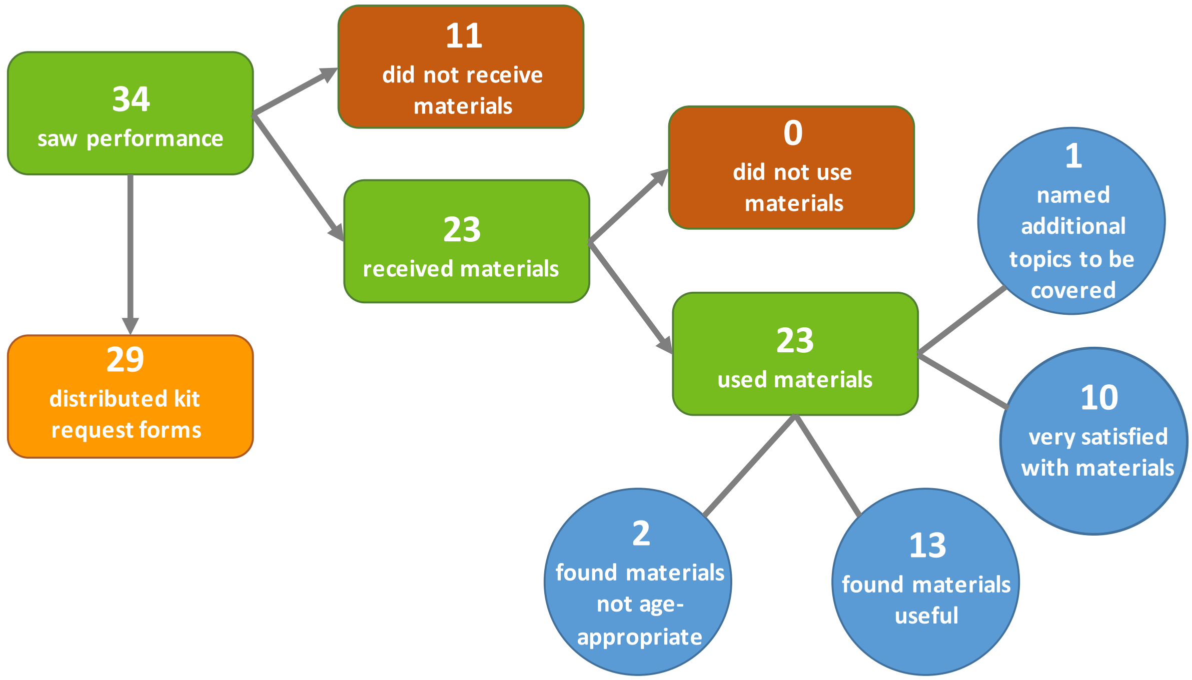
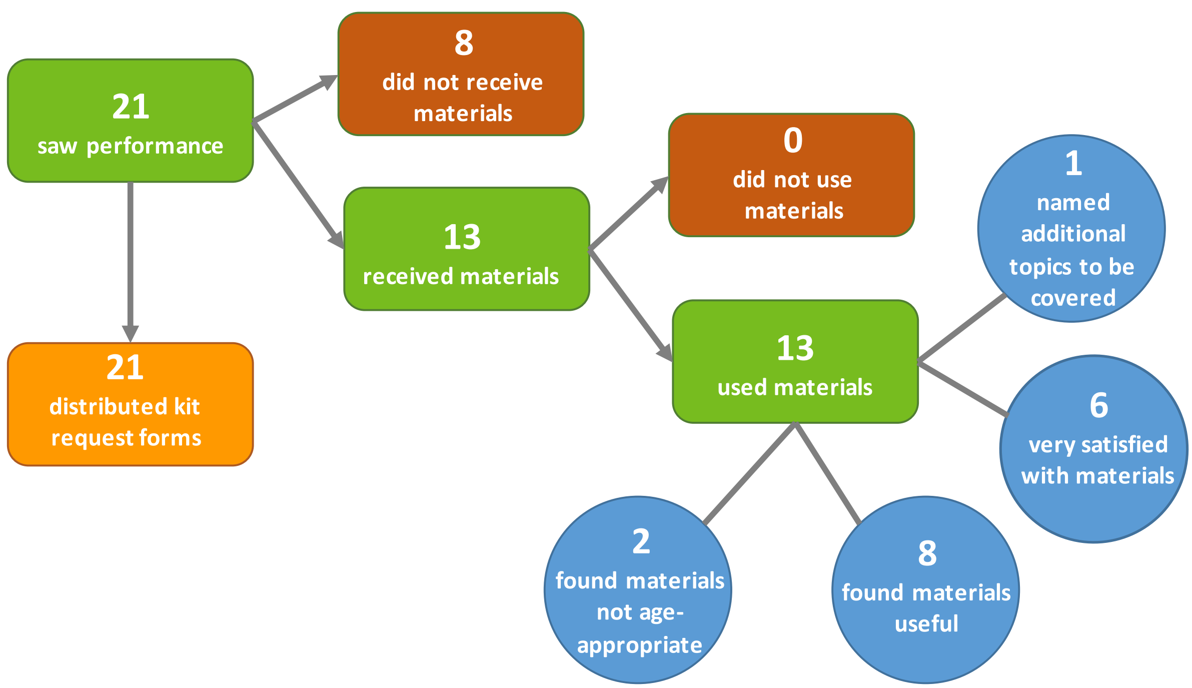


Figure 5-4: DEP Teachers Use of Forms and Instructional Materials



Twenty-three teachers in DEC and 13 teachers in DEP reported use of the instructional materials; they were subsequently surveyed on the materials' usefulness, age-appropriateness, alignment with state science standards, or concepts children had trouble understanding. From their comments, also reflected in interview findings, the following observations emerged:

- Use of materials was minimal to moderate in both territories: Ten teachers in DEC and six in DEP characterized their use as “a little”. A further 12 teachers from DEC and and the remaining seven DEP teachers used the materials “moderately.” Only one respondent from DEC reported using the materials extensively.
- Materials were useful: When asked to rate the usefulness of the materials, from “1” (not at all useful) to “5” (highly useful), over half of respondents in both DEC (13 of 23) and DEP (8 of 13) rated the usefulness as a “4” or “5”. The remaining respondents respondents in DEC and DEP scored the usefulness as a “2” or “3”, with the exception of one DEP teacher who did not know how useful the materials were.
- Materials were age-appropriate: Nineteen DEC teachers reported the material was age-appropriate; one high school science teacher reported it was somewhat too basic, and an elementary school science teacher reported that it was somewhat too advanced. In DEP, 11 teachers thought that the materials were age appropriate while two middle school teachers – a math/social studies teacher and a science teacher– thought that the material was too basic.
- Around half of respondents said that the materials aligned with state science standards: Thirteen DEC respondents reported the curriculum “mostly” aligned with state science standards, while eight stated it “somewhat” aligned, and two did not know if the materials aligned. DEP teachers stated that the materials were less in alignment with state standards; four reported that the curriculum “mostly” aligned and eight stated that it “somewhat” aligned, while one did not know if the materials aligned.

The teachers reporting “a little” use explained their rationale for limited use of the material. None of the comments in either survey focused on the quality of the materials per se. Rather, the reason for minimal use was because the materials did not align with their teaching priorities at that time (DEC and DEP, five mentions each) and alternative methods of distributing the workbooks, such as sending the materials home with children to review with their parents (DEC only, two mentions). Additionally, two DEC teachers and one DEP teacher reported that challenges surrounding virtual learning hindered their use of classroom materials. Some interviewed teachers also indicated that they were not aware that digital resources (student workbooks) were available.

The DEP middle school science teacher who thought the materials were too basic also stated that for the workbooks to be more useful, they should have covered “safety”. Although they had rated the materials as being about right for their students, a middle school science teacher in DEC also stated that more information on “energy transformation” would enhance the materials. Twenty of twenty-three DEC teachers and eight of thirteen DEP teachers reported being satisfied with the materials (scored a “4” or “5” on a five-point scale), indicating that the material was found to be generally acceptable in the capacity that they were using it.

Kit Request Forms

As Figures Figure 5-3 and Figure 5-4 show, teachers reported sending kit request forms home with children. However, teachers also indicated in interviews that student families predominantly requested kits online.

About 85% of survey teachers in DEC and all of the surveyed teachers in DEP distributed the kit request forms to their students. Of the teachers who distributed the forms, just over half (55%) of DEC teachers distributed the the kit request form separately from the workbook and the remainder distributed workbooks with the kit request form included. Even more DEP teachers distributed the kit request form separately, with 71% of teachers stating that this was how they sent the form to their students, while the remainder distributed forms as a part of the workbook.

Just under half of the teachers in both territories (DEC: 45%, DEP: 48%) reported following up with students to find out whether their household requested a kit. Of those, teachers in DEC estimated between 0% and 90% of families ordered a kit, and teachers in DEP estimated between 0% and 70% of families ordered a kit. This results in an estimated average of 25% of DEP student families and 18% of student families in DEP that requested a kit.[2] Two interviewed teachers expressed a desire to receive more communication after the performance—reminders for them to check in with students about signing up.

Kilowatt Krush App

About half (DEC: 19 of 34, DEP: 12 of 21) teachers reported that either the performers or instructional material had mentioned the Kilowatt Krush app. A majority of DEC teachers (12 of 19) reported that they didn't know if students had downloaded the app, while a quarter of DEP teachers (3 of 12) weren't sure. In both DEC and DEP, all remaining teachers estimated that less than 40% of students had downloaded the app. In addition, some interviewed teachers mentioned that they did not recall seeing or hearing about the app. Observations from parents support the low estimates from teachers; 228 parents (of 300 surveyed) in DEC reported that their children did not download it, while another 47 were not sure. The numbers in DEP were similarly low, 160 out of 215 parents stated that their child had not downloaded the app and an additional 34 parents were unsure. Of the parents who noticed their child using the app, most of those children (DEC: 22 of 25, DEP: 19 of 21) were in elementary school.

5.2.4 Student Family Experience with the Program

Installation and Use Rates

Almost all (DEC: 86%, DEP: 91%) participants used at least one measure in the kit; DEC parents installed an average of 3.2 measures, and DEP parents installed 3.4 measures on average. Table 5-5 details the installation rates of all kit measures for both jurisdictions; most kit recipients in DEC and DEP installed the lighting measures including LEDs (DEC: 98%, DEP: 95%) and nightlights (DEC: 89%, DEP: 87%); far fewer used the insulator gaskets and water

[2] The Evaluation Team calculated the mean of the mid-point values of each teacher's selected range. For example, if one teacher selected 81%-90% and another selected 91%-100%, the mid-points are 85% and 95%, and the mean is 90%.

related measures (ranging from 36% to 51% in DEC and 34% to 60% in DEP). Water related measures were also removed more often than lighting measures, at up to 3 times the rate in both DEC and DEP. Most of the respondents who chose to remove kit measures reported dissatisfaction with the measure performance or stated that the measure was removed due to other circumstances (e.g. purchasing a new sink that had a faucet pre-attached).

Table 5-5: Installation Rates

Measure	DEC (n = 258)	DEP (n = 197)
Showerhead	51%	60%
Kitchen Faucet Aerator	47%	49%
Bathroom Faucet Aerator	47%	48%
Night Light	89%	87%
Energy Efficient Light Bulbs (LEDs)	98%	95%
Insulator Gaskets	36%	34%

The large majority of those installing light bulbs said they installed both bulbs included in the kit (90% in DEC and 88% in DEP). Parents in both DEC and DEP reported that the LEDs typically replaced incandescent lightbulbs (DEC: 44%, DEP: 49%) and CFLs (DEC: 29%, DEP: 20%).

Of those who did not install all items in the kit, around two in five respondents (43% in DEC and 40% in DEP) said they do not plan to install any of the items they had not yet installed. Respondents generally said they would not install the remaining items because the currently installed item is still working, they already had an efficient measure installed, they attempted to install the measure but it didn't fit, or they had not "gotten around to it."

Measure Satisfaction

Nearly all kit recipients reported high satisfaction with the items they installed from their kit in both Duke territories (Figure 5-5 and Figure 5-6). To best gauge the experience with the measures, we asked respondents to rate their satisfaction with all measures they installed, including those they later removed. Respondents explained that any dissatisfaction they had with water measures was due to low water pressure (DEC: 22 customers, DEP: 14 customers) or that the measures did not fit properly (8 customers each in DEC and DEP).

Figure 5-5: DEC Kit Recipient Satisfaction with Installed Measures

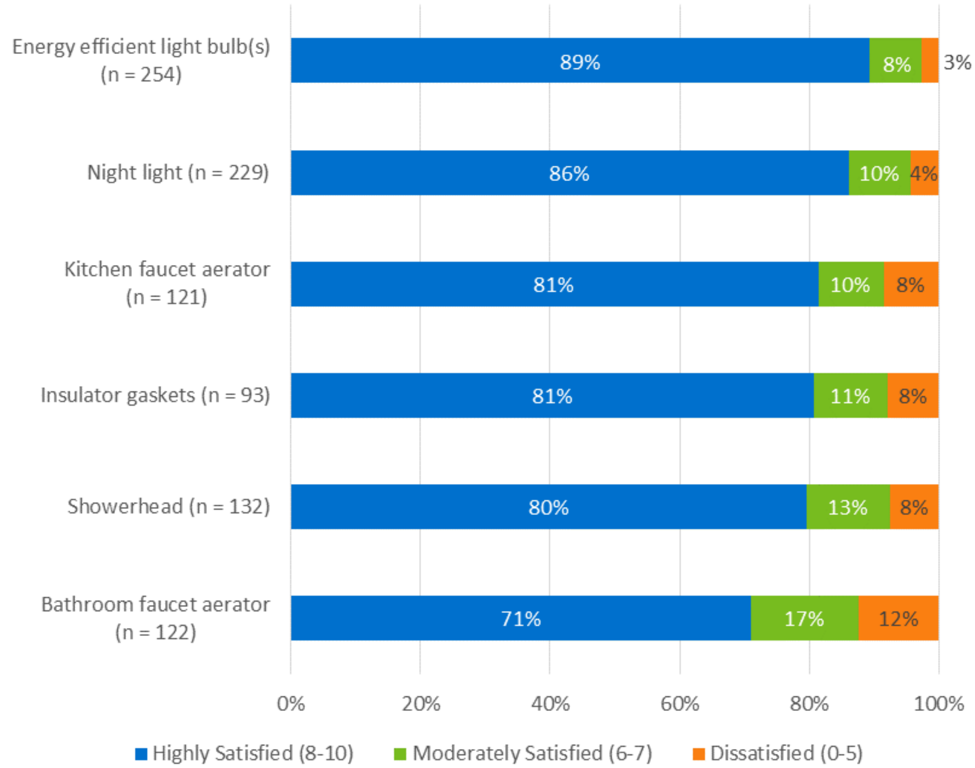
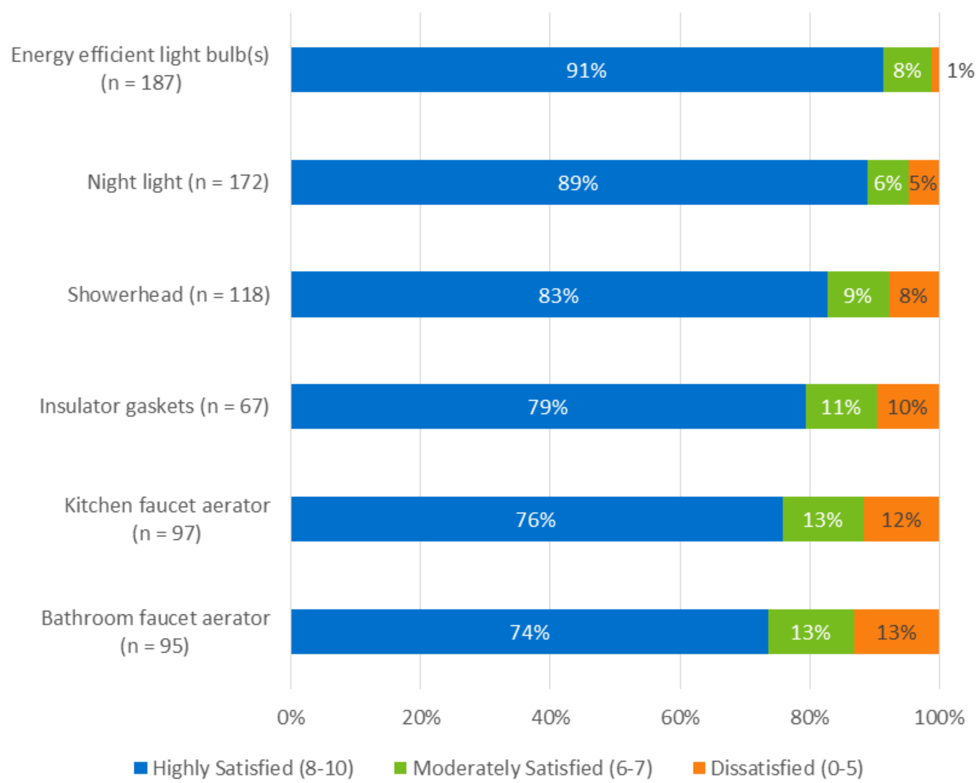


Figure 5-6: DEP Kit Recipient Satisfaction with Installed Measures



Energy Saving Educational Materials in the Kit

The Energy Efficiency Kit includes a Duke Energy-labeled Department of Energy (DOE) Energy Saver Booklet that includes educational information on saving energy at home. Most (DEC: 70%, DEP: 75%) respondents said they read the booklet. Of the kit recepients who read the energy saving booklet, approximately two-thirds in DEC and just over half in DEP found the information to be very helpful.[3] Those not finding the booklet helpful stated they already knew the information presented in the booklet or that information in the booklet could have been presented more concisely.

Additional Energy Saving Actions

Parents and children reported adopting new energy-saving actions since their involvement in the program. About eight in ten parents (DEC: 79%, DEP: 81%) reported taking an energy-saving action and a large majority (74% in DEC and 67% in DEP) reported their child has adopted new energy saving behaviors since receiving their kit. Parents most commonly said that their child now turns off lights when not using a room (DEC: 64%, DEP: 59%) or that they turn off electronic devices when not in use (DEC: 48%, DEP: 42%) (Table 5-6). More than half of respondents (57% in DEC and 50% in DEP) reporting new energy saving behaviors said the Duke Energy sponsored kit and materials were “highly influential” on their adoption of those behaviors.[4]

[3] We asked respondents to rate the helpfulness of the Duke Energy-labeled DOE Energy Saver Booklet on a scale from “0” (“not at all helpful”) to “10” (“very helpful”). In DEC 65% percent of respondents who reported reading the booklet gave a rating of “8” or higher. 23% gave ratings of “6” or “7”, and 11% gave ratings of “0” through “5”. DEP respondents were shifted a bit closer to the middle; 55% of respondents provided ratings of “8” and above, 30% provided ratings of “6” or “7”, and 15% provided ratings of “0” through “5”.

[4] We asked respondents to rate the influence of Duke Energy’s kit and energy saving educational materials on their reported behavior changes, using a scale from “0” (“not at all influential”) to “10” (“extremely influential”). Fifty-seven percent of respondents in DEC (or, 135 out of 235) who reported behavior changes gave a rating of “8” or higher; 50% of respondents in DEP (86 out of 171) gave a rating of “8” or higher

Table 5-6: New Behaviors Adopted by DEC Parents and Children since Receiving Kit (Multiple Responses Allowed; DEC n = 300, DEP n = 215)

New Behaviors Child Has Adopted	DEC		DEP	
	Parents	Children	Parents	Children
Adopted new behaviors since receiving kit	79%	74%	81%	67%
Turn off lights when not in a room	62%	64%	60%	59%
Changing thermostat settings to use less energy	53%	-	53%	-
Turning off electronics when not in use	49%	48%	43%	42%
Using fans instead of air conditioning	35%	-	35%	-
Turning off air conditioning when not home	26%	-	27%	-
Taking shorter showers	23%	21%	29%	18%
Turning off furnace when not home	15%	-	16%	-
Turning water heater thermostat down	10%	-	12%	-
Other reason	2%	3%	1%	3%

Receiving a kit may drive a desire to make additional energy efficiency improvements. Most student families reported a desire to receive more kit measures (98% in DEC, 97% in DEP), specifying interest in LEDs (DEC: 86%, DEP: 83%), nightlights (DEC: 68%, DEP: 67%), showerheads (25% in both DEC and DEP), bathroom and kitchen aerators (17% for both measures in DEC and 15% for both measures in DEP), and gasket insulators (16% in both territories). Parents indicated that they would prefer requesting additional measures via the internet (73% in both DEC and DEP) or pre-paid postcards (DEC: 18%, DEP: 17%).

The kit motivated some respondents to purchase energy efficient equipment or services (Table 5-7). About one-third of customers in DEC (34%) reported purchasing or installing additional energy efficiency measures since receiving their kit, while slightly more than two out of every five customers in DEP (45%) stated that they had purchased or installed additional measures. Efficient light bulbs were the most commonly reported measure, mentioned by 87 respondents in DEC and 76 in DEP.

Fourteen respondents in DEC reported receiving a Duke Energy rebate for their measure, eleven of whom said they received rebates for purchasing LEDs, five for efficient appliances, three for their efficient heating or cooling equipment, one for efficient windows and another customer who received an incentive for purchasing a smart thermostat.

Fifteen respondents in DEP stated that they received a rebate from Duke Energy for their measure. Of those, five received rebates for purchasing LEDs, three for smart thermostats, two each for energy efficient water heaters, efficient heating equipment and products to seal air leaks, and one each for additional insulation and energy efficient appliances. Around half of customers in both territories (DEC: 52 in 103, DEP: 43 in 96) said the Duke Energy schools program was at least partially influential on their decision to purchase and install additional energy saving measures.

Table 5-7: Additional Energy Saving Measures Purchased (Multiple Responses Allowed; DEC n= 103, DEP n = 96)

	DEC Parents			DEP Parents		
	Count of Respondents Reporting Purchases After Receiving the Kit	Count Reporting Duke Rebates for Measure	Count Reporting High Program Influence on Purchase*	Count of Respondents Reporting Purchases After Receiving the Kit	Count Reporting Duke Rebates for Measure	Count Reporting High Program Influence on Purchase*
At least one measure	103	14	52	96	15	43
Bought LEDs and/or CFLs	87	11	45	76	5	33
Bought energy efficient appliances	46	5	19	35	1	17
Sealed air leaks	22	-	8	29	2	12
Added insulation	15	-	3	15	1	7
Bought efficient heating or cooling equipment	15	3	7	12	2	5
Installed an energy efficient water heater	15	-	4	6	2	3
Bought efficient windows	11	1	5	7	-	2
Sealed ducts	6	-	1	5	-	3
Other	4	1	3	7	3	1

*Respondents that rated the influence of the program as “8” or higher on 10-point scale, where “0” was not at all influential and “10” was extremely influential.

5.3 Key Findings

Overall, the DEC/DEP K12 Education Program performed effectively during the 2019-2020 school year. Key findings from the process evaluation include:

Awareness:

- Both teachers and parents were aware of Duke Energy's sponsorship of the K12 Education Program; 97% of teachers and 88% of parents in DEC, and 95% of teachers and 91% of parents in DEP indicated that they were aware of this fact.
- Teachers in DEC primarily learned about Duke Energy's sponsorship of the program through material provided by NTC about the program, NTC staff or Duke marketing materials. Similarly, teachers in DEP learned about the sponsorship of the program most often through Duke marketing materials and materials provided by the NTC.
- Most parents in both DEC and DEP reported that they learned of Duke's involvement in the program through informational material provided in the kit, followed by educational material provided by NTC and brought home from school by their child.
- Parents are largely unaware of the NTC performances and program related classroom activities with 25% of them in DEC and 18% of them in DEP reporting knowledge of these activities.
- Awareness of digital materials, performances, and the Kilowatt Krush app is inconsistent for teachers.
- Kilowatt Krush app usage by students is increasing, though still relatively low; elementary students are most likely to have used it.
- While 19 of 34 teachers in DEC reported that NTC staff or materials mentioned the Kilowatt Krush app, 7 reported that their students were using it. In DEP more teachers reported that their students were using it than not; 12 of 21 teachers stated that NTC staff or materials mentioned the app, and 9 teachers said that their students were using it.
- In DEC, 275 of 300 student families reported that either the student had not downloaded the Kilowatt Krush app, or that they were not sure if they had or not. In DEP, 194 of 215 families stated that their child had not downloaded the app or they were unsure.

Program Experience and Satisfaction:

- Teacher satisfaction with the performances and interactions with NTC staff was very high with 32 of 34 DEC teachers and 20 of 21 DEP teachers rating the performance a 4 or a 5, or "highly satisfied".
- Parents reported high levels of satisfaction with the measures provided in the efficiency kits. Measure satisfaction was highest amongst parents who installed LED bulbs; 81% of DEC and 91% of DEP respondents said that they were "highly

satisfied" with the measure. Satisfaction measures were lowest with bathroom faucet aerators; 71% of parents in DEC and 74% of parents in DEP reported that they were "highly satisfied" with this measure.

In-Service Rates:

- An average of 3.2 measures from the kit were installed per household in DEC, and an average of 3.4 measures were installed in DEP. Nineteen respondents (6%) in DEC installed all of the items, and 42 respondents (14%) installed none of the items. In DEP, 21 respondents (10%) installed all items and 19 respondents (9%) installed none of the items.
- The lighting measures provided in the kit were installed more often than the water saving measures. When asked why they did not install water saving measures, respondents most frequently reported low water pressure or that the measures didn't fit or match their fixture. Concerns about lighting measures were minimal and limited to night lights, where most of the respondents who didn't install the measure reported that they did not need it.
- Large majorities of parents (79% and 81% in DEC and DEP) and children (DEC: 74%, DEP: 67%) changed their behaviors after receiving the kit or seeing the performance. The most commonly changed behavior was turning off lights when not in the room and was shared amongst parents and children in both territories. Almost as many parents in DEC stated that they changed their thermostat settings as said turned lights off when leaving a room.

6 Conclusions and Recommendations

Based on evaluation findings, the evaluation team concluded the following and provides several recommendations for program improvement:

Conclusion: The use of AMI meter data as the primary input in the impact analysis was effective in reliably estimating savings attributable to the program.

> **Recommendation:** When proven to be feasible, continue to use an AMI-based consumption analysis approach in future EE Education program evaluations.

Conclusion: Teachers are highly satisfied with NTC performances and materials, although many teachers are unable to effectively utilize the materials within their curriculum due to timing issues. Some teachers additionally reported that they were unaware of the availability of online resources.

> **Recommendation:** Though the amount of online content has increased, it is important to prioritize making teachers aware of the availability of these online resources, including assuring these resources are prominently included in performances, instructional materials, and promotional materials. This may help address any problems stemming from the misalignment of these lessons. Additionally, ensuring that teachers are aware of any online content will be of particular importance in cases of remote learning, when traditional materials cannot be distributed as effectively.

Conclusion: A majority of parents who received energy efficiency kits installed at least one measure. Light bulbs and night lights were much more popular than water saving measures and were widely cited as items that respondents would like to receive more of. Parents primarily indicated that they would prefer to request additional kit items via the internet.

> **Recommendation:** Consider including additional lightbulbs in the efficiency kits, as they are relatively inexpensive and can enhance savings rates.

Conclusion: Large numbers of parents and students adopted energy saving behaviors as a result of tips and materials included in the kit.

> **Recommendation:** Expand behavioral guidance in both student and parent materials to maximize effects of the program. Parents in particular indicated that the primary reason for not finding energy saving tips useful was previous knowledge of those tips, suggesting that more advanced behavioral guidance (e.g. utilizing the scheduling feature of their thermostat to cool or heat the house in off peak periods) may be beneficial.

Conclusion: Teachers at smaller schools noted that reaching the 100 kit request threshold that qualifies for the $250 enrollment bonus is difficult. The program is also highly reliant on engaged teachers to drive performances and distribution of kits/student materials.

> **Recommendation:** Consider adjusting the award structure to encourage more teachers to become “champions” at unenrolled schools and drive more sign-ups. In addition, consider altering the incentive framework for schools that reach 100 kit requests and receive the $250 enrollment bonus to a proportion-based system, using quantity of received kit requests and student enrollment. This will make it easier for smaller schools to receive the enrollment bonus, and thus be more likely to be motivated to join and remain in the program. It is the evaluator’s understanding that an adjustment to the incentive structure was implemented for the 2021-2022 School Year that rewards teachers with $50 that reach 20 kit requests.

Conclusion: It is not clear how many teachers are attending performances, which makes estimating population parameters of evaluation and tracking data for this group difficult.

> **Recommendation:** Evaluate data gathering and tracking protocols to ensure that accurate teacher and student attendance is gathered at each school. This might include teacher sign-in sheets.

Appendix A Summary Forms

DEC Summary Form

Description of program

The K12 Education Program is an energy efficiency program that provides free in-school performances by the National Theatre for Children (NTC) that teach elementary, middle, and high school students about energy and conservation concepts in a humorous and engaging format. NTC provides teachers with: 1) student workbooks that reinforce topics taught in the NTC performance, which include a take-home form that students and parents can complete to receive an energy efficiency starter kit from DEC/DEP and 2) lesson plans associated with the content in the student workbooks.

Date	November 30, 2021
Region(s)	Carolinas
Evaluation Period	August 1, 2019 – July 31, 2020
Annual kWh Savings	9,904,700 kWh
Per Household kWh Savings	475 kWh
Annual Summer kW Savings	-1,689 kW
Annual Winter kW Savings	62 kW
Net-to-Gross Ratio	Not applicable
Process Evaluation	Yes
Previous Evaluation(s)	2015-2016, 2017-2018

Evaluation Methodology

Impact Evaluation Activities

- *AMI consumption data analysis via difference-in-differences regression modeling with matched control group.*

Impact Evaluation Findings

- *The program produced significant energy savings of 475 kWh annually per household. Program-level savings in DEC were 9,900 MWh.*
- *The program did not generate meaningful load reductions during peak periods.*

Process Evaluation Activities

- *300 web surveys with student families and analysis of 6 unique measures.*
- *43 web surveys with teachers from participating schools; 5 in-depth follow up interviews*
- *1 in-depth interview with program staff*
- *1 in-depth interview with NTC implementation staff*
- *1 in-depth interview with R1 implementation staff*

Process Evaluation Findings

- *Teachers are highly satisfied with the performance*
- *Parents largely learning about performances, kits, and materials from their children*
- *Student families are generally satisfied with kit items, although lighting measures are more popular than water measures*
- *The NTC program is successfully influencing families to adopt energy saving behaviors*

DEP Summary Form

Description of program

The K12 Education Program is an energy efficiency program that provides free in-school performances by the National Theatre for Children (NTC) that teach elementary, middle, and high school students about energy and conservation concepts in a humorous and engaging format. NTC provides teachers with: 1) student workbooks that reinforce topics taught in the NTC performance, which include a take-home form that students and parents can complete to receive an energy efficiency starter kit from DEC/DEP and 2) lesson plans associated with the content in the student workbooks.

Date	November 30, 2021
Region(s)	Progress
Evaluation Period	August 1, 2019 – July 31, 2020
Annual kWh Savings	2,540,300 kWh
Per Household kWh Savings	475 kWh
Annual Summer kW Savings	-433 kW
Annual Winter kW Savings	16 kW
Net-to-Gross Ratio	Not applicable
Process Evaluation	Yes
Previous Evaluation(s)	2015-2016, 2017-2018

Evaluation Methodology

Impact Evaluation Activities

- *AMI consumption data analysis via difference-in-differences regression modeling with matched control group.*

Impact Evaluation Findings

- *The program produced significant energy savings of 475 kWh annually per household. Program-level savings in DEP were 2,540 MWh.*
- *The program did not generate meaningful load reductions during peak periods.*

Process Evaluation Activities

- *215 web surveys with student families and analysis of 6 unique measures*
- *29 web surveys with teachers from participating schools; 3 in-depth follow up interviews*
- *1 in-depth interview with program staff*
- *1 in-depth interview with NTC implementation staff*
- *1 in-depth interview with R1 implementation staff*

Process Evaluation Findings

- *Teachers are highly satisfied with the performance*
- *Parents largely learning about performances, kits, and materials from their children*
- *Student families are generally satisfied with kit items, although lighting measures are more popular than water measures*
- *The NTC program is successfully influencing families to adopt energy saving behaviors*

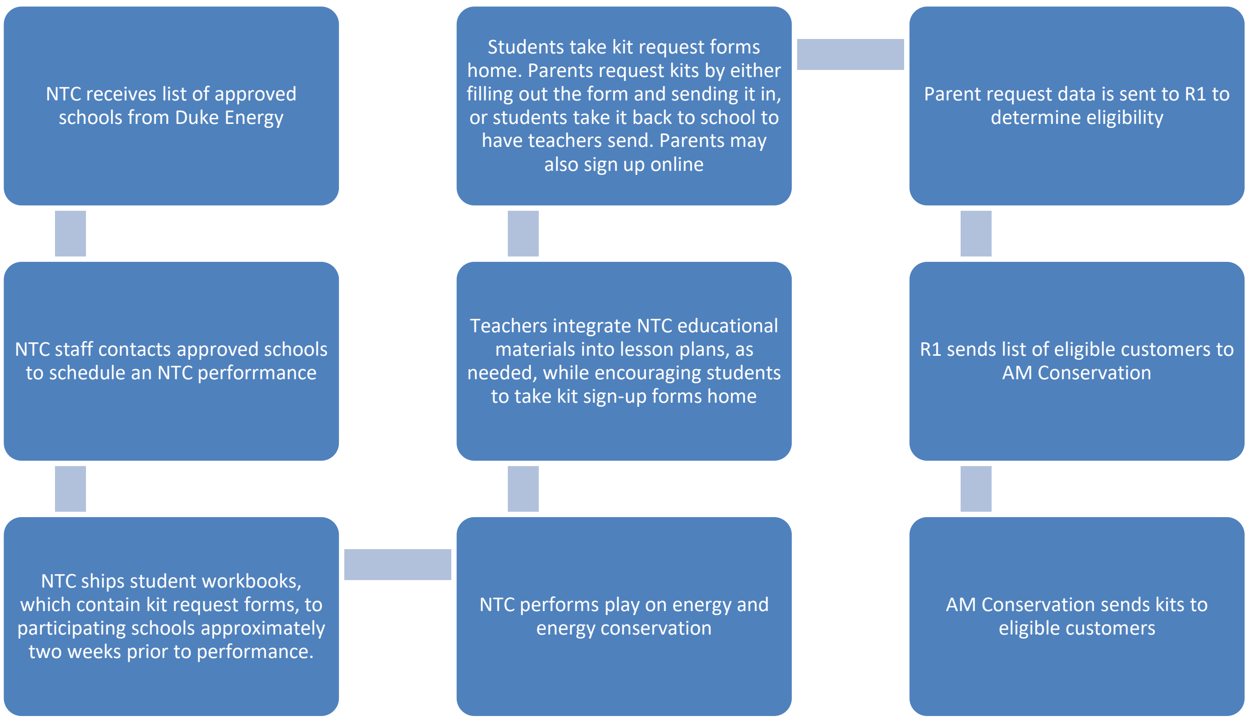
Appendix B Measure Impact Results

Table B-1: DEP and DEP Program Year 2019-2020 per Unit Verified Impacts by Measure – Key Measure Parameters

Measure	Gross Energy Savings (kWh)	Gross Summer Demand (kW)	Gross Winter Demand (kW)	Realization Rate (Energy)	Free Ridership	Spillover	Net to Gross Ratio*	M&V Factor (Energy) (RR x NTG)	Measure Life
Energy Efficiency Kit - DEC	475.21	-0.08075	0.002685	N/A	N/A	N/A	N/A	N/A	N/A
Energy Efficiency Kit - DEP	475.21	-0.08075	0.002685	N/A	N/A	N/A	N/A	N/A	N/A

*The impact analysis approach performed in this evaluation yields a savings estimate that is net of any naturally occurring changes, so there is no need to perform a net-to-gross adjustment

Appendix C Program Process Flow Chart



Appendix D Program Performance Metrics

Figure D-1: DEC Student Family Demographics Reach PPIs

Housing Type

Detached	74%
Attached	18%
Mobile	8%

Ownership Status

Own	69%
Rent	30%
Occupy Rent-free	1%

Number of People in Home

One	4%
Two	19%
Three	22%
Four	33%
Five+	22%

Highest Educational Attainment

Exited before/during High school	2%
High school/Trade school	18%
Some college	32%
Bachelors Degree	25%
Some graduate school	2%
Graduate/Professional Degree	18%
Doctorate	3%

Income

<$35k	31%
$35k to $50k	18%
$50k to $75k	19%
$75k to $150k	22%
$150k+	10%

Figure D-2: DEP Student Family Demographics Reach PPIs

Housing Type

Detached	69%
Attached	17%
Mobile	14%
Other	<1%

Ownership Status

Own	72%
Rent	27%
Occupy Rent-free	1%

Number of People in Home

One	3%
Two	10%
Three	30%
Four	30%
Five+	27%

Highest Educational Attainment

Exited before/during High school	3%
High school/Trade school	21%
Some college	29%
Bachelors Degree	24%
Some graduate school	2%
Graduate/Professional Degree	17%
Doctorate	4%

Income

<$35k	29%
$35k to $50k	17%
$50k to $75k	18%
$75k to $150k	30%
$150k+	6%

Appendix E Instruments

E.1 Program Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program in the Duke Energy **Carolina and Progress** territories. We would like to learn about your experiences in administering this program in the 2019-2020 school year. Your comments are confidential. If I ask you about areas you don't know about, please feel free to tell me that and we will move on.

Your comments are confidential. If I ask you about areas you don't know about, please feel free to tell me that and we will move on. Also, if you want to refer me to specific documents to answer any of my questions, that's great – I'm happy to look things up if I know where to get the information.

Also, I would like to record this interview for my note-taking purposes. Do I have your permission? Do you have any questions before we start?

Roles and Responsibilities

Q1. Has anything changed regarding your role in Duke Energy's Energy Efficiency Education Program since we last spoke? (Program Manager)

Q2. Has Duke Energy's role changed in terms of program delivery since we last spoke?

Delivery and Operations

Q3. What were your targets for the 2019-2020 school year for the following metrics, and were you successful in meeting them?:

1. Number of schools recruited:
2. Number of students involved:
3. Use of curricula by teachers:
4. Number of kit requests:
5. Savings:
6. Subcontractor SLAs (NTC, R1, AMC):

Q4. Has the delivery process changed since 2018-2019, prior to any forced upon the program by COVID-19? Separately, how did COVID-19 affect program delivery, if at all, in terms of the (ask respondent to describe established protocols as necessary):

1. Recruitment, Marketing, Outreach, Website (request materials):
2. Curriculum and Performance:
3. App (KiloWatt Krush):
4. Kit: contents, request process, delivery schedule (how long):

Q5. Any noteworthy concerns about the age appropriateness of the materials and performances, or has that largely been addressed?

Q6. In what ways, if at all, does the delivery strategy for the high school program differ from the others?

Q7. Can you talk a bit about the development of the high school delivery strategy? What were the priorities, goals, etc.?

Q8. How has the high school program been going generally in NC and SC? Have there been any significant challenges or successes specific to the high school program in 2019-2020? How have these been addressed?

Q9. Are there any changes, beyond those caused by COVID-19, that you have implemented in the 2020-2021 school year? Any planned for 2021-2022?

Q10. Does the operational staff still gather on weekly calls (NTC, R1, Duke Energy)? Are there any other established communication protocols? Any changes there?

Q11. Has anything changed with staffing or management of the program (communications, staff, budget, program goals, data management, subcontractor perfomance, etc.) since we last spoke? If so, how has this affected program delivery or operations? Any problems with any of these?

Wrap Up

Q12. What would you say were the greatest strengths of the program in 2019-2020?

Q13. What would you say were the biggest challenges in administering this program in 2019-2020? Is this specific to he DEC/P jurisdictions? Last time, for DEI, you primarily discussed difficulties with recruitment—both schools and student families.

Q14. Do you have any other thoughts about the program that we didn't discuss that you think may be important?

Q15. Is there anything in particular you'd like to learn from the program evaluation?

Thank you for your time. Have a great day!

E.2 NTC Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program in the Duke Energy **Carolina and Progress** territories. We would like to learn about your experiences in administering this program in the 2019-2020 school year. Your comments are confidential. If I ask you about areas you don't know about, please feel free to let me know and we will move on.

Also, I would like to record this interview for my note-taking purposes. Do I have your permission? Do you have any questions before we start?

Roles and Responsibilities

Q1. Can you describe your title, and your role in NTCs work with the Duke Energy Energy Efficiency Education in Schools program?

Q2. Has NTC's role changed in terms of program delivery? Last time we spoke you told me that NTC's role primarily involves designing and distributing classroom materials (including kit request forms), recruiting schools, and designing and executing the performances. Is there anything else?

Delivery and Operations

Q3. Has the delivery process changed since 2018-2019, prior to any forced upon the program? Separately, how did COVID-19 affect program delivery, if at all, in terms of (ask respondent to describe established protocols as necessary):

1. Marketing and outreach (Can you provide recruitment materials?):
2. Curriculum:
3. Performance:
4. Kit request process:

Q4. In what ways, if at all, does the delivery strategy for the high school program differ from the others?

Q5. Can you talk a bit about the development of the high school delivery strategy, including how this applies to materials, performances, etc.?

Q6. Have there been any significant challenges or successes specific to the high school program in 2019-2020? How have these been addressed?

Q7. Do you have copies of the 2019-2020 materials for all three programs that you could send me?

Q8. Are there any changes, beyond those caused by COVID-19, that you have implemented in the 2020-2021 school year? Any planned for 2021-2022?

Q9. Does the operational staff still gather on weekly calls (NTC, R1, Duke Energy)? Are there any other established communication protocols? Any changes there?

Q10. Has anything changed with staffing/management at NTC (communications, content creation, admin, or management staff)? If so, how has this affected program delivery or operations?

Wrap Up

Q11. What would you say were the greatest strengths of the program in 2019-2020?

Q12. What would you say were the biggest challenges in administering this program in 2019-2020? Is this specific to the DEC/P jurisdictions? Last time, for DEI, you discussed a few things: the finite number of schools to work with, the eligibility window for kits, and the existence of non-Duke Energy customers.

Q13. Do you have any other thoughts about the program that we didn't discuss that you think may be important?

Thank you for your time. Have a great day!

E.3 R1 Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program in the Duke Energy **Carolinas and Progress** territories. We would like to learn about your experiences in administering this program in the 2019-2020 school year. Your comments are confidential. If I ask you about areas you don't know about, please feel free to tell me that and we will move on. Also, I would like to record this interview for my note-taking purposes. Do I have your permission? Do you have any questions before we start?

Roles and Responsibilities

Q1. Has anything changed regarding your position at R1 and your role in Duke Energy's Energy Efficiency Education Program since we last spoke? (VP of IT)

Q2. Has R1's role changed in terms of program delivery? Last time we spoke you told me that R1's role primarily involves maintaining the program website (for kit delivery), maintaining the customer database, and processing paper applications.

Delivery and Operations

Q3. Has anything changed in this delivery process? (Prompts: relationship with AMC, data verification and transfer with Duke Energy, (hand) processing of paper applications)

Q4. Does all the operational staff still gather on weekly calls? Can you briefly describe communication protocols?

Challenges and Successes

Q5. Have you experienced any issues due to the introduction of the high school program?

Q6. Have you experienced any issues due to COVID?

Q7. Were there any other challenges or successes in program delivery from your perspective in the 2019-2020 program year?

Q8. What would you say are the greatest strengths of this program?

Wrap Up

Q9. Do you have any other thoughts about the program that we didn't discuss that you think may be important?

Thank you for your time. Have a great day!

E.4 Teacher Survey

Landing Page Introduction

Thank you for agreeing to take this survey. It starts with a few questions about what grades and subjects you teach, which we need for our analysis of the survey responses. The survey then asks for your feedback on various elements of the program.

Grades and Subjects Taught

Q1. What grade(s) did you teach during the 2019-2020 school year? *Please select all that apply.*

[multiple response]

1. Pre-K – TERMINATE
2. Kindergarten
3. Grade 1
4. Grade 2
5. Grade 3
6. Grade 4
7. Grade 5
8. Grade 6 [SKIP TO Q3]
9. Grade 7 [SKIP TO Q3]
10. Grade 8 [SKIP TO Q3]
11. Grade 9 [SKIP TO Q3)
12. Grade 10 [SKIP TO Q3)
13. Grade 11 [SKIP TO Q3)
14. Grade 12 [SKIP TO Q3)
15. Other, please specify: [Open-ended response] – Collect open end response- then TERMINATE
16. None; I did not teach last year [TERMINATE]

[IF Q1= 1-Kindergarten to 7- Grade 5 AND Q1 <> 8-Grade 6 to 14- Grade 12]

Q2. Are you a home room teacher?

[SINGLE RESPONSE]

1. Yes
2. No [TERMINATE]

[IF Q1= 8-Grade 6 to 14-Grade 12]

Q3. What subjects do you teach? *Please select all that apply.(TEST)*

[MULTIPLE RESPONSE]

1. Math
2. Natural sciences
3. English/language arts
4. Social studies/social sciences/history
5. Music
6. Art
7. Physical education

8. Other – please specify: [OPEN-ENDED RESPONSE]

[IF Q2=1 or Q3<>1 or 2]
Q4. Do you teach any topics on energy (electricity, gas, coal, etc.) generation, transformation, use, or conservation (including, but not limited to, topics/materials provided by the Energy Efficiency for Schools program)?
[SINGLE RESPONSE]
1. Yes
2. No [TERMINATE]

Q5. Have you previously taken a survey (not fielded by NTC) regarding your participation in this program?
[SINGLE RESPONSE]
1. Yes
2. No
98. Don’t know

Performance Seen

[IF Q1=2-Kindergarten to 7- Grade 5 AND Q1<> 8-Grade 6 to 14-Grade 12]
Q6. Did you attend The National Theatre for Children performance for elementary school students in [PERFORMANCE_MONTH] of [PERFORMANCE_YEAR]?
1. Yes
2. No [TERMINATE]
98. Don't know/ Can’t recall [TERMINATE]

[IF Q6 = 1]
Q7. Did your students see a performance even more specific to their grade level?
1. Yes, they saw the K-2 performance
2. Yes, they saw the performance for grades 3-5
3. No, they saw the K-5 performance
4. Don’t know / Can’t recall

[IF Q1= 8- Grade 6 to 10- Grade 8]
Q8. Did you see the National Theatre for Children performance for middle school students in [PERFORMANCE_MONTH] of [PERFORMANCE_YEAR]?
1. Yes
2. No [TERMINATE]
98. Don't know/ Can’t recall [TERMINATE]

[IF Q1= 11- Grade 9 to 14- Grade 12]
Q9. Did you see the National Theatre for Children performance for high school students in [PERFORMANCE_MONTH] of [PERFORMANCE_YEAR]?
1. Yes
2. No [TERMINATE]
98. Don't know/ Can’t recall [TERMINATE]

[TERMINATION SCREEN TEXT: We have determined that you do not meet the qualification criteria for this study. Thank you for your time!]

Awareness of Duke Energy Sponsorship

Q10. Before today, were you aware that Duke Energy sponsored the National Theatre for Children performance(s) in your school?

1. Yes
2. No [SKIP TO Q14]
98. Don't know [SKIP TO Q14]

[If Q10= 1 (YES)]
Q11. How did you learn of Duke Energy's involvement with the National Theatre for Children program? *Please select all that apply.*
[MULTIPLE RESPONSE]

1. Another teacher
2. Duke Energy marketing materials
3. Duke Energy staff
4. National Theatre for Children staff
5. National Theatre for Children materials
6. Other, please describe: [OPEN-ENDED RESPONSE]
98. Don't know

Q12. Are you (one of) the decision-maker(s) regarding the NTC performances at your school?

1. Yes
2. No [SKIP TO Q14]
3. Don't know [SKIP TO Q14]

[IF Q132= 1 (YES)]
Q13. Do you recall how the importance of the program was communicated to you? If so, how was it communicated to you?

1. Yes: [OPEN-ENDED RESPONSE]
2. No

Program Experience and Satisfaction

The next few questions are about the **performance(s)** that National Theatre for Children presented to your school.

Q14. Thinking back to the school performance, would you say that energy related concepts presented in the performance were:
[SINGLE RESPONSE]

1. Far too advanced for most of your students
2. Somewhat too advanced for most of your students
3. About right for most of your students
4. Somewhat too basic for most of your students

5. Far too basic for most of your students
96 Other, please specify: [Open-ended response]
98. Don't know

[IF Q14= 1 or 2]
Q15. What about the performance was too advanced for most of your students?
1. [OPEN-ENDED RESPONSE]

[IF Q14= 4 or 5]
Q16. What about the performance was too basic for most of your students?
1. [OPEN-ENDED RESPONSE]

Q17. Were there any concepts that the performance(s) did not cover that *should have been* covered?
1. Yes
2. No [SKIP TO Q19]
98. Don't know [SKIP TO Q19]

[IF Q17= 1 (YES)]
Q18. What concepts were not covered that *should have been* covered?
1. [OPEN ENDED]

Q19. Please estimate your student's overall engagement level with the National Theatre for Children **performance** on the following scale WHERE 1=NOT AT ALL ENGAGED AND 5=COMPLETELY ENGAGED, with DK; LABEL ONLY THE END POINTS (1 AND 5) – DISPLAY AS HORIZONTAL GRID:

Not at all Engaged				Completely Engaged	Don't Know
1	2	3	4	5	98

Q20. Please rate your overall satisfaction with the National Theatre for Children **performance** on the following scale. [Single response; insert 1-5 scale WHERE 1=NOT AT ALL SATISFIED AND 5=COMPLETELY SATISFIED, with DK; LABEL ONLY THE END POINTS (1 AND 5) – DISPLAY AS HORIZONTAL GRID

Not at all Satisfied				Completely Satisfied	Don't Know
1	2	3	4	5	98

Q21. Please explain why you offered this satisfaction rating.
1. [OPEN ENDED]

The next few questions are about the **<u>curriculum or instructional materials</u>** that you may have received from the National Theatre for Children around the time of the performance.

Q22. Did you receive curriculum or instructional materials, such as student workbooks, related to energy and energy conservation from National Theatre for Children for the Fall 2019-Spring 2020 school year?

1. Yes
2. No [SKIP TO Q36]
98. Don't know [SKIP TO Q36]

[IF Q22= 1 (YES)]
Q23. To what degree did you use the curriculum or instructional materials in teaching your students about energy?
[Single response]

1. Not at all [SKIP TO Q35]
2. A little
3. Moderately
4. A lot
5. Extensively
98. Don't know [SKIP TO Q36]

[IF Q23= 2 (A little)]
Q24. Why did you only use the curriculum or instructional materials “a little” in teaching your students about energy?

1. [OPEN-ENDED RESPONSE]

[IF Q23= 2 through 5]
Q25. Thinking about how the student workbooks explained energy-related concepts, would you say that the material was generally:
[SINGLE RESPONSE]

1. Far too advanced for most of your students
2. Somewhat too advanced for most of your students
3. About right for most of your students
4. Somewhat too basic for most of your students
5. Far too basic for most of your students
96. Other, please specify: [Open-ended response]
98. Don't know
99. Refused

[IF Q23= 2, 3, 4, or 5]
Q26. Please rate how useful the materials were to you in teaching your students about energy. [Single response; insert 1-5 scale WHERE 1=NOT AT ALL USEFUL AND 5=EXTREMELY USEFUL, with DK

Not at all Useful				Extremely Useful	Don't Know
1	2	3	4	5	98

[IF Q23= 2, 3, 4, or 5]

Q27. Please rate the degree to which the topics in the workbook aligned with your state's science standards for the grade(s) you teach.

1. Completely aligned
2. Mostly aligned
3. Somewhat aligned
4. Poorly aligned
5. Not aligned at all
6. N/A – no science standards for my grade(s)

98. Don't know
99. Refused

[IF Q27= 4 or 5]

Q28. Which topic(s) was or were poorly aligned or not aligned at all with your state's science standards? In what way(s)?

1. [OPEN-ENDED RESPONSE]

[IF Q23= 2, 3, 4, or 5]

Q29. Were there any concepts covered in the curriculum or instructional materials that your students had challenges with?

1. Yes
2. No [SKIP TO Q31]

98. Don't know [SKIP TO Q31]
99. Refused [SKIP TO Q31]

[IF Q29= 1 (yes)]

Q30. What concepts did your students have challenges with?

1. [OPEN-ENDED RESPONSE]

[IF Q23= 2, 3, 4, or 5]

Q31. Were there any concepts that the materials did not cover that *should have been* covered?

1. Yes
2. No [SKIP TO Q33]

98. Don't know [SKIP TO Q33]
99. Refused [SKIP TO Q33]

[IF Q31= 1 (YES)]

Q32. What concepts were not covered that *should have been* covered?

1. [OPEN-ENDED RESPONSE]

[IF Q23= 2 through 5]

Q33. Please rate your overall satisfaction with curriculum or instructional materials you received from the National Theatre for Children program using the following scale. [Single response; insert 1-5 scale WHERE 1=NOT AT ALL SATISFIED AND 5=COMPLETELY SATISFIED with DK; LABEL ONLY END POINTS (1 and 5)]

Not at all Satisfied				Completely Satisfied	Don't Know
1	2	3	4	5	98

[IF Q22= 1 (YES)]
Q34. Do you have any additional input regarding the **curriculum or instructional materials** received from the National Theatre for Children that you would like to provide, including other things you liked or think could be improved? This might include things like overall presentation, length, level of detail, messaging, or anything else.
1. [OPEN ENDED]

[IF Q23= 1 (NOT AT ALL)]
Q35. Why did you *not* use the curriculum or instructional materials in teaching your students about energy?
1. [OPEN ENDED]

Interactions with NTC Staff

Q36. Did you have any interactions with anyone from the National Theatre for Children regarding the curriculum or instructional materials?
1. Yes
2. No [SKIP TO Q39]
98. Don't know [SKIP TO Q39]

[IF Q36= 1 (YES)]
Q37. What did those interactions involve?
1. [OPEN-ENDED RESPONSE]

[IF Q36= 1 (YES)]
Q38. Using the scale provided, how satisfied were you with:
a. Your interactions with the National Theatre for Children staff, overall
b. The professionalism and courtesy of the National Theatre for Children staff
c. The National Theatre for Children staff's knowledge about the topics you discussed with them

[Single response; for each item, insert 1-5 scale WHERE 1=NOT AT ALL SATISFIED AND 5=COMPLETELY SATISFIED with; LABEL ONLY THE END POINTS (1 AND 5)]

Not at all Satisfied				Completely Satisfied	Don't Know
1	2	3	4	5	98

Encouragement of Students to Complete Kit Request Form; Use of App

In the student workbooks provided by the National Theatre for Children there is a form that parents can fill out to receive a kit from Duke Energy. The kit contains energy efficient bulbs, low flow showerheads, and a few additional items that students and their parents can install in their home to save energy.

Q39. Did you distribute the kit request form to your students?

1. Yes – I distributed the workbooks, which included the kit request form
2. Yes – I distributed the kit request form separately
3. No [SKIP TO Q44]
98. Don't recall [SKIP TO Q43]

[IF Q39= 1 OR 2 (YES)]
Q40. On average, about what percentage of your students took the kit request form home? Your best estimate is fine.

1. 0% to 10%
2. 11% to 20%
3. 21% to 30%
4. 31% to 40%
5. 41% to 50%
6. 51% to 60%
7. 61% to 70%
8. 71% to 80%
9. 81% to 90%
10. 91% to 100%
98. Don't know

[IF Q39Q39= 1 OR 2 (YES)]
Q41. After students take the kit form home, do you follow up with students later to find out if their parents completed the form or signed up online?

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

[IF Q39= 1 OR 2 (YES)]
Q42. About what percentage of your students either brought the kit form back to you to mail, or reported their parents completed and sent the form to Duke Energy to receive their kit?

1. 0% to 10%
2. 11% to 20%
3. 21% to 30%
4. 31% to 40%
5. 41% to 50%
6. 51% to 60%

7. 61% to 70%
8. 71% to 80%
9. 81% to 90%
10. 91% to 100%
98. Don't know

Q43. About what percentage of student families who had signed up for kits signed up on the website?

1. 0% to 10%
2. 11% to 20%
3. 21% to 30%
4. 31% to 40%
5. 41% to 50%
6. 51% to 60%
7. 61% to 70%
8. 71% to 80%
9. 81% to 90%
10. 91% to 100%
98. Don't know

[IF Q39= 3 (NO)]
Q44. Why didn't you distribute the kit request forms to your students?

1. [OPEN-ENDED]

Q45. Did the NTC performers or the instructional materials mention the "Kilowatt Krush" app?

1. Yes
2. No [SKIP TO Q48]
98. Don't know [SKIP TO Q48]

[IF Q45= 1 (YES)]
Q46. About what percentage of students would you say downloaded and used the app?

1. 0% to 10%
2. 11% to 20%
3. 21% to 30%
4. 31% to 40%
5. 41% to 50%
6. 51% to 60%
7. 61% to 70%
8. 71% to 80%
9. 81% to 90%
10. 91% to 100%
98. Don't know

Q47. Do you have any suggestions to improve the app or how it was presented to students?
1. Yes; [OPEN ENDED RESPONSE]
2. No

Challenges and Opportunities for Improvement

Q48. Did government or organizational responses to COVID-19 offer any challenges for you regarding your participation in this program, other than those you've already discussed? If so, what were they, and how do you think they might best be addressed moving forward?
1. Yes: [OPEN-ENDED RESPONSE]
2. No
98. Don't know

Q49. Do you have any additional feedback regarding this program or Duke Energy that you would like to provide?
1. Yes; [OPEN ENDED RESPONSE]
2. No

Q50. Would you be willing to participate in an interview, so we might learn more about you and your students' experience with the program?
1. Yes
2. No [SKIP TO CLOSE]
98. Don't know [SKIP TO CLOSE]

[IF Q50= 1 (YES)]
Q51. Thank you for your willingness to be interviewed! We will be in touch with you regarding scheduling.

Thank you for your time completing this survey. Your responses have been recorded. Have a great day!

E.5 Teacher Interview Guide

Awareness, Grades and Subjects Taught, Type of Performance Seen

Q1. What grade(s) and subject(s) do you teach?

Q2. What type of performance did you see? In-person(live) or online(recorded)?

Q3. Do you recall how you heard about the program?

Q4. Do you know how performances are scheduled for your school? Are you involved with this? If so, in what way? [IF NOT ADDRESSED IN Q3]

Q5. Do you have any suggestions regarding recruitment and/or performance scheduling that might improve these processes?

Program Experience and Satisfaction

Q6. What topics were covered in the performance?

Q7. Do you think any of the topics could have been better emphasized or explained? If so, which ones and why?

Q8. Should any topics be removed from the performance? If so, which ones and why?

Q9. What about age appropriateness – was the content appropriate for all ages [ELEMENTARY, MIDDLE, OR HIGH]? If not, what was not age appropriate? How could that be improved?

Q10. Did the performance keep your students' attention? If not, how could the content be improved to keep the students entertained and attentive?

Q11. What did you like the most about the performance?

Is there anything you disliked?

Q12. How did your students respond to the performance?

- *Probes:* What did students say about the performance? Did they like it? What specifically did they like most about it?

Q13. One of the goals of the NTC program is for performers to get students' families to sign up for energy efficiency kits from Duke Energy that contain energy efficient bulbs, low-flow shower heads, and other items that students' families can install in their home to save energy. Did the performers talk about the kits, and/or how to sign up?

- [*If* yes] What did they say?

Q14. How many NTC performances have you seen? [*If they saw multiple NTC performances:*] When did you see that/these performance(s)? How did the latest performance compare to the prior performance(s)?

Q15. On a scale of 1 to 5, where 1 is "not at all interested" and 5 is "very interested", how interested would you be in using virtual or recorded performances in your classroom?

Q16. Do you have any suggestions that might improve the National Theatre for Children performance(s)?

Q17. NTC provides student workbooks that contain educational materials and a form to get an energy saver kit for their home. Have you distributed these workbooks to your students? [THESE NOW ARE AVAILABLE FULLY ELECTRONIC, IF THE TEACHER HAS OPTED OUT OF PRINTED MATERIAL]

- [*If no:*] Why not?
- [*If yes:*] How does the workbook distribution work? Do the students get them in a class?
  - Did you print them yourselves, view it online, or were paper copies delivered?
  - How did you use the workbooks in your classroom?

Q18. Did you get any teacher-facing instructional material from NTC? [*If* yes] What was it? How did you receive it? [*Probe: Left in your box, emailed if in digital form, or in some other way?*] To what extent did you use that material?

- [*If material was not used:*] Why haven't you used the material(s)? What would make you more likely to use them?
- [*If used:*] Using a 1 to 5 scale where 1 means "not at all useful" and 5 means "extremely useful," how useful was the instructional material? Why did you give that rating? What was most/least useful about them?

Q19. Were any other materials handed out by the performers before, during, or after the performance? If so, what was handed out? Did you use these materials in your classroom, or did the students take them home? *[probe about value of these materials]*

Q20. Thinking about the educational materials NTC provided…

- In what ways, if any, did you incorporate the material into your lesson plans? [*IF NOT* MENTIONED] That is, did you extensively use it – such as weaving it into your course work over the year – or did you briefly utilize it in the time surrounding the performance? Please explain how extensively you used the material.

- Was the content age appropriate? Or was it too advanced or too basic? What was too basic/advanced? Is it age appropriate for all ages (ELEMENTARY, MIDDLE, HIGH) How effective is it in teaching kids about energy concepts?

Q21. Do you have any suggestions that might improve the classroom materials received from the National Theatre for Children?

Q22. Did anyone or any of the materials you received emphasize the value of the kits to you? If so, what did they say?

Q23. In the online survey you said you [DID / DID NOT] distribute the kit request form to your students.

- [*IF DISTRIBUTED*] What challenges, if any, did you encounter when trying to distribute the kit forms? Did you have to coordinate with other faculty or staff? If so, can you describe this process and how well the process worked? What can NTC or Duke Energy do to make this process easier for you?
- [*IF NOT DISTRIBUTED*] Why did you not distribute the kit forms? What can NTC or Duke Energy do to make this process easier for you?

Q24. What, if anything, did you say or do to encourage your students to take the kit form and have their parents fill it out? Did you encourage your students to sign up online? If so, what did you say or do in doing so?

Q25. Do you have suggestions that might improve the distribution of the kit forms to students, or the online sign-up process?

Q26. In what ways did the performers or the materials mention the Kilowatt Krush app, if at all? Did your students report using it? Do you have any feedback about the app or how its communicated to participants?

Q27. Thinking about the performance and curriculum as a whole, in what ways, if any, did your students subsequently demonstrate knowledge on the topics presented? [*IF NOT* MENTIONED] What were some of their main takeaways? What is the evidence of their increased knowledge? (test scores, etc.?)

Wrap Up

Q28. Do you have any other thoughts about the program that we didn't discuss that you think may be important?

Thank you for your time. Have a great day!

E.6 Student Parent Survey

Landing Page Introduction

Thank you for agreeing to take this survey. It starts with a few questions about your experience in the program. The survey then asks for your feedback on various elements of the kit you received.

Introduction/Screening

Q1. [IF OUTBOUND CATI] Hi, I'm _______ , calling on behalf of Duke Energy, may I please speak with [CONTACT NAME]? We're returning your call regarding the survey about an energy efficiency educational program that Duke Energy sponsored in your child's school during the **2019-2020 school year.**

We would like to know about your participation in an energy efficiency educational program that Duke Energy sponsored in your child's school during the **2019-2020 school year**. In addition to sponsoring classroom activities, Duke Energy sent a kit containing energy saving items to your home. This kit included light bulbs, a showerhead, and other items that help you save energy in your home. Do you recall receiving this kit?

1. Yes
2. No [IF WEB: TERMINATE] [IF CATI: If no: Can I speak with another adult who may know something about this kit?]
98. Don't know [IF WEB: TERMINATE] [IF CATI: If DK: Can I speak with someone who may know something about this kit?]
99. Refused [TERMINATE]

[IF CATI: INTERVIEWER INSTRUCTIONS: *If no adults are able to speak about the kit, thank and terminate.*]

Q1.1 [IF Q1 = 1]. Were you aware of this program, prior to your child's involvement, due to your work at an elementary, middle, or high school?

1. Yes [→ TERMINATE]
2. No

Program Experience

Q2. Before today, did you know the kit you received was sponsored by Duke Energy?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q2 = 1]

Q3. How did you learn that the kit was sponsored by Duke Energy? *[Select all that apply]*

1. Classroom materials brought home by child
2. My child's teacher/school
3. Information material included in/on the kit
4. Other (specify: ___________)
98. Don't know
99. Refused

Q4. How did you hear about the opportunity to receive the kit from Duke Energy? *[Select all that apply]*

1. Classroom materials brought home by child
2. School newsletter
3. Email from my child's teacher/school
4. School website or school web portal
5. In-person conversations with my child's teacher
6. Saw a poster at my child's school
7. After hours event at my child's school
8. Other (specify: ___________)
98. Don't know
99. Refused

Q4b. How did you request your kit?

1. Program's website (www.myenergykit.org)
2. Sign-up form in the classroom materials my child brought home
3. By calling the toll-free number
4. Via the "Kilowatt Krush" app on my smartphone
98. Don't know
99. Refused

Q4c. Has your child used the "Kilowatt Krush" app on any smartphone in your household?

1. Yes
2. No [SKIP TO Q5]
98. Don't know [SKIP TO Q5]
99. Refused [SKIP TO Q5]

Q4d. About how often would you say that your child uses the "Kilowatt Krush" app?

1. They used it once
2. They used it a few times
3. They use it daily
4. They use it weekly
5. Other: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Q4e. Have you noticed your child engaging in energy saving behaviors you can attribute to their use of the "Kilowatt Krush" app?

1. Yes [Q4e.1 What energy saving behaviors have you noticed? OPEN-ENDED RESPONSE]
2. No
3. Don't know

Q4f. Do you have any feedback that might help improve the "Kilowatt Krush" app?

1. Yes [Q4f.1 What might improve the app? [OPEN-ENDED RESPONSE 98 Don't Know 99 = Refused]
2. No

98. Don't know
99. Refused

Q5. Did you read any of the Energy Savers booklet that came in the kit? This is the 44-page booklet with information about how to save energy in the home.

1. Yes
2. No
98. Don't know
99. Refused

[ASK Q6 IF Q5 = 1]

Q6. On a scale from 0 to 10 where 0 is not at all helpful and 10 is very helpful, how helpful was the Energy Savers booklet in identifying ways your household could save energy at home?

0. Not at all helpful
1.
2.
3.
4.
5.
6.
7.
8.
9.
10. Very helpful
98. Don't know
99. Refused

[ASK Q7 IF Q6 < 7]

Q7. What might have made the information more helpful?

[OPEN-ENDED RESPONSE] 98=Don't Know 99= Refused

Q8. In addition to sending the energy saving kits, Duke Energy sponsored a program about energy and energy efficiency at your child's school, which included classroom materials and an in-school performance by the National Theatre for Children. Were you aware of this program before today?
[IF CATI: Interviewer: Record 'yes' if the respondent reported any awareness of any aspect of the school program]

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF Q8 = 1]

Q9. From who or where did you hear about this program?

[MULTIPLE RESPONSE]

1. From my child/children
2. From a teacher/school administrator
3. On Duke Energy website

4 Other, please specify: Q94.1 From who or where did you hear about this program? [OPEN-ENDED RESPONSE]
98 Don't Know
99. Refused

Assessing Energy Saver Kit Installation

We'd like to ask you about the energy saving items included in your kit.
The kit contained an energy-efficient showerhead, faucet aerators for the bathroom and kitchen, energy efficient light bulbs, a night light, and some insulator gaskets for light switches and electricity outlets.
IF CATI: [*IF NEEDED:* The bathroom and kitchen faucet aerators are small metal pieces that you can screw into a sink faucet to reduce water flow. The insulator gaskets are made of foam and are the size and shape of a light switch or electric outlet.]
IF WEB: (The bathroom and kitchen faucet aerators are small metal pieces that you can screw into a sink faucet to reduce water flow. The insulator gaskets are made of foam and are the size and shape of a light switch or electric outlet.)

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later?
[IF CATI: Interviewer: Throughout interview, remind respondent as needed to report whether someone else in the home installed or uninstalled any items]

[SINGLE RESPONSE]

1. Yes
2. No [→Q18]
98. Don't know [→ TERMINATE]
99. Refused [→ TERMINATE]

[ASK IF Q10 = 1]
Q11. Which of the items did you install, even if they were taken out later?
[IF CATI: Interviewer: Record each response, then prompt with the list items.]

Item	Response
Q11a Showerhead	1. Yes 2. No 98. DK 99. REF
Q11b Kitchen faucet aerator	1. Yes 2. No 98. DK 99. REF
Q11c Bathroom faucet aerator	1. Yes 2. No 98. DK 99. REF
Q11d Night light	1. Yes 2. No 98. DK 99. REF
Q11e Energy efficient light bulb(s) (LEDs)	1. Yes 2. No 98. DK 99. REF
Q11f Insulator gaskets for light switches and electricity outlets	1. Yes 2. No 98. DK 99. REF

[ASK IF Q11e (ENERGY EFFICIENT LIGHT BULB(S)) = 1 (YES)]
Q12. In addition to the night light, there were two LED light bulbs in the kit. Did you install one or both LED light bulbs in the kit?

[SINGLE RESPONSE]

1. I installed both LEDs
2. I installed only one LED light bulb
98. Don't know
99. Refused

[ASK IF Q11f = 1]
Q13. How many of the light switch and electric outlet gasket insulators from the kit di*d you, or someone else,* install in your home?

[SINGLE RESPONSE]

1. None
2. One
3. Two
4. Three
5. Four
6. Five
7. Six
8. Seven
9. Eight
10. Nine
11. Ten
12. Eleven
13. Twelve
98. Don't know
99. Refused

[ASK IF ANY PART OF Q11 = 1]
Q14. Overall, how satisfied are you with the item[s] you installed? Please use 0 to 10 scales, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...?

DISPLAY IF	Item	Rating
Q11a = 1	Q14a Showerhead	0-10 with 98=DK, 99=REF
Q11b = 1	Q14b Kitchen faucet aerator	0-10 with 98=DK, 99=REF
Q11c = 1	Q14c Bathroom faucet aerator	0-10 with 98=DK, 99=REF
Q11d = 1	Q14d Night light	0-10 with 98=DK, 99=REF
Q11e = 1	Q14e Energy efficient light bulbs (LEDs)	0-10 with 98=DK, 99=REF
Q11f = 1	Q14f Insulator gaskets	0-10 with 98=DK, 99=REF

[ASK IF ANY ITEMS IN Q14a - Q14f < 7]
Q14.1. Can you please explain any dissatisfaction you had with the [DISPLAY ALL ITEMS IN Q14 THAT ARE <7]?

Q14.1a [IF Q14a < 7] Showerhead
Q14.1b [IF Q14b < 7] Kitchen Faucet aerator
Q14.1c [IF Q14c <7] Bathroom faucet aerator
Q14.1d [IF Q14d< 7] Night light
Q14.1e [IF Q14e <7] Energy efficient light bulbs (LEDs)
Q14.1f [IF Q14f < 7] Insulator gaskets
[OPEN END: RECORD VERBATIM]

[ASK IF Q11a OR Q11b OR Q11c OR Q11d OR Q11e OR Q11f = 1]
Q15. Have you since uninstalled any of the items from the kit that you had previously installed?

[SINGLE RESPONSE]

1. Yes

2. No
98. Don't know
99. Refused

[ASK IF Q15 = 1]
Q16. Which of the items did you uninstall?
[IF CATI: Interviewer: Record the response, then prompt with the list items.]

[MULTIPLE RESPONSE]

1. [DISPLAY IF Q11a = 1] Showerhead
2. [DISPLAY IF Q11b = 1] Kitchen faucet aerator
3. [DISPLAY IF Q11c = 1] Bathroom faucet aerator
4. [DISPLAY IF Q11d = 1] Night light
5. [DISPLAY IF Q11e = 1] Energy efficient light bulbs(LEDs)
6. [DISPLAY IF Q11f = 1] Insulator gaskets
98. Don't know
99. Refused

[ASK IF Q16 1-6 OPTIONS WERE SELECTED]
Q17. Why were those items uninstalled? Let's start with…
[IF CATI: *Interviewer: Read each item*]

	Item	Reason
IF Q16 = 1	Q17a Showerhead	Repeat reason options
IF Q16 = 2	Q17b Kitchen faucet aerator	Repeat reason options
IF Q16 = 3	Q17c Bathroom faucet aerator	Repeat reason options
IF Q16 = 4	Q17d Night light	Repeat reason options
IF Q16 = 5	Q17e Energy efficient light bulbs	Repeat reason options
IF Q16 = 6	Q17f Insulator gaskets	Repeat reason options

Response options:

[MULTIPLE RESPONSE]

1. It was broken
2. I didn't like how it worked
3. I didn't like how it looked
4. Other: (specify)
98. Don't Know
99. Refused

[ASK IF Q11a OR Q11b OR Q11c OR Q11d OR Q11e OR Q11f = 2 OR Q10 = 2]
Q18. You said you haven't installed [INPUT ONLY THOSE ITEMS IN Q11 IF Q11a-f = 2] OR [IF Q10=2, RECALL "any of the items"]. Which of those items do you plan to install in the next three months?
[IF CATI: READ LIST - SELECT ALL THAT APPLY].]

[MULTIPLE RESPONSE] [DISPLAY ALL IF = 2]

1 [IF Q10 = 2 OR Q11a = 2] Showerhead
2 [IF Q10 = 2 OR Q11b = 2] Kitchen faucet aerator
3 [IF Q10 = 2 OR Q11c = 2] Bathroom faucet aerator

4 [IF Q10 = 2 OR Q11d = 2] Night light
5 [IF Q10 = 2 OR Q11e = 2] Energy efficient light bulbs(LEDs)
6 [IF Q10 =2 OR Q11f = 2] Insulator gaskets
98. None
99. Refused

[ASK IF ANY 1-6 OPTIONS WERE NOT SELECTED IN Q18 OR OPTION 98 “NONE” WAS SELECTED]

Q19. What’s preventing you from installing those items? Let’s start with….
[IF CATI: *Interviewer: Read items*]

[MULTIPLE RESPONSE]

DISPLAY IF	Item	Reason
SKIP IF Q18=1,98,99	Q19a Showerhead	Use multiple response options below
SKIP IF Q18=2,98,99	Q19b Kitchen faucet aerator	Use multiple response options below
SKIP IF Q18=3,98,99	Q19c Bathroom faucet aerator	Use multiple response options below
SKIP IF Q18=4,98,99	Q19d Night light	Use multiple response options below
SKIP IF Q18=5,98,99	Q19e Energy efficient light bulbs	Use multiple response options below
SKIP IF Q18=6,98,99	Q19f Insulator gaskets	Use multiple response options below

[MULTIPLE RESPONSE OPTIONS FOR Q19]

1. Didn’t know what that was
2. Tried it, didn’t fit
3. Tried it, didn’t work as intended (Please specify: ____________________________)
4. Haven’t gotten around to it
5. Current one is still working
6. Takes too much time to install it/No time/Too busy
7. Too difficult to install it, don’t know how to do it
8. Don’t have the tools I need
9. Don’t have the items any longer (threw away, gave away)
10. [DISPLAY IF Q18.5 was not selected] Already have energy efficient light bulbs
11. [DISPLAY IF Q18.1 was not selected] Already have efficient showerhead
12. [DISPLAY IF Q18.2 was not selected] Already have efficient kitchen faucet aerator
13. [DISPLAY IF Q18.3 was not selected] Already have efficient bathroom faucet aerators
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[IF ANY PART OF Q11 = 1 AND IT’S NOT THE CASE THAT ALL PARTS OF Q16=SELECTED (THAT IS, THEY INSTALLED ANYTHING AND DID NOT UNINSTALL EVERYTHING THEY INSTALLED)]

[SKIP Q20 IF Q10=2]

Q20. Thinking of the items you installed, would you be interested in receiving any more of them from Duke Energy? If so, which ones?
[MULTIPLE RESPONSES]

1. [IF Q11a = 1 AND Q16 <> 1] Yes, I would like another energy-efficient showerhead
2. [IF Q11b = 1 AND Q16 <> 2] Yes, I would like another kitchen faucet aerator
3. [IF Q11c = 1 AND Q16 <> 3] Yes, I would like more bathroom faucet aerators

4. [IF Q11d = 1 AND Q16 <>4] Yes, I would like more night lights
5. [IF Q11e = 1 AND Q16 <> 5 Yes, I would like more energy-efficient light bulbs (LEDs)
6. [IF Q11f = 1 AND Q16 <>6 Yes, I would like more switch/outlet gasket insulators
7. No, I am not interested in receiving any more of the items
98. Don't know
99. Refused

[IF Q20=1-6]

Q21. What would be your preferred way to request these additional items? [MULTIPLE RESPONSES]

1. Internet
2. Telephone
3. Pre-paid postcard
4. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF Q11a (SHOWERHEAD)) = 1 (YES) AND Q16 <>1 (SHOWERHEAD); THAT IS, SHOWERHEAD WAS INSTALLED AND NOT UNINSTALLED]

Q22. On average, what is the typical shower length in your household?

[SINGLE RESPONSE]

1. One minute or less
2. Two to four minutes
3. Five to eight minutes
4. Nine to twelve minutes
5. Thirteen to fifteen minutes
6. Sixteen to twenty minutes
7. Twenty-one to thirty minutes
8. More than thirty minutes
98. Don’t know
99. Refused

[ASK IF Q11a (SHOWERHEAD)) = 1 (YES) AND Q16 <>1 (SHOWERHEAD); THAT IS, SHOWERHEAD WAS INSTALLED AND NOT UNINSTALLED]

Q23. Thinking of the efficient showerhead currently installed in your home…on average, how many showers per day are taken in this shower?

[SINGLE RESPONSE]

1. Fewer than one
2. One
3. Two
4. Three
5. Four
6. Five
7. Six
8. Seven
9. Eight
98. Don't know
99. Refused

[ASK IF Q11d = 1 AND Q16 <>4 NIGHT LIGHT OPTION WAS NOT SELECTED]

Q24. YOU SAID YOU INSTALLED THE NIGHT LIGHT. Did the night light replace an existing night light?

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF Q24= 1]

Q25. Did the old nightlight have a bulb that you could take out and replace once it burned out?

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF (Q11e = 1 AND Q16 <> 5 (ENERGY EFFICIENT LIGHTS WERE NOT SELECTED)]

Q26. You said you installed at least one of the energy efficient lights. What type of bulb(s) did you replace with the energy efficient lightbulbs?

1. All incandescent [IF CATI: *Interviewer: describe as an old-fashioned light bulb - likely purchased more than two years ago*]
2. All halogen [IF CATI: *Interviewer: describe as bulb that looks like an incandescent, but has a glass tube inside of the bulb*]
3. All CFL [IF CATI: *Interviewer: describe as spiral, or twisty shape bulb that fit into ordinary light fixtures]*
4. All LED [IF CATI: *Interviewer: describe as a new bulb type that uses little electricity and lasts a long time*]
5. Some combination; Please describe: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF (Q11e = 1 AND Q16 <> 5 (ENERGY EFFICIENT LIGHT BULBS NOT SELECTED)]

Q27. In what rooms did you install the energy efficient lightbulbs that were included in the kit? [MULTIPLE RESPONSE] [IF CATI: *Interviewer: If the respondent gives more than two responses, remind them that there were only two bulbs.]*

1. Living room
2. Dining room
3. Bedroom
4. Kitchen
5. Bathroom
6. Den
7. Garage
8. Hallway
9. Basement
10. Outdoors
11. Other area (please specify):_______
12. Don’t Know
13. Refused

Q28. Have you adjusted the temperature of your water heater based on the Hot Water Gauge Card included in your kit?

1. Yes
2. No
3. Don’t recall seeing the Hot Water Gauge Card
98. Don't know
99. Refused

[ASK IF Q28 = 1]
Q29. Do you know what the old temperature setting on your hot water heater was? (Numeric answers only, please)

1. Yes (please type in previous temperature setting here)
2. No

[ASK IF Q28 = 1]
Q30. And what was the new temperature setting you set your hot water heater to? (Numeric answers only, please)

[Record response]

98. Don’t know

[ASK IF Q28 = 1]
Q31. Is the new water heater temperature setting still in place?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q31 = 2]
Q32. Why did you change the water heater temperature a second time?

[Record response]

Q33. What is the fuel type of your water heater?

1. Electricity
2. Natural Gas
3. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

Q34. How old is your water heater?

1. Less than five years old
2. Five to nine years old
3. Ten to fifteen years old
4. More than fifteen years old
98. Don't know

NTG

[IF ANY PART OF Q11 = 1 AND IT'S NOT THE CASE THAT ALL PARTS OF Q16 =SELECTED (THAT IS, THEY INSTALLED ANYTHING AND DID NOT UNINSTALL EVERYTHING THEY INSTALLED)]

ASK Q35 IF [Q11a = 1 AND Q16<>1]OR [Q11b = 1 AND Q16 <>2] OR [Q11c = 1 AND Q16 <> 3] OR [Q11d = 1 AND Q16 <>4] OR Q11e = 1 AND Q16 <> 5] OR [Q11f = 1 AND Q16 <>6]

Q35. If you had not received the free efficiency items in the kit, how likely is it that you would have purchased and installed any of these same items within the next six months?

0 – Not at all likely	1	2	3	4	5	6	7	8	9	10 – Extremely likely	98 DK	99 RF

Q35_1. [DISPLAY IF Q11a = 1 AND Q16 <>1] Energy-Efficient Showerhead
Q35_2. [DISPLAY IF Q11b = 1 AND Q16 <> 2] Kitchen Faucet Aerator
Q35_3. [DISPLAY IF Q11c = 1 AND Q16 <>3] Bathroom Faucet Aerator
Q35_4. [DISPLAY IF Q11d = 1 AND Q16 <>4] Energy-Efficient Night Light
Q35_5. [DISPLAY IF Q11e = 1 AND Q16 <> 5] Energy-Efficient Light Bulbs (LEDs)
Q35_6. [DISPLAY IF Q11f = 1 AND Q16 <>6] Switch/Outlet Gasket Insulators

[ASK Q36 IF Q35_4 > 4 AND Q12 = 1]

Q36. If you had not received them for free in the kit, how many LED light bulbs would you have purchased?

1. One
2. Two
98. Don't know
99. Refused

[IF (Q11a = 1 AND Q16 <> 1) OR (Q11b = 1 AND Q16 <> 2) OR (Q11c = 1 AND Q16 <> 3)]

Q37. Now, thinking about the water savings items that were provided in the kit - using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential" how influential were the following factors on your decision to install the **water saving items (showerhead and faucet aerators)** from the kit? *How influential was…*

1[*97 = Not Applicable 98= Don't Know 99 = Refused* [MATRIX QUESTION: SCALE]

Elements	**Responses**
The fact that the items were free	0-10 scale with DK and REF options
The fact that the items were mailed to your house	0-10 scale with DK and REF options
Information in the kit about how the items would save energy	0-10 scale with DK and REF options
Information that your child brought home from school	0-10 scale with DK and REF options
Other information or advertisements from Duke Energy, including its website	0-10 scale with DK and REF options

[ASK Q38 IF Q11e = 1 AND Q16 <> 5]

Q38. Using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential" how influential were the following factors on your decision to install the **lightbulb(s)** from the kit? *How influential was…*

1 *97 = Not Applicable 98= Don't Know 99 = Refused* [MATRIX QUESTION: SCALE]

Elements	**Responses**
The fact that the items were free	0-10 scale with DK and REF options
The fact that the items were mailed to your house	0-10 scale with DK and REF options
Information in the kit about how the items would save energy	0-10 scale with DK and REF options
Information that your child brought home from school	0-10 scale with DK and REF options
Other information or advertisements from Duke Energy, including its website	0-10 scale with DK and REF options

Q39. Since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy, has **your child** adopted any **new behaviors** to help save energy in your home? This would only include new energy saving **behaviors** that your child adopted since receiving the kit.

[MULTIPLE RESPONSE]

1. Not applicable - no new behaviors
2. Turning off lights when not in a room
3. Turning off electronics when not using them
4. Taking shorter showers
5. Other (specify: ____________)
98. Don't know
99. Refused

Q39b. [IF =2 OR 3 OR 4 OR 5] Before receiving the kit, was your child already… [DISPLAY ITEMS SELECTED IN Q39]

Q39b.2 [Display IF Q39 = 2] Turning off lights when not in a room
Q39b.3 [Display IF Q39 = 3] Turning off electronics when not using them
Q39b.4 [Display if Q39 = 4] Taking shorter showers
Q39b.5 [Display IF Q39 = 5 [Insert Q39 "other"]__________)

1. Yes
2. No
98. Don't know
99. Refused

Q40. Since receiving your energy kit from Duke Energy, have **you** adopted or increased any of the following **behaviors** to help save energy in your home?

[MULTIPLE RESPONSE]

1. Not applicable - no new behaviors
2. Turning off lights when not in a room

3. Turning off furnace when not home
4. Turning off air conditioning when not home
5. Changing thermostat settings so heating or cooling system uses less energy
6. Using fans instead of air conditioning
7. Turning off electronics when not using them
8. Taking shorter showers
9. Turning water heat thermostat down
10. Other (specify: ____________)
98. Don't know
99. Refused

Q40b. [IF Q40 = 2-10] Before receiving the kit, were you already…

[DISPLAY ITEMS SELECTED IN Q40- [Question labels: Q40b2 – Q40b10]

1. Yes
2. No
98. Don't know
99. Refused

[ASK Q41 IF Q40b2 OR Q40b3 OR Q40b4 OR Q40b5 OR Q40b6 OR Q40b7 OR Q40b8 OR Q40b9 OR Q40b10 = 2]

Q41. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential," how much influence did Duke Energy's kit and materials on saving energy have on this change of energy using behaviors?

0 – Not at all influential	1	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF

Q42. Since receiving your energy kit from Duke Energy, have you purchased and installed any other **products** or made any improvements to your home to help save energy?

1. Yes
2. No
98. Don't know
99. Refused

[If Q42b= 1] [IF Q42 = 2, 98, 99 SKIP TO Q60]

Q43. What **products** have you purchased and installed to help save energy in your home?

[IF CATI: Do not read list. After each response, ask, "Anything else?"] [MULTIPLE RESPONSE]

1. Energy efficient appliances
2. Efficient heating or cooling equipment
3. Efficient windows
4. Insulation
5. Products to seal air leaks in your home
6. Products to seal ducts
7. LEDs and/or CFLs

8. Energy efficient water heater
9. None – no other actions taken
96. Other, please specify: ____________________
98. Don't know
99. Refused

[ASK IF Q43 <> 9, 98, OR 99]
Q44. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

[LOGIC] Item	Response
Q44.1 [IF Q43.1 IS SELECTED] 1. Energy efficient appliances	Yes, No DK REF
Q44.2 [IF Q43.2 IS SELECTED] 2. Efficient heating or cooling equipment	Yes, No DK REF
Q44.3 [IF Q43.3 IS SELECTED] 3. Efficient windows	Yes, No DK REF
Q44.4 [IF Q43.4 IS SELECTED] 4. Additional insulation	Yes, No DK REF
Q44.5 [IF Q43.5 IS SELECTED] 5. Products to seal air leaks in your home	Yes, No DK REF
Q44.6 [IF Q43.6 IS SELECTED] 6. Products to seal ducts	Yes, No DK REF
Q44.7 [IF Q43.7 IS SELECTED] 7. LEDs and/or CFLs	Yes, No DK REF
Q44.8 [IF Q43.8 IS SELECTED] 8. Install an energy efficient water heater	Yes, No DK REF
Q44.96 [IF Q43.96 IS SELECTED] 96 [**Q43 OPEN ENDED RESPONSE]**	Yes, No DK REF

[ASK IF ANY ITEM IN Q43 WAS SELECTED]
Q45. On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how much influence did the Duke Energy schools program have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] Item	Response
Q45.1 [IF Q43.1 IS SELECTED] 1. Buy energy efficient appliances	0-10 scale with DK and REF
Q45.2 [IF Q43.2 IS SELECTED] 2. Buy efficient heating or cooling equipment	0-10 scale with DK and REF
Q45.3 [IF Q43.3 IS SELECTED] 3. Buy efficient windows	0-10 scale with DK and REF
Q45.4 [IF Q43.4 IS SELECTED] 4. Buy additional insulation	0-10 scale with DK and REF
Q45.5 [IF Q43.5 IS SELECTED] 5. Seal air leaks in your home	0-10 scale with DK and REF
Q45.6 [IF Q43.6 IS SELECTED] 6. Seal ducts	0-10 scale with DK and REF
Q45.7[IF Q43.7 IS SELECTED] 7. Buy LEDs and/or CFLs	0-10 scale with DK and REF
Q45.8 [IF Q43.8 IS SELECTED] 8. Install an energy efficient water heater	0-10 scale with DK and REF
Q45.96[IF Q43.96 IS SELECTED] **[Q45 open ended response]**	0-10 scale with DK and REF

[ASK IF Q43.1 IS SELECTED AND Q45.1 <> 0, DK, REF]
Q46. What kinds of appliance(s) did you buy?

1*[IF CATI: Do not read list]* [MULTIPLE RESPONSE]

1. Refrigerator
2. Stand-alone Freezer
3. Dishwasher
4. Clothes washer
5. Clothes dryer
6. Oven
7. Microwave
96. Other, please specify: ____________
98. Don't know
99. Refused

[A*SK Q47* IF Q46 = 1-96] [REPEAT *Q47* FOR EACH ITEM MENTIONED IN Q46]

Q47. Was the [INSERT Q46 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1 Yes
2 No
98. Don't know
99. Refused

[ASK IF Q46 = 5]
Q48. Does the new clothes dryer use natural gas?

1 Yes - it uses natural gas
2 No – does not use natural gas
98. Don't know
99. Refused

[ASK IF Q43 = 2 AND Q45.2 > 0]
Q49. What type of heating or cooling equipment did you buy?

[Do not read list] [MULTIPLE RESPONSE]

1. Central air conditioner
2. Window/room air conditioner unit
3. Wall air conditioner unit
4. Air source heat pump
5. Geothermal heat pump
6. Boiler
7. Furnace
8. WIFI-enabled thermostat
96. Other, please specify: _______________
98. Don't know
99. Refused

[ASK IF Q49 = 6-7]
Q50. Does the new [INSERT RESPONSE] use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don't know
99. Refused

[A*SK* IF Q49 = 1-8, 96] QUESTION LABELS: Q51.1, Q51.2, Q51.3, Q51.4, Q51.5, Q51.6, Q51.7, Q51.96

Q51. Was the heating or cooling equipment an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[REPEAT Q51 FOR EACH ITEM MENTIONED IN Q49, EXCLUDING 49=8 WIFI -enabled thermostat]

[ASK IF Q43 = 3 AND Q45.3 > 0]

Q52. HOW MANY WINDOWS DID YOU INSTALL?

1. [_______________][Numeric Response 1-30
1. Don’t know
99. Refused

[ASK IF Q43 = 4 AND Q45.4 > 0]

Q53. Did you add insulation to your attic, walls, or below the floor?

[IF CATI: Do not read list] [MULTIPLE RESPONSE]

1. Attic
2 Walls
3 Below the floor
98. Don't know
99. Refused

[ASK IF Q53 <> 98-99]

[PROGRAMMER: REPEAT Q54 FOR EACH ITEM MENTIONED IN Q53] Q54.1 = ATTIC Q54.2 = WALLS Q54.3 = BELOW THE FLOOR]

Q54. Approximately what proportion of the [ITEM MENTIONED IN Q53] SPACE DID YOU ADD INSULATION TO? Your best estimate is fine.

1 [RECORD AS %] [NUMERIC RANGE 1 – 100]
98 Don’t know
99. Refused

[ASK IF Q43 = 7 AND Q45.7 > 0]

Q55. How many of LEDs and CFLs did you install in your property?

[IF NEEDED: *Your best estimate is fine]*

1. [NUMERIC RESPONSE 1- 100]
1. Don’t know

99. Refused

[ASK IF Q55 > 50)

Q56. You said that you installed [Q55 RESPONSE] LED and CFL bulbs on your property. Is this the correct number?

1. Yes, this is number of LED and CFL bulbs I installed
2. No, the correct number is: (Numeric answers only, please) _______
98. Don’t know
99. Refused

[ASK IF Q43 = 8 IS SELECTED AND Q45.8 > 0]
Q57. Does the new water heater use natural gas?

1Yes - it uses natural gas
2. No – does not use natural gas
98. Don’t know
99. Refused

[ASK IF Q43 = 8 IS SELECTED AND Q45.8 > 0]
Q58. Which of the following water heaters did you purchase?

1. A traditional water heater with a large tank that holds the hot water
2. A tankless water heater that provides hot water on demand
3. A solar water heater
4. Other, please specify: _______________
98. Don’t know
99. Refused

[ASK IF Q43 = 8 AND Q45.8 > 0]
Q59. Is the new water heater an ENERGY STAR model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

Demographics

Q60. Which of the following types of housing units would you say best describes your home?

1 Single-family detached house
2 Single-family attached home (such as a townhouse or condo)
3 Duplex, triplex or four-plex
4 Apartment or condominium with 5 units or more
5 Manufactured or mobile home
6 Other ______________
98. Don't know
99. Refused

Q61. How many showers are in your home? Please include both stand-up showers and bathtubs with showerheads.

1. One
2. Two

3. Three
4. Four
5. Five or more
98. Don't know
99. Refused

Q62. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?

1 Less than 500 square feet
2 500 to under 1,000 square feet
3 1,000 to under 1,500 square feet
4 1,500 to under 2,000 square feet
5 2,000 to under 2,500 square feet
6 2,500 to under 3,000 square feet
7 Greater than 3,000 square feet
98. Don't know
99. Refused

Q63. Do you or members of your household own your home, or do you rent it?

1. Own / buying
2. Rent / lease
3. Occupy rent-free
98. Don't know
99. Refused

Q64. Including yourself, how many people currently live in your home year-round

1 I live by myself
2 Two people
3 Three people
4 Four people
5 Five people
6 Six people
7 Seven people
8 Eight or more people
98. Don't know
99. Refused

Q65. What was your total annual household income for 2020, before taxes?

1 Under $15,000
2 15 to under $25,000
3 25 to under $35,000
4 35 to under $50,000
5 50 to under $75,000
6 75 to under $100,000
7 100 to under $150,000
8 150 to under $200,000
9 $200,000 or more
98. Don't know
99. Prefer not to say

Q66. In what year were you born?

1. [NUMERIC RESPONSE – FIELD WIDTH =4, 1900-2003]
98. Don't know
99. Prefer not to say

Q67. What is the highest level of education achieved among those living in your household?

1 Less than high school
2 Some high school
3 High school graduate or equivalent (such as GED)
4 Trade or technical school
5 Some college (including Associate degree)
6 College degree (Bachelor's degree)
7 Some graduate school
8 Graduate degree, professional degree
9 Doctorate
98 Don't know
99. Prefer not to say

Q68. Lastly, did the COVID-19 pandemic, or government or organizational responses to it, offer any challenges to you regarding your participation in this program? If so, what were these challenges, and how do you think they might best be addressed moving forward?

1 Yes: [OPEN-ENDED RESPONSE]
2 No
98 Don't know

Thank you for your time completing this survey. Your responses have been recorded. Have a great day!

Appendix F Survey Results

F.1 Teacher Survey - DEC

Q1.What grade(s) do you teach?

	# of responses	Percent
PreK-2nd	1	**2%**
PreK-5th	7	**16%**
PreK-8th	1	**2%**
Kindergarten	1	**2%**
K-5th	1	**2%**
K-6th	1	**2%**
1st	1	**2%**
1st-12th	1	**2%**
3rd	1	**2%**
3rd-5th	1	**2%**
4th	3	**7%**
5th & 6th	1	**2%**
6th	6	**14%**
6th-8th	4	**9%**
7th	2	**5%**
7th & 8th	1	**2%**
8th	1	**2%**
9th & 10th	1	**2%**
9th-11th	2	**5%**
9th-12th	3	**7%**
9th, 10th & 12th	1	**2%**
10th-12th	2	**5%**
Total	43	**100%**

Q2. Are you a home room teacher?

Group	Yes	No	Total
Elementary	8	12	20
Percent	**40%**	**60%**	**100%**
Middle	0	14	14
Percent	**0%**	**100%**	**100%**
High	0	9	9
Percent	**0%**	**100%**	**100%**
Total	8	35	43
Percent	**19%**	**81%**	**100%**

Q3. What subject(s) do you teach?

Group	Art, Other	English/ language arts, Other	English/language arts, Social studies/social sciences/history	Natural Sciences	Natural Sciences, Social studies/social sciences/history	Other	Social studies/social sciences/history	Total
Elementary	0	0	2	0	0	0	1	3
Percent	**0%**	**0%**	**66%**	**0%**	**0%**	**0%**	**33%**	**100%**
Middle	1	0	0	8	1	3	1	14
Percent	**7%**	**0%**	**0%**	**57%**	**7%**	**21%**	**7%**	**100%**
High	0	1	0	7	0	1	0	9
Percent	**0%**	**11%**	**0%**	**78%**	**0%**	**11%**	**0%**	**100%**
Total	1	1	2	15	1	4	2	26
Percent	**4%**	**4%**	**8%**	**58%**	**4%**	**15%**	**8%**	**100%**

Q4. Do you teach any topics on energy (electricity, gas, coal, etc.) generation, transformation, use, or conservation (including, but not limited to, topics/materials provided by the Energy Efficiency for Schools Program)?

Group	Yes	No	Total
Elementary	11	0	11
Percent	**100%**	**0%**	**100%**
Middle	5	0	5
Percent	**100%**	**0%**	**100%**
High	2	0	2
Percent	**100**	**0%**	**100%**
Total	18	0	18
Percent	**100%**	**0%**	**100%**

Q5. Have you previously taken a survey (not fielded by the National Theatre for Children) regarding your participation in this program?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	10	1	11
Percent	**0%**	**91%**	**9%**	**100%**
Middle	1	9	4	14
Percent	**7%**	**64%**	**29%**	**100%**
High	0	5	4	9
Percent	**0%**	**56%**	**44%**	**100%**
Total	1	24	9	34
Percent	**3%**	**71%**	**26%**	**100%**

Q6. Did you attend The National Theatre for Children performance for elementary school students in [performance_month] of [performance_year]?

	Yes	No	Don't Know	Total
# of responses	8	0	0	8
Percent	**100%**	**0%**	**0%**	**100%**

Q7. Did your students see a performance event more specific to their grade level?

	Yes, they saw the K-2 performance	Yes, they saw the performance for Grades 3-5	No, they saw the K-5 performance	Don't know/ Can't recall	Total
# of responses	3	5	0	0	8
Percent	**37%**	**63%**	**0%**	**0%**	**100%**

Q8. Did you see the National Theatre for Children performance for middle school students in [performance_month] of [performance_year]?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	3	0	0	3
Percent	**100%**	**0%**	**0%**	**100%**
Middle	14	0	0	14
Percent	**100%**	**0%**	**0%**	**100%**
High	0	0	0	0
Percent	**0%**	**0%**	**0%**	**100%**
Total	17	0	0	17
Percent	**100%**	**0%**	**0%**	**100%**

Q9. Did you see the National Theatre for Children performance for high school students in [performance_month] of [performance_year]?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
Middle	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**
High	9	0	0	0
Percent	**100%**	**0%**	**0%**	**100%**
Total	17	0	0	17
Percent	**100%**	**0%**	**0%**	**100%**

Q10. Before today, were you aware the Duke Energy sponsored the National Theatre for Children performance(s) in your schoool?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	11	0	0	11
Percent	**100%**	**0%**	**0%**	**100%**
Middle	14	0	0	14
Percent	**100%**	**0%**	**0%**	**0%**
High	8	1	0	9
Percent	**89%**	**11%**	**0%**	**100%**
Total	33	1	0	34
Percent	**97%**	**3%**	**0%**	**100%**

Q11. How did you learn of Duke Energy's involvement with the National Theatre for Children program?

	Elementary	*Percent*	Middle	*Percent*	High	*Percent*	Total	*Percent*
Another teacher	2	**18%**	2	**14%**	0	**0%**	4	**12%**
Another teacher; Duke Energy marketing materials	0	**0%**	1	**7%**	0	**0%**	1	**3%**
Don't know	0	**0%**	1	**7%**	0	**0%**	1	**3%**
Duke Energy marketing materials	3	**27%**	2	**14%**	0	**0%**	5	**15%**
Duke Energy marketing materials; National Theatre for Children materials	1	**9%**	0	**0%**	1	**13%**	2	**6%**
Duke Energy marketing materials; National Theatre for Children staff	0	**0%**	0	**0%**	1	**13%**	1	**3%**
Duke Energy marketing materials; National Theatre for Children staff; National Theatre for Children materials	1	**9%**	0	**0%**	2	**25%**	3	**9%**
Duke Energy staff; National Theatre for Children staff; National Theatre for Children materials	0	**0%**	1	**7%**	0	**0%**	1	**3%**
National Theatre for Children materials	2	**18%**	2	**14%**	0	**0%**	4	**12%**
National Theatre for Children staff	0	**0%**	2	**14%**	2	**25%**	4	**12%**
National Theatre for Children staff; National Theatre for Children materials	0	**0%**	1	**7%**	2	**25%**	3	**9%**
Other	2	**18%**	2	**14%**	0	**0%**	4	**12%**
Total	11	**100%**	14	**100%**	8	**100%**	33	**100%**

Q12. Are you (one of) the decision-maker[s] regarding the NTC performances at your school?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	9	1	1	11
Percent	**82%**	**9%**	**9%**	**100%**
Middle	14	0	0	14
Percent	**100%**	**0%**	**0%**	**0%**
High	8	0	0	8
Percent	**100%**	**0%**	**0%**	**100%**
Total	31	1	1	33
Percent	**94%**	**3%**	**3%**	**100%**

Q13. Do you recall how the importance of the program was communicated to you?

Group	Yes	No	Total
Elementary	5	4	9
Percent	**56%**	**44%**	**100%**
Middle	9	5	14
Percent	**64%**	**36%**	**100%**
High	6	2	8
Percent	**75%**	**25%**	**100%**
Total	20	11	31
Percent	**65%**	**35%**	**100%**

Q14. Thinking back to the school performance, would you say that energy related concepts presented in the performance were:

Group	Far too advanced for most of your students	Somewhat too advanced for most of your students	About right for most of your students	Somewhat too basic for most of your students	Far too basic for most of your students	Other	Don't know	Total
Elementary	0	0	10	1	0	0	0	11
Percent	**0%**	**0%**	**91%**	**9%**	**0%**	**0%**	**0%**	**100%**
Middle	0	0	12	2	0	0	0	14
Percent	**0%**	**0%**	**86%**	**14%**	**0%**	**0%**	**0%**	**100%**
High	0	0	6	3	0	0	0	9
Percent	**0%**	**0%**	**67%**	**33%**	**0%**	**0%**	**0%**	**100%**
Total	0	0	28	6	0	0	0	34
Percent	**0%**	**0%**	**82%**	**18%**	**0%**	**0%**	**0%**	**100%**

Q15. What about the performance was too advanced for most of your students?

Open-ended response type; no tabulation available

Q16. What about the performance was too basic for most of your students?

Open-ended response type; no tabulation available

Q17. Were there any concepts that the performance(s) did not cover that SHOULD HAVE BEEN covered?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	10	1	11
Percent	**0%**	**91%**	**9%**	**100%**
Middle	0	10	4	14
Percent	**0%**	**71%**	**29%**	**100%**
High	1	8	0	9
Percent	**11%**	**89%**	**0%**	**100%**
Total	1	28	5	34
Percent	**3%**	**82%**	**15%**	**100%**

Q18. What concepts were not covered that SHOULD HAVE BEEN covered?

Open-ended response type; no tabulation available

Q19. Please estimate your student's overall engagement level with the National Theatre for Children performance on the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	1	6	4	0	11
Percent	**0%**	**0%**	**9%**	**55%**	**37%**	**0%**	**100%**
Middle	0	1	1	7	5	0	14
Percent	**0%**	**7%**	**7%**	**50%**	**36%**	**0%**	**100%**
High	0	0	3	4	2	0	9
Percent	**0%**	**0%**	**33%**	**44%**	**22%**	**0%**	**100%**
Total	0	1	5	17	11	0	34
Percent	**0%**	**3%**	**15%**	**50%**	**32%**	**0%**	**100%**

Q20. Please rate your overall satisfaction with the National Theatre for Children performance on the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	3	8	0	11
Percent	**0%**	**0%**	**0%**	**27%**	**73%**	**0%**	**100%**
Middle	0	0	1	2	11	0	14
Percent	**0%**	**0%**	**7%**	**14%**	**79%**	**0%**	**100%**
High	0	0	1	4	4	0	9
Percent	**0%**	**0%**	**11%**	**44%**	**44%**	**0%**	**100%**
Total	0	0	2	9	23	0	34
Percent	**0%**	**0%**	**6%**	**26%**	**68%**	**0%**	**100%**

Q21. Please explain why you offered this satisfaction rating

Open-ended response type; no tabulation available

Q22. Did you receive curriculum or instructional materials, such as student workbooks, related to energy and energy conservation from National Theatre for Children for the Fall 2019 - Spring 2020 school year?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	9	1	1	11
Percent	**82%**	**9%**	**9%**	**100%**
Middle	9	4	1	14
Percent	**64%**	**29%**	**7%**	**100%**
High	5	4	0	9
Percent	**56%**	**44%**	**0%**	**100%**
Total	23	9	2	34
Percent	**68%**	**26%**	**6%**	**100%**

Q23. To what degree did you use the curriculum or instructional materials in teaching your students about energy?

Group	Not at all	A little	Moderately	A lot	Extensively	Don't know	Total
Elementary	0	6	3	0	0	0	9
Percent	**0%**	**67%**	**33%**	**0%**	**0%**	**0%**	**100%**
Middle	0	3	6	0	0	0	9
Percent	**0%**	**33%**	**67%**	**0%**	**0%**	**0%**	**100%**
High	0	1	3	1	0	0	5
Percent	**0%**	**20%**	**60%**	**20%**	**0%**	**0%**	**100%**
Total	0	10	12	1	0	0	23
Percent	**0%**	**43%**	**53%**	**3%**	**0%**	**0%**	**100%**

Q24. Why did you only use the workbooks "a little" in teaching your students about energy?

Open-ended response type; no tabulation available

Q25. Thinking about how the student workbooks explained energy related concepts, would you say that the materials were generally:

Group	Far too advanced for most of your students	Somewhat too advanced for most of your students	About right for most of your students	Somewhat too basic for most of your students	Far too basic for most of your students	Other	Don't know	Refused	Total
Elementary	0	1	7	0	0	0	1	0	9
Percent	**0%**	**11%**	**78%**	**0%**	**0%**	**0%**	**11%**	**0%**	**100%**
Middle	0	0	8	0	0	1	0	0	9
Percent	**0%**	**0%**	**89%**	**0%**	**0%**	**11%**	**0%**	**0%**	**100%**
High	0	0	4	1	0	0	0	0	5
Percent	**0%**	**0%**	**80%**	**20%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total	0	1	19	1	0	1	1	0	23
Percent	**0%**	**4%**	**83%**	**4%**	**0%**	**4%**	**4%**	**0%**	**100%**

Q26. Please rate how useful the materials were to you in teaching your students about energy.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	2	4	2	1	0	9
Percent	**0%**	**22%**	**44%**	**22%**	**11%**	**0%**	**100%**
Middle	0	1	1	3	3	1	9
Percent	**0%**	**11%**	**11%**	**33%**	**33%**	**11%**	**100%**
High	0	0	1	2	2	0	5
Percent	**0%**	**0%**	**20%**	**40%**	**40%**	**0%**	**100%**
Total	0	3	6	7	6	1	23
Percent	**0%**	**13%**	**26%**	**30%**	**26%**	**4%**	**100%**

Q27. Please rate the degree to which the topics in the workbook aligned with your state's science standards for the grade(s) you teach.

Group	Completely aligned	Mostly aligned	Somewhat aligned	Poorly aligned	Not at all aligned	N/A - no science standards for my grade(s)	Don't know	Refused	Total
Elementary	0	4	3	0	0	0	2	0	9
Percent	**0%**	**44%**	**33%**	**0%**	**0%**	**0%**	**22%**	**0%**	**100%**
Middle	0	6	3	0	0	0	0	0	9
Percent	**0%**	**67%**	**33%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
High	0	3	2	0	0	0	0	0	5
Percent	**0%**	**60%**	**40%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total	0	13	8	0	0	0	2	0	23
Percent	**0%**	**57%**	**35%**	**0%**	**0%**	**0%**	**9%**	**0%**	**100%**

Q28. Which topic(s) was or were poorly aligned or not aligned at all with your state's science standards? In what way(s)?

Open-ended response type; no tabulation available

Q29. Were there any concepts covered in the curriculum or instructional materials that your students had challenges with?

Group	Yes	No	Don't Know/ Can't Recall	Refused	Total
Elementary	0	6	3	0	9
Percent	**0%**	**67%**	**33%**	**0%**	**100%**
Middle	1	6	2	0	9
Percent	**11%**	**67%**	**22%**	**0%**	**100%**
High	0	3	2	0	5
Percent	**0%**	**60%**	**40%**	**0%**	**100%**
Total	1	15	7	0	23
Percent	**4%**	**65%**	**30%**	**0%**	**100%**

Q30. What concepts did your students have challenges with?

Open-ended response type; no tabulation available

Q31. Were there any concepts that the materials did not cover that SHOULD HAVE BEEN covered?

Group	Yes	No	Don't Know/ Can't Recall	Refused	Total
Elementary	0	7	2	0	9
Percent	**0%**	**78%**	**22%**	**0%**	**100%**
Middle	1	7	1	0	9
Percent	**11%**	**78%**	**11%**	**0%**	**100%**
High	0	4	1	0	5
Percent	**0%**	**80%**	**20%**	**0%**	**100%**
Total	1	18	4	0	23
Percent	**4%**	**78%**	**17%**	**0%**	**100%**

Q32. What concepts were not covered that SHOULD HAVE BEEN covered?

Open-ended response type; no tabulation available

Q33. Please rate your overall satisfaction with curriculum or instructional materials you received from the National Theatre for Children program using the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	2	5	2	0	9
Percent	**0%**	**0%**	**22%**	**56%**	**22%**	**0%**	**100%**
Middle	0	0	1	3	5	0	9
Percent	**0%**	**0%**	**11%**	**33%**	**56%**	**0%**	**100%**
High	0	0	0	2	3	0	5
Percent	**0%**	**0%**	**0%**	**40%**	**60%**	**0%**	**100%**
Total	0	0	3	10	10	0	23
Percent	**0%**	**0%**	**13%**	**43%**	**43%**	**0%**	**100%**

Q34. Do you have any additional input regarding the curriculum or instructional materials received from the National Theatre for Children that you would like to provide, including other things you liked or think could be improved? This might include things like overall presentation, length, level of detail, messaging, or anything else.

Open-ended response type; no tabulation available

Q35. Why did you NOT use the curriculum or instructional materials in teaching your students about energy?

Open-ended response type; no tabulation available

Q36. Did you have any interactions with anyone from the National Theatre for Children regarding the curriculum or instructional materials?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	5	6	0	11
Percent	**45%**	**55%**	**0%**	**100%**
Middle	5	8	1	14
Percent	**36%**	**57%**	**7%**	**100%**
High	4	5	0	9
Percent	**44%**	**56%**	**0%**	**100%**
Total	14	19	1	34
Percent	**41%**	**56%**	**3%**	**100%**

Q37. What did those interactions involve?

Open-ended response type; no tabulation available

Q38. Using the scale provided, how satisfied were you with:

Your interactions with the National Theatre for Children staff, overall

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	2	3	0	5
Percent	**0%**	**0%**	**0%**	**40%**	**60%**	**0%**	**100%**
Middle	0	0	0	0	5	0	5
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	4	0	4
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Total	0	0	0	2	12	0	14
Percent	**0%**	**0%**	**0%**	**14%**	**86%**	**0%**	**100%**

The professionalism and courtesy of the National Theatre for Children staff

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	1	4	0	5
Percent	**0%**	**0%**	**0%**	**20%**	**80%**	**0%**	**100%**
Middle	0	0	0	0	5	0	5
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	4	0	4
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Total	0	0	0	1	13	0	14
Percent	**0%**	**0%**	**0%**	**7%**	**93%**	**0%**	**100%**

The National Theatre for Children staff's knowledge about the topics you discussed with them

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	0	5	0	5
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Middle	0	0	0	0	5	0	5
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	4	0	4
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Total	0	0	0	0	14	0	14
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**

Q39. Did you distribute the kit request form to your students?

Group	Yes - I distributed the workbooks, which included the kit request form	Yes - I distributed the kit request forms separately	No	Don't Recall	Total
Elementary	4	5	1	1	11
Percent	**36%**	**45%**	**9%**	**9%**	**100%**
Middle	5	6	2	1	14
Percent	**36%**	**43%**	**14%**	**7%**	**100%**
High	4	5	0	0	9
Percent	**44%**	**56%**	**0%**	**0%**	**100%**
Total	13	16	3	2	34
Percent	**38%**	**47%**	**9%**	**6%**	**100%**

Q40. On average, about what percentage of your students took the kit request form home?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	0	2	0	1	0	0	0	1	5	0	9
Percent	**0%**	**0%**	**22%**	**0%**	**11%**	**0%**	**0%**	**0%**	**11%**	**56%**	**0%**	**100%**
Middle	2	1	1	0	2	3	0	0	1	1	0	11
Percent	**18%**	**9%**	**9%**	**0%**	**18%**	**27%**	**0%**	**0%**	**9%**	**9%**	**0%**	**100%**
High	0	1	2	3	0	0	0	0	3	0	0	9
Percent	**0%**	**11%**	**22%**	**33%**	**0%**	**0%**	**0%**	**0%**	**33%**	**0%**	**0%**	**100%**
Total	2	2	5	3	3	3	0	0	5	6	0	29
Percent	**7%**	**7%**	**17%**	**10%**	**10%**	**10%**	**0%**	**0%**	**17%**	**21%**	**0%**	**100%**

Q41. After students take the kit form home, do you follow up with students later to find out if their parents completed the form?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	2	5	2	9
Percent	**22%**	**56%**	**22%**	**100%**
Middle	7	3	1	11
Percent	**64%**	**27%**	**9%**	**100%**
High	4	5	0	9
Percent	**44%**	**56%**	**0%**	**100%**
Total	13	13	3	29
Percent	**45%**	**45%**	**10%**	**100%**

Q42. About what percentage of your students either brought the kit form back to you to mail, or reported their parents completed and sent the form to Duke Energy to receive their kit?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	3	2	0	1	0	0	0	0	0	3	9
Percent	**0%**	**33%**	**22%**	**0%**	**11%**	**0%**	**0%**	**0%**	**0%**	**0%**	**33%**	**100%**
Middle	4	1	3	1	0	0	2	0	0	0	0	11
Percent	**36%**	**9%**	**27%**	**9%**	**0%**	**0%**	**18%**	**0%**	**0%**	**0%**	**0%**	**100%**
High	1	3	2	0	0	0	0	0	1	0	2	9
Percent	**11%**	**33%**	**22%**	**0%**	**0%**	**0%**	**0%**	**0%**	**11%**	**0%**	**22%**	**100%**
Total	5	7	7	1	1	0	2	0	1	0	5	29
Percent	**17%**	**24%**	**24%**	**3%**	**3%**	**0%**	**7%**	**0%**	**3%**	**0%**	**17%**	**100%**

Q43. About what percentage of student families who had signed up for kits signed up on the website?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	2	1	0	1	0	0	1	0	0	4	9
Percent	0%	22%	11%	0%	11%	0%	0%	11%	0%	0%	44%	100%
Middle	3	0	2	0	0	1	1	0	0	1	3	11
Percent	27%	0%	18%	0%	0%	9%	9%	0%	0%	9%	27%	100%
High	0	3	1	0	0	0	0	1	0	0	4	9
Percent	0%	33%	11%	0%	0%	0%	0%	11%	0%	0%	44%	100%
Total	3	5	4	0	1	1	1	2	0	1	11	29
Percent	10%	17%	14%	0%	3%	3%	3%	7%	0%	3%	38%	100%

Q44. Why didn't you distribute the kit request forms to your students?

Open-ended response type; no tabulation available

Q45. Did the NTC performers or the instructional materials mention the "Kilowatt Krush" app?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	7	1	3	11
Percent	**64%**	**9%**	**27%**	**100%**
Middle	8	4	2	14
Percent	**57%**	**29%**	**14%**	**100%**
High	4	0	5	9
Percent	**44%**	**0%**	**56%**	**100%**
Total	19	5	10	34
Percent	**56%**	**15%**	**29%**	**100%**

Q46. About what percentage of students would you say downloaded and used the app?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	2	0	0	0	0	0	0	0	0	5	7
Percent	**0%**	**29%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**71%**	**100%**
Middle	3	0	0	1	0	0	0	0	0	0	4	8
Percent	**38%**	**0%**	**0%**	**13%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**50%**	**100%**
High	0	0	0	1	0	0	0	0	0	0	3	4
Percent	**0%**	**0%**	**0%**	**25%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**75%**	**100%**
Total	3	2	0	2	0	0	0	0	0	0	12	19
Percent	**16%**	**11%**	**0%**	**11%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**63%**	**100%**

Q47. Do you have any suggestions to improve the app or how it was presented to students?

Open-ended response type; no tabulation available

Q48. Did government or organizational responses to COVID-19 offer any challenges for you regarding your participation in this program, other than those you've already discussed? If so, what were they, and how do you think they might best be addressed moving forward?

Open-ended response type; no tabulation available

Q49. Do you have any additional feedback regarding this program or Duke Energy that you would like to provide?

Open-ended response type; no tabulation available

Q50. Would you be willing to participate in an interview, so that we might learn more about you and your students' experience with the program?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	3	4	4	11
Percent	**27%**	**36%**	**36%**	**100%**
Middle	5	9	0	14
Percent	**36%**	**64%**	**0%**	**100%**
High	5	4	0	9
Percent	**56%**	**44%**	**0%**	**100%**
Total	13	17	4	34
Percent	**38%**	**50%**	**12%**	**100%**

F.2 Teacher Survey - DEP

Q1.What grade(s) do you teach?

	# of responses	Percent
PreK & Kindergarten	1	**3%**
PreK-1st	1	**3%**
PreK-2nd	1	**3%**
PreK-3rd	1	**3%**
PreK-5th	2	**7%**
PreK-6th	1	**3%**
PreK-9th	1	**3%**
Kindergarten	2	**7%**
1st-3rd	1	**3%**
2nd	1	**3%**
3rd	2	**7%**
5th	1	**3%**
6th	4	**14%**
6th-12th	1	**3%**
7th	2	**7%**
8th	6	**21%**
9th-11th	1	**3%**
Total	29	**100%**

Q2. Are you a home room teacher?

Group	Yes	No	Total
Elementary	6	8	14
Percent	**43%**	**57%**	**100%**
Middle	1	13	14
Percent	**7%**	**93%**	**100%**
High	0	1	1
Percent	**0%**	**100%**	**100%**
Total	7	22	29
Percent	**24%**	**76%**	**100%**

Q3. What subject(s) do you teach?

Group	Math	Math, Natural Sciences	Math, Other	Math, Social studies/social sciences/history	Natural Sciences	Other	Total
Elementary	0	0	0	0	1	0	1
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Middle	1	2	0	1	8	1	13
Percent	**8%**	**15%**	**0%**	**8%**	**62%**	**8%**	**100%**
High	0	0	1	0	0	0	1
Percent	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**100%**
Total	1	2	1	1	9	1	15
Percent	**7%**	**13%**	**7%**	**7%**	**60%**	**7%**	**100%**

Q4. Do you teach any topics on energy (electricity, gas, coal, etc.) generation, transformation, use, or conservation (including, but not limited to, topics/materials provided by the Energy Efficiency for Schools Program)?

Group	Yes	No	Total
Elementary	6	0	6
Percent	**100%**	**0%**	**100%**
Middle	2	0	2
Percent	**100%**	**0%**	**100%**
High	0	0	0
Percent	**0%**	**0%**	**0%**
Total	8	0	8
Percent	**100%**	**0%**	**100%**

Q5. Have you previously taken a survey (not fielded by the National Theatre for Children) regarding your participation in this program?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	5	2	7
Percent	**0%**	**71%**	**29%**	**100%**
Middle	0	10	4	14
Percent	**0%**	**71%**	**29%**	**100%**
High	0	1	0	1
Percent	**0%**	**100%**	**0%**	**100%**
Total	0	16	6	22
Percent	**0%**	**73%**	**27%**	**100%**

Q6. Did you attend The National Theatre for Children performance for elementary school students in [performance_month] of [performance_year]?

	Yes	No	Don't Know	Total
# of responses	7	0	0	7
Percent	**100%**	**0%**	**0%**	**100%**

Q7. Did your students see a performance event more specific to their grade level?

	Yes, they saw the K-2 performance	Yes, they saw the performance for Grades 3-5	No, they saw the K-5 performance	Don't know/ Can't recall	Total
# of responses	4	0	1	2	7
Percent	**57%**	**0%**	**14%**	**29%**	**100%**

Q8. Did you see the National Theatre for Children performance for middle school students in [performance_month] of [performance_year]?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**
Middle	13	0	0	13
Percent	**100%**	**0%**	**0%**	**100%**
High	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**
Total	13	0	0	13
Percent	**100%**	**0%**	**0%**	**100%**

Q9. Did you see the National Theatre for Children performance for high school students in [performance_month] of [performance_year]?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**
Middle	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
High	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
Total	2	0	0	2
Percent	**100%**	**0%**	**0%**	**100%**

Q10. Before today, were you aware the Duke Energy sponsored the National Theatre for Children performance(s) in your schoool?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	5	1	0	6
Percent	**83%**	**17%**	**0%**	**100%**
Middle	14	0	0	14
Percent	**100%**	**0%**	**0%**	**100%**
High	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
Total	20	1	0	21
Percent	**95%**	**5%**	**0%**	**100%**

Q11. How did you learn of Duke Energy's involvement with the National Theatre for Children program?

	Elementary	*Percent*	Middle	*Percent*	High	*Percent*	Total	*Percent*
Another teacher; Duke Energy marketing materials; National Theatre for Children staff	0	**0%**	1	**7%**	0	**0%**	1	**5%**
Duke Energy marketing materials	0	**0%**	5	**36%**	0	**0%**	5	**25%**
Duke Energy marketing materials; National Theatre for Children materials	0	**0%**	1	**7%**	0	**0%**	1	**5%**
National Theatre for Children materials	2	**40%**	4	**29%**	0	**0%**	6	**30%**
National Theatre for Children staff	1	**20%**	2	**14%**	0	**0%**	3	**15%**
Other	2	**40%**	1	**7%**	1	**100%**	4	**20%**
Total	5	**100%**	14	**100%**	1	**100%**	20	**100%**

Q12. Are you (one of) the decision-maker[s] regarding the NTC performances at your school?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	4	1	0	5
Percent	80%	20%	0%	100%
Middle	13	1	0	14
Percent	93%	7%	0%	100%
High	0	0	1	1
Percent	0%	0%	100%	100%
Total	17	2	1	20
Percent	85%	10%	5%	100%

Q13. Do you recall how the importance of the program was communicated to you?

Group	Yes	No	Total
Elementary	3	1	4
Percent	75%	25%	100%
Middle	10	3	13
Percent	77%	23%	100%
High	0	0	0
Percent	0%	0%	100%
Total	13	4	17
Percent	76%	24%	100%

Q14. Thinking back to the school performance, would you say that energy related concepts presented in the performance were:

Group	Far too advanced for most of your students	Somewhat too advanced for most of your students	About right for most of your students	Somewhat too basic for most of your students	Far too basic for most of your students	Other	Don't know	Total
Elementary	0	0	6	0	0	0	0	6
Percent	0%	0%	100%	0%	0%	0%	0%	100%
Middle	0	0	11	3	0	0	0	14
Percent	0%	0%	79%	21%	0%	0%	0%	100%
High	0	0	1	0	0	0	0	1
Percent	0%	0%	100%	0%	0%	0%	0%	100%
Total	0	0	18	3	0	0	0	21
Percent	0%	0%	86%	14%	0%	0%	0%	100%

Q15. What about the performance was too advanced for most of your students?

Open-ended response type; no tabulation available

Q16. What about the performance was too basic for most of your students?

Open-ended response type; no tabulation available

Q17. Were there any concepts that the performance(s) did not cover that SHOULD HAVE BEEN covered?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	0	4	2	6
Percent	**0%**	**67%**	**33%**	**100%**
Middle	2	11	1	14
Percent	**14%**	**79%**	**7%**	**100%**
High	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
Total	3	15	3	21
Percent	**14%**	**71%**	**14%**	**100%**

Q18. What concepts were not covered that SHOULD HAVE BEEN covered?

Open-ended response type; no tabulation available

Q19. Please estimate your student's overall engagement level with the National Theatre for Children performance on the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	2	4	0	6
Percent	**0%**	**0%**	**0%**	**33%**	**67%**	**0%**	**100%**
Middle	0	1	3	4	6	0	14
Percent	**0%**	**7%**	**21%**	**29%**	**43%**	**0%**	**100%**
High	0	0	0	1	0	0	1
Percent	**0%**	**0%**	**0%**	**100%**	**0%**	**0%**	**100%**
Total	0	1	3	7	10	0	21
Percent	**0%**	**5%**	**14%**	**33%**	**48%**	**0%**	**100%**

Q20. Please rate your overall satisfaction with the National Theatre for Children performance on the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	2	4	0	6
Percent	**0%**	**0%**	**0%**	**33%**	**67%**	**0%**	**100%**
Middle	0	0	1	3	10	0	14
Percent	**0%**	**0%**	**7%**	**21%**	**71%**	**0%**	**100%**
High	0	0	0	0	1	0	1
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Total	0	0	1	5	15	0	21
Percent	**0%**	**0%**	**5%**	**24%**	**71%**	**0%**	**100%**

Q21. Please explain why you offered this satisfaction rating

Open-ended response type; no tabulation available

Q22. Did you receive curriculum or instructional materials, such as student workbooks, related to energy and energy conservation from National Theatre for Children for the Fall 2019 - Spring 2020 school year?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	5	1	0	6
Percent	**83%**	**17%**	**0%**	**100%**
Middle	7	7	0	14
Percent	**50%**	**50%**	**0%**	**100%**
High	1	0	0	1
Percent	**100%**	**0%**	**0%**	**100%**
Total	13	8	0	21
Percent	**62%**	**38%**	**0%**	**100%**

Q23. To what degree did you use the curriculum or instructional materials in teaching your students about energy?

Group	Not at all	A little	Moderately	A lot	Extensively	Don't know	Total
Elementary	0	3	2	0	0	0	5
Percent	**0%**	**60%**	**40%**	**0%**	**0%**	**0%**	**100%**
Middle	0	2	5	0	0	0	7
Percent	**0%**	**29%**	**71%**	**0%**	**0%**	**0%**	**100%**
High	0	1	0	0	0	0	1
Percent	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total	0	6	7	0	0	0	13
Percent	**0%**	**46%**	**54%**	**0%**	**0%**	**0%**	**100%**

Q24. Why did you only use the workbooks "a little" in teaching your students about energy?

Open-ended response type; no tabulation available

Q25. Thinking about how the student workbooks explained energy related concepts, would you say that the materials were generally:

Group	Far too advanced for most of your students	Somewhat too advanced for most of your students	About right for most of your students	Somewhat too basic for most of your students	Far too basic for most of your students	Other	Don't know	Refused	Total
Elementary	0	0	5	0	0	0	0	0	5
Percent	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Middle	0	0	5	2	0	0	0	0	7
Percent	**0%**	**0%**	**71%**	**29%**	**0%**	**0%**	**0%**	**0%**	**100%**
High	0	0	1	0	0	0	0	0	1
Percent	**0%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Total	0	0	11	2	0	0	0	0	13
Percent	**0%**	**0%**	**85%**	**15%**	**0%**	**0%**	**0%**	**0%**	**100%**

Q26. Please rate how useful the materials were to you in teaching your students about energy.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	2	1	2	0	5
Percent	**0%**	**0%**	**40%**	**20%**	**40%**	**0%**	**100%**
Middle	0	1	1	5	0	0	7
Percent	**0%**	**14%**	**14%**	**71%**	**0%**	**0%**	**100%**
High	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	0	1	3	6	2	1	13
Percent	**0%**	**8%**	**23%**	**46%**	**15%**	**8%**	**100%**

Q27. Please rate the degree to which the topics in the workbook aligned with your state's science standards for the grade(s) you teach.

Group	Completely aligned	Mostly aligned	Somewhat aligned	Poorly aligned	Not at all aligned	N/A - no science standards for my grade(s)	Don't know	Refused	Total
Elementary	0	1	4	0	0	0	0	0	5
Percent	**0%**	**20%**	**80%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Middle	0	3	4	0	0	0	0	0	7
Percent	**0%**	**43%**	**57%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
High	0	0	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	0	4	8	0	0	0	0	1	13
Percent	**0%**	**31%**	**62%**	**0%**	**0%**	**0%**	**0%**	**8%**	**100%**

Q28. Which topic(s) was or were poorly aligned or not aligned at all with your state's science standards? In what way(s)?

Open-ended response type; no tabulation available

Q29. Were there any concepts covered in the curriculum or instructional materials that your students had challenges with?

Group	Yes	No	Don't Know/ Can't Recall	Refused	Total
Elementary	1	4	0	0	5
Percent	**20%**	**80%**	**0%**	**0%**	**100%**
Middle	0	6	1	0	7
Percent	**0%**	**86%**	**14%**	**0%**	**100%**
High	0	0	1	0	1
Percent	**0%**	**0%**	**100%**	**0%**	**100%**
Total	1	10	2	0	13
Percent	**8%**	**77%**	**15%**	**0%**	**100%**

Q30. What concepts did your students have challenges with?

Open-ended response type; no tabulation available

Q31. Were there any concepts that the materials did not cover that SHOULD HAVE BEEN covered?

Group	Yes	No	Don't Know/ Can't Recall	Refused	Total
Elementary	0	5	0	0	5
Percent	**0%**	**100%**	**0%**	**0%**	**100%**
Middle	1	4	2	0	7
Percent	**14%**	**57%**	**29%**	**0%**	**100%**
High	0	0	1	0	1
Percent	**0%**	**0%**	**100%**	**0%**	**100%**
Total	1	9	3	0	13
Percent	**8%**	**69%**	**23%**	**0%**	**100%**

Q32. What concepts were not covered that SHOULD HAVE BEEN covered?

Open-ended response type; no tabulation available

Q33. Please rate your overall satisfaction with curriculum or instructional materials you received from the National Theatre for Children program using the following scale.

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	2	0	3	0	5
Percent	**0%**	**0%**	**40%**	**0%**	**60%**	**0%**	**100%**
Middle	0	0	2	2	3	0	7
Percent	**0%**	**0%**	**29%**	**29%**	**43%**	**0%**	**100%**
High	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	0	0	4	2	6	1	13
Percent	**0%**	**0%**	**31%**	**15%**	**46%**	**8%**	**100%**

Q34. Do you have any additional input regarding the curriculum or instructional materials received from the National Theatre for Children that you would like to provide, including other things you liked or think could be improved? This might include things like overall presentation, length, level of detail, messaging, or anything else.

Open-ended response type; no tabulation available

Q35. Why did you NOT use the curriculum or instructional materials in teaching your students about energy?

Open-ended response type; no tabulation available

Q36. Did you have any interactions with anyone from the National Theatre for Children regarding the curriculum or instructional materials?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	2	4	0	6
Percent	**33%**	**67%**	**0%**	**100%**
Middle	1	11	2	14
Percent	**7%**	**79%**	**14%**	**100%**
High	0	0	1	1
Percent	**0%**	**0%**	**100%**	**100%**
Total	3	15	3	21
Percent	**14%**	**71%**	**14%**	**100%**

Q37. What did those interactions involve?

Open-ended response type; no tabulation available

Q38. Using the scale provided, how satisfied were you with:

Your interactions with the National Theatre for Children staff, overall

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	0	2	0	2
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Middle	0	0	0	0	1	0	1
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Total	0	0	0	0	3	0	3
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**

The professionalism and courtesy of the National Theatre for Children staff

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	0	2	0	2
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Middle	0	0	0	0	1	0	1
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Total	0	0	0	0	3	0	3
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**

The National Theatre for Children staff's knowledge about the topics you discussed with them

Group	1	2	3	4	5	Don't know	Total
Elementary	0	0	0	0	2	0	2
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Middle	0	0	0	0	1	0	1
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
High	0	0	0	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Total	0	0	0	0	3	0	3
Percent	**0%**	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**

Q39. Did you distribute the kit request form to your students?

Group	Yes - I distributed the workbooks, which included the kit request form	Yes - I distributed the kit request forms separately	No	Don't Recall	Total
Elementary	2	4	0	0	6
Percent	**33%**	**67%**	**0%**	**0%**	**100%**
Middle	3	11	0	0	14
Percent	**21%**	**79%**	**0%**	**0%**	**100%**
High	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**
Total	6	15	0	0	21
Percent	**29%**	**71%**	**0%**	**0%**	**100%**

Q40. On average, about what percentage of your students took the kit request form home?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	1	1	0	0	0	0	1	0	3	0	6
Percent	**0%**	**17%**	**17%**	**0%**	**0%**	**0%**	**0%**	**17%**	**0%**	**50%**	**0%**	**100%**
Middle	0	3	3	0	0	3	0	2	0	3	0	14
Percent	**0%**	**21%**	**21%**	**0%**	**0%**	**21%**	**0%**	**14%**	**0%**	**21%**	**0%**	**100%**
High	0	0	0	0	0	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	0	4	4	0	0	3	0	3	0	6	1	21
Percent	**0%**	**19%**	**19%**	**0%**	**0%**	**14%**	**0%**	**14%**	**0%**	**29%**	**5%**	**100%**

Q41. After students take the kit form home, do you follow up with students later to find out if their parents completed the form?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	2	4	0	6
Percent	**33%**	**67%**	**0%**	**100%**
Middle	8	5	1	14
Percent	**57%**	**36%**	**7%**	**100%**
High	0	1	0	1
Percent	**0%**	**100%**	**0%**	**100%**
Total	10	10	1	21
Percent	**48%**	**48%**	**5%**	**100%**

Q42. About what percentage of your students either brought the kit form back to you to mail, or reported their parents completed and sent the form to Duke Energy to receive their kit?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	2	2	0	1	0	1	0	0	0	0	0	6
Percent	**33%**	**33%**	**0%**	**17%**	**0%**	**17%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**
Middle	6	2	3	1	1	0	0	0	0	0	1	14
Percent	**43%**	**14%**	**21%**	**7%**	**7%**	**0%**	**0%**	**0%**	**0%**	**0%**	**7%**	**100%**
High	0	0	0	0	0	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	8	4	3	2	1	1	0	0	0	0	2	21
Percent	**38%**	**19%**	**14%**	**10%**	**5%**	**5%**	**0%**	**0%**	**0%**	**0%**	**10%**	**100%**

Q43. About what percentage of student families who had signed up for kits signed up on the website?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	1	2	0	0	1	0	0	0	0	1	1	6
Percent	**17%**	**33%**	**0%**	**0%**	**17%**	**0%**	**0%**	**0%**	**0%**	**17%**	**17%**	**100%**
Middle	7	1	2	1	1	0	0	0	0	0	2	14
Percent	**50%**	**7%**	**14%**	**7%**	**7%**	**0%**	**0%**	**0%**	**0%**	**0%**	**14%**	**100%**
High	0	0	0	0	0	0	0	0	0	0	1	1
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**	**100%**
Total	8	3	2	1	2	0	0	0	0	1	4	21
Percent	**38%**	**14%**	**10%**	**5%**	**10%**	**0%**	**0%**	**0%**	**0%**	**5%**	**19%**	**100%**

Q44. Why didn’t you distribute the kit request forms to your students?

Open-ended response type; no tabulation available

Q45. Did the NTC performers or the instructional materials mention the "Kilowatt Krush" app?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	4	0	2	6
Percent	**67%**	**0%**	**33%**	**100%**
Middle	8	3	3	14
Percent	**57%**	**21%**	**21%**	**100%**
High	0	0	1	1
Percent	**0%**	**0%**	**100%**	**100%**
Total	12	3	6	21
Percent	**57%**	**14%**	**29%**	**100%**

Q46. About what percentage of students would you say downloaded and used the app?

Group	0% - 10%	11% - 20%	21% - 30%	31% - 40%	41% - 50%	51% - 60%	61% - 70%	71% - 80%	81% - 90%	91% - 100%	Don't know	Total
Elementary	0	0	1	1	0	0	0	0	0	0	2	4
Percent	**0%**	**0%**	**25%**	**25%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**50%**	**100%**
Middle	3	3	0	1	0	0	0	0	0	0	1	8
Percent	**38%**	**38%**	**0%**	**13%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**13%**	**100%**
High	0	0	0	0	0	0	0	0	0	0	0	0
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Total	3	3	1	2	0	0	0	0	0	0	3	12
Percent	**25%**	**25%**	**8%**	**17%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**25%**	**100%**

Q47. Do you have any suggestions to improve the app or how it was presented to students?

Open-ended response type; no tabulation available

Q48. Did government or organizational responses to COVID-19 offer any challenges for you regarding your participation in this program, other than those you've already discussed? If so, what were they, and how do you think they might best be addressed moving forward?

Open-ended response type; no tabulation available

Q49. Do you have any additional feedback regarding this program or Duke Energy that you would like to provide?

Open-ended response type; no tabulation available

Q50. Would you be willing to participate in an interview, so that we might learn more about you and your students' experience with the program?

Group	Yes	No	Don't Know/ Can't Recall	Total
Elementary	3	2	1	6
Percent	**50%**	**33%**	**17%**	**100%**
Middle	5	7	2	14
Percent	**36%**	**50%**	**14%**	**100%**
High	0	1	0	1
Percent	**0%**	**100%**	**0%**	**100%**
Total	8	10	3	21
Percent	**38%**	**48%**	**14%**	**100%**

F.3 Student Parent Survey - DEC

Q1. This kit included light bulbs, a showerhead, and other items that help you save energy in your home. Do you recall receiving this kit?

	Yes	No	Don't Know	Total
# of responses	300	0	0	300
Percent	**100%**	**0%**	**0%**	**100%**

Q1.1) Were you aware of this program, prior to your child's involvement, due to your work at an elementary, middle or high school?

	Yes	No	Don't Know	Total
# of responses	0	300	0	300
Percent	**0%**	**100%**	**0%**	**100%**

Q2. Before today, did you know the kit you received was sponsored by Duke Energy?

	Yes	No	Don't Know	Total
# of responses	265	29	6	300
Percent	**88%**	**10%**	**2%**	**100%**

Q3. How did you learn that the kit was sponsored by Duke Energy?

	# of responses	Percent
Classroom materials brought home by child	76	**29%**
Classroom materials brought home by child, Information material included in/on the kit	30	**11%**
Classroom materials brought home by child, My child's teacher/school	8	**3%**
Classroom materials brought home by child, My child's teacher/school, Information material included in/on the kit	22	**8%**
Information material included in/on the kit	82	**31%**
My child's teacher/school	26	**10%**
My child's teacher/school, Information material included in/on the kit	7	**3%**
Other	10	**4%**
Don't know	4	**2%**
Refused	0	**0%**
Total	265	**100%**

Q4. How did you hear about the opportunity to receive the kit from Duke Energy?

	# of responses	Percent
After hours event at my child's school	3	1%
Classroom materials brought home by child	140	47%
Classroom materials brought home by child, After hours event at my child's school	1	0%
Classroom materials brought home by child, Email from my child's teacher/school	16	5%
Classroom materials brought home by child, Email from my child's teacher/school, Saw a poster at my child's school	1	0%
Classroom materials brought home by child, Email from my child's teacher/school, School website or school web portal	4	1%
Classroom materials brought home by child, Other	2	1%
Classroom materials brought home by child, Saw a poster at my child's school	1	0%
Classroom materials brought home by child, School newsletter	11	4%
Classroom materials brought home by child, School newsletter, Email from my child's teacher/school	7	2%
Classroom materials brought home by child, School newsletter, Email from my child's teacher/school, In-person conversations with my child's teacher	1	0%
Classroom materials brought home by child, School newsletter, Email from my child's teacher/school, Saw a poster at my child's school	1	0%
Classroom materials brought home by child, School newsletter, Email from my child's teacher/school, School website or school web portal	3	1%
Classroom materials brought home by child, School newsletter, Email from my child's teacher/school, School website or school web portal, In-person conversations with my child's teacher	1	0%
Classroom materials brought home by child, School newsletter, Saw a poster at my child's school	1	0%
Classroom materials brought home by child, School newsletter, School website or school web portal	4	1%
Classroom materials brought home by child, School newsletter, School website or school web portal, In-person conversations with my child's teacher	1	0%
Classroom materials brought home by child, School website or school web portal	2	1%
Email from my child's teacher/school	19	6%
Email from my child's teacher/school, Other	1	0%
Email from my child's teacher/school, School website or school web portal	5	2%
Email from my child's teacher/school, School website or school web portal, Other	1	0%
In-person conversations with my child's teacher	3	1%
Saw a poster at my child's school	1	0%
School newsletter	9	3%
School newsletter, Email from my child's teacher/school	3	1%

	# of responses	Percent
School newsletter, Email from my child's teacher/school, Other	1	**0%**
School newsletter, Saw a poster at my child's school	1	**0%**
School newsletter, School website or school web portal	1	**0%**
School website or school web portal	12	**4%**
Other	16	**5%**
Don't know	27	**9%**
Refused	0	**0%**
Total	300	**100%**

Q4b. How did you request your kit?

	Program's website	Sign-up form in the classroom materials my child brought home	By calling the toll-free number	Via the "Kilowatt Krush" app on my smartphone	Don't know	Refused	Total
# of responses	197	57	12	4	29	1	300
Percent	**66%**	**19%**	**4%**	**1%**	**10%**	**0.3%**	**100%**

Q4c. Has your child used the "Kilowatt Krush" app on any smartphone in your household?

	Yes	No	Don't Know	Refused	Total
# of responses	25	228	47	0	300
Percent	**8%**	**76%**	**16%**	**0%**	**100%**

Q4d. About how often would you say that your child uses the "Kilowatt Krush" app?

	They used it once	They used it a few times	They use it daily	They use it weekly	Other	Don't know	Refused	Total
# of responses	1	18	1	3	0	2	0	25
Percent	**4%**	**72%**	**4%**	**12%**	**0%**	**8%**	**0%**	**100%**

Q4e. Have you noticed your child engaging in energy saving behaviors you can attribute to their use of the "Kilowatt Krush" app?

	Yes	No	Don't Know	Total
# of responses	14	6	5	25
Percent	**56%**	**24%**	**20%**	**100%**

Q4f. Do you have any feedback that might help improve the "Kilowatt Krush" app?

	Yes	No	Don't Know	Refused	Total
# of responses	0	22	3	0	25
Percent	**0%**	**88%**	**12%**	**0%**	**100%**

Q5. Did you read any of the Energy Savers booklet that came in the kit?

	Yes	No	Don't Know	Refused	Total
# of responses	205	70	25	0	300
Percent	**68%**	**23%**	**8%**	**0%**	**100%**

Q6. On a scale from 0 to 10 where 0 is not at all helpful and 10 is very helpful, how helpful was the Energy Savers booklet in identifying ways your household could save energy at home?

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	0	0	3	5	14	25	22	43	17	74	2	0	205
Percent	**0%**	**0%**	**0%**	**1%**	**2%**	**7%**	**12%**	**11%**	**21%**	**8%**	**36%**	**1%**	**0%**	**100%**

Q7. What might have made the information more helpful?

	Provided response	Don't Know	Refused	Total
# of responses	17	30	0	47
Percent	**36%**	**64%**	**0%**	**100%**

Q8. In addition to sending the energy saving kits, Duke Energy sponsored a program about energy and energy efficiency at your child's school, which included classroom materials and in in-school performance by the National Theatre for Children. Were you aware of the program before today?

	Yes	No	Don't Know	Refused	Total
# of responses	78	210	12	0	300
Percent	**26%**	**70%**	**4%**	**0%**	**100%**

Q9. From who or where did you hear about this program?

	From a teacher/school administrator	From my child/children	From my child/children, From a teacher/school administrator	From my child/children, On Duke Energy Website	On Duke Energy Website	Other	Don't know	Refused	Total
# of responses	15	43	10	1	6	2	1	0	78
Percent	**19%**	**55%**	**13%**	**1%**	**8%**	**3%**	**1%**	**0%**	**100%**

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later?

	Yes	No	Don't Know	Refused	Total
# of responses	258	42	0	0	300
Percent	**86%**	**14%**	**0%**	**0%**	**100%**

Q11. Which of the items did you install, even if they were taken out later?

Q11a. Showerhead

	Yes	No	Don't Know	Refused	Total
# of responses	123	3	0	258	123
Percent	**48%**	**1%**	**0%**	**100%**	**48%**

Q11b. Kitchen faucet aerator

	Yes	No	Don't Know	Refused	Total
# of responses	121	128	9	0	258
Percent	**47%**	**50%**	**3%**	**0%**	**100%**

Q11c. Bathroom faucet aerator

	Yes	No	Don't Know	Refused	Total
# of responses	122	131	5	0	258
Percent	**47%**	**51%**	**2%**	**0%**	**100%**

Q11d. Night light

	Yes	No	Don't Know	Refused	Total
# of responses	229	27	2	0	258
Percent	**89%**	**10%**	**1%**	**0%**	**100%**

Q11e. Energy efficient light bulb(s)

	Yes	No	Don't Know	Refused	Total
# of responses	254	4	0	0	258
Percent	**98%**	**2%**	**0%**	**0%**	**100%**

Q11f. Insulator gaskets for light switches and electricity outlets

	Yes	No	Don't Know	Refused	Total
# of responses	93	145	20	0	258
Percent	**36%**	**56%**	**8%**	**0%**	**100%**

Q12. In addition to the night light, there were two LED light bulbs in the kit. Did you install one or both LED light bulbs in the kit?

	I installed both LEDs	I installed only one LED bulb	Don't Know	Refused	Total
# of responses	231	19	4	0	254
Percent	**91%**	**7%**	**2%**	**0%**	**100%**

Q13. How many of the light switch and electric outlet gasket insulators from the kit did you, or someone else, install in your home?

	None	1	2	3	4	5	6	7	8	9	10	11	12	Don't know	Refused	Total
# of responses	1	13	23	11	6	4	7	0	3	1	0	0	8	16	0	93
Percent	**1%**	**14%**	**25%**	**12%**	**6%**	**4%**	**8%**	**0%**	**3%**	**1%**	**0%**	**0%**	**9%**	**17%**	**0%**	**100%**

Q14. Overall, how satisfied are you with the item[s] you installed? Please use 0 to 10 scales, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...?

Q14a. Showerhead

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	1	1	0	7	8	9	13	13	79	0	0	132
Percent	**1%**	**0%**	**1%**	**1%**	**0%**	**5%**	**6%**	**7%**	**10%**	**10%**	**60%**	**0%**	**0%**	**100%**

Q14b. Kitchen faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	0	2	2	5	5	7	9	11	76	2	1	121
Percent	**1%**	**0%**	**0%**	**2%**	**2%**	**4%**	**4%**	**6%**	**7%**	**9%**	**63%**	**2%**	**1%**	**100%**

Q14c. Bathroom faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	2	1	0	3	6	3	7	13	10	6	70	1	0	122
Percent	**2%**	**1%**	**0%**	**2%**	**5%**	**2%**	**6%**	**11%**	**8%**	**5%**	**57%**	**1%**	**0%**	**100%**

Q14d. Night light

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	0	1	2	6	5	17	20	19	158	0	0	229
Percent	**0%**	**0%**	**0%**	**0%**	**1%**	**3%**	**2%**	**7%**	**9%**	**8%**	**69%**	**0%**	**0%**	**100%**

Q14e. Energy efficient light bulb(s)

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	1	1	1	3	4	16	18	30	178	1	0	254
Percent	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**2%**	**6%**	**7%**	**12%**	**70%**	**0%**	**0%**	**100%**

Q14f. Insulator gaskets for light switches and electricity outlets

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	1	0	0	0	6	3	7	8	6	57	5	0	93
Percent	**0%**	**1%**	**0%**	**0%**	**0%**	**6%**	**3%**	**8%**	**9%**	**6%**	**61%**	**5%**	**0%**	**100%**

Q14.1 Can you please explain any dissatisfaction you had with the [X item]

Q14.1a) Showerhead

Open-ended response type; no tabulation available

Q14.1b) Kitchen faucet aerator

Open-ended response type; no tabulation available

Q14.1c) Bathroom faucet aerator

Open-ended response type; no tabulation available

Q14.1d) Night light

Open-ended response type; no tabulation available

Q14.1e) Energy efficient light bulb(s)

Open-ended response type; no tabulation available

Q14.1f) Insulator gaskets for light switches and electricity outlets

Open-ended response type; no tabulation available

Q15. Have you since uninstalled any of the items from the kit that you had previously installed?

	Yes	No	Don't Know	Refused	Total
# of responses	39	211	8	0	258
Percent	**15%**	**82%**	**3%**	**0%**	**100%**

Q16. Which of the items did you uninstall?

	# of responses	Percent
Bathroom faucet aerator	5	**13%**
Energy efficient light bulbs	1	**3%**
Kitchen faucet aerator	9	**23%**
Kitchen faucet aerator, Bathroom faucet aerator	2	**5%**
Kitchen faucet aerator, Night light	1	**3%**
Night light	4	**10%**
Showerhead	8	**21%**
Showerhead, Bathroom faucet aerator	1	**3%**
Showerhead, Kitchen faucet aerator	3	**8%**
Showerhead, Kitchen faucet aerator, Bathroom faucet aerator	2	**5%**
Showerhead, Kitchen faucet aerator, Bathroom faucet aerator, Insulator Gaskets	1	**3%**
Don't know	1	**3%**
Refused	1	**3%**
Total	39	**100%**

Q17. Why were those items uninstalled? Let's start with...

Q17a. Showerhead

	It was broken	I didn't like how it looked	I didn't like how it worked	I didn't like how it worked, Other	Other	Don't know	Refused	Total
# of responses	0	1	11	1	2	0	0	15
Percent	**0%**	**7%**	**73%**	**7%**	**13%**	**0%**	**0%**	**100%**

Q17b. Kitchen faucet aerator

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	8	2	8	0	0	18
Percent	**0%**	**44%**	**11%**	**44%**	**0%**	**0%**	**100%**

Q17c. Bathroom faucet aerator

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	8	1	2	0	0	11
Percent	**0%**	**73%**	**9%**	**18%**	**0%**	**0%**	**100%**

Q17d. Night light

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	1	0	1	3	0	0	5
Percent	**20%**	**0%**	**20%**	**60%**	**0%**	**0%**	**100%**

Q17e. Energy efficient light bulb(s)

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	1	0	0	0	0	1
Percent	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**

Q17f. Insulator gaskets for light switches and electricity outlets

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	1	0	0	0	0	1
Percent	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**100%**

Q18. You said you haven't installed [X items]. Which of those items did you plan to install in the next three months?

	# of responses	Percent
Bathroom faucet aerator	11	**4%**
Bathroom faucet aerator, Energy efficient light bulbs	1	**0%**
Bathroom faucet aerator, Insulator Gaskets	4	**1%**
Bathroom faucet aerator, Night light	2	**1%**
Bathroom faucet aerator, Night light, Energy efficient light bulbs	1	**0%**
Energy efficient light bulbs	6	**2%**
Insulator Gaskets	25	**9%**
Kitchen faucet aerator	12	**4%**
Kitchen faucet aerator, Bathroom faucet aerator	4	**1%**
Kitchen faucet aerator, Bathroom faucet aerator, Insulator Gaskets	3	**1%**
Kitchen faucet aerator, Bathroom faucet aerator, Night light, Energy efficient light bulbs	1	**0%**
Kitchen faucet aerator, Insulator Gaskets	1	**0%**
Kitchen faucet aerator, Night light, Energy efficient light bulbs	1	**0%**
Night light	8	**3%**
Night light, Energy efficient light bulbs	10	**4%**
Night light, Energy efficient light bulbs, Insulator Gaskets	2	**1%**
Showerhead	14	**5%**
Showerhead, Bathroom faucet aerator	1	**0%**
Showerhead, Energy efficient light bulbs	2	**1%**
Showerhead, Kitchen faucet aerator	1	**0%**
Showerhead, Kitchen faucet aerator, Bathroom faucet aerator	1	**0%**
Showerhead, Kitchen faucet aerator, Bathroom faucet aerator, Energy efficient light bulbs, Insulator Gaskets	1	**0%**

	# of responses	Percent
Showerhead, Kitchen faucet aerator, Bathroom faucet aerator, Night light, Energy efficient light bulbs, Insulator Gaskets	4	**1%**
Showerhead, Kitchen faucet aerator, Night light	2	**1%**
Showerhead, Night light	2	**1%**
Showerhead, Night light, Energy efficient light bulbs	1	**0%**
None	148	**55%**
Don't know	0	**0%**
Refused	1	**0%**
Total	270	**100%**

Q19. What's preventing you from installing them? Let's start with...

Q19a. Showerhead

	# of responses	Percent
Already have efficient showerhead	33	**24%**
Current one is still working	26	**19%**
Current one is still working; Already have efficient showerhead	12	**9%**
Current one is still working; Don't have the items any longer (threw away, gave away)	1	**1%**
Current one is still working; Don't have the items any longer (threw away, gave away); Already have efficient showerhead	1	**1%**
Current one is still working; Other, (please specify:___)	1	**1%**
Current one is still working; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it; Already have efficient showerhead	1	**1%**
Current one is still working; Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Didn't know what that was	3	**2%**
Didn't know what that was; Haven't gotten around to it	1	**1%**
Didn't know what that was; Haven't gotten around to it; Current one is still working	1	**1%**
Didn't know what that was; Other, (please specify:___)	1	**1%**
Didn't know what that was; Too difficult to install it, don't know how to do it	1	**1%**
Don't have the tools I need	1	**1%**
Haven't gotten around to it	11	**8%**
Haven't gotten around to it; Already have efficient showerhead	2	**1%**
Haven't gotten around to it; Current one is still working; Already have efficient showerhead	2	**1%**
Other, (please specify:___)	14	**10%**
Takes too much time to install/No time/Too busy	2	**1%**
Too difficult to install it, don't know how to do it	1	**1%**
Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Tried it, didn't fit	11	**8%**
Tried it, didn't fit; Already have efficient showerhead	1	**1%**
Tried it, didn't fit; Current one is still working; Already have efficient showerhead	1	**1%**
Tried it, didn't fit; Current one is still working; Takes too much time to install/No time/Too busy; Already have efficient showerhead	1	**1%**
Tried it, didn't fit; Haven't gotten around to it; Current one is still working; Already have efficient showerhead	1	**1%**
Tried it, didn't work as intended	3	**2%**
Don't know	1	**1%**
Refused	0	**0%**
Total	136	**100%**

Q19b. Kitchen faucet aerator

	# of responses	Percent
Already have efficient kitchen faucet aerator	33	**24%**
Current one is still working	20	**14%**
Current one is still working; Already have efficient kitchen faucet aerator	5	**4%**
Current one is still working; Don't have the items any longer (threw away, gave away); Already have efficient kitchen faucet aerator	1	**1%**
Didn't know what that was	13	**9%**
Didn't know what that was; Already have efficient kitchen faucet aerator	1	**1%**
Didn't know what that was; Current one is still working; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it	1	**1%**
Didn't know what that was; Haven't gotten around to it	3	**2%**
Didn't know what that was; Haven't gotten around to it; Current one is still working	1	**1%**
Don't have the items any longer (threw away, gave away)	2	**1%**
Don't have the tools I need	1	**1%**
Don't have the tools I need; Other, (please specify:___)	1	**1%**
Haven't gotten around to it	11	**8%**
Haven't gotten around to it; Current one is still working	1	**1%**
Takes too much time to install/No time/Too busy	1	**1%**
Too difficult to install it, don't know how to do it	2	**1%**
Too difficult to install it, don't know how to do it; Don't have the tools I need	2	**1%**
Tried it, didn't fit	20	**14%**
Tried it, didn't fit; Don't have the items any longer (threw away, gave away)	1	**1%**
Tried it, didn't fit; Too difficult to install it, don't know how to do it	1	**1%**
Tried it, didn't work as intended	1	**1%**
Other, (please specify:___)	15	**11%**
Don't know	2	**1%**
Refused	0	**0%**
Total	139	**100%**

Q19c. Bathroom faucet aerator

	# of responses	Percent
Already have efficient bathroom faucet aerators	27	**19%**
Current one is still working	17	**12%**
Current one is still working; Already have efficient bathroom faucet aerators	4	**3%**
Current one is still working; Don't have the items any longer (threw away, gave away); Already have efficient bathroom faucet aerators	1	**1%**
Didn't know what that was	11	**8%**
Didn't know what that was; Haven't gotten around to it	4	**3%**
Didn't know what that was; Haven't gotten around to it; Current one is still working	1	**1%**
Didn't know what that was; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Didn't know what that was; Too difficult to install it, don't know how to do it	1	**1%**
Didn't know what that was; Tried it, didn't fit; Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it	1	**1%**
Don't have the items any longer (threw away, gave away)	2	**1%**
Don't have the tools I need	2	**1%**
Haven't gotten around to it	20	**14%**
Takes too much time to install/No time/Too busy	1	**1%**
Takes too much time to install/No time/Too busy; Don't have the tools I need	1	**1%**
Too difficult to install it, don't know how to do it	3	**2%**
Too difficult to install it, don't know how to do it; Already have efficient bathroom faucet aerators	1	**1%**
Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Tried it, didn't fit	22	**16%**
Tried it, didn't fit; Don't have the items any longer (threw away, gave away)	1	**1%**
Tried it, didn't fit; Other, (please specify:___)	2	**1%**
Tried it, didn't fit; Too difficult to install it, don't know how to do it	1	**1%**
Other, (please specify:___)	9	**6%**
Don't know	5	**4%**
Refused	0	**0%**
Total	139	**100%**

Q19d. Night light

	# of responses	Percent
Current one is still working	6	**17%**
Didn't know what that was	2	**6%**
Haven't gotten around to it	11	**31%**
Haven't gotten around to it; Current one is still working; Too difficult to install it, don't know how to do it	1	**3%**
Haven't gotten around to it; Too difficult to install it, don't know how to do it	1	**3%**
Takes too much time to install/No time/Too busy	1	**3%**
Other, (please specify:___)	7	**20%**
Don't know	5	**14%**
Refused	1	**3%**
Total	35	**100%**

Q19e. Energy efficient light bulb(s)

	# of responses	Percent
Already have LEDs	2	**13%**
Current one is still working	2	**13%**
Current one is still working; Already have LEDs	1	**6%**
Didn't know what that was	1	**6%**
Haven't gotten around to it	2	**13%**
Takes too much time to install/No time/Too busy	1	**6%**
Tried it, didn't fit	1	**6%**
Other, (please specify:___)	4	**25%**
Don't know	2	**13%**
Refused	0	**0%**
Total	16	**100%**

Q19f. Insulator gaskets

	# of responses	Percent
Current one is still working	15	**10%**
Didn't know what that was	42	**29%**
Didn't know what that was; Haven't gotten around to it	9	**6%**
Didn't know what that was; Haven't gotten around to it; Current one is still working; Too difficult to install it, don't know how to do it	1	**1%**
Didn't know what that was; Other, (please specify:___)	1	**1%**
Didn't know what that was; Too difficult to install it, don't know how to do it	2	**1%**
Don't have the items any longer (threw away, gave away)	2	**1%**
Haven't gotten around to it	33	**22%**
Haven't gotten around to it; Current one is still working	1	**1%**
Haven't gotten around to it; Takes too much time to install/No time/Too busy	1	**1%**
Takes too much time to install/No time/Too busy	2	**1%**
Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it	1	**1%**
Too difficult to install it, don't know how to do it	7	**5%**
Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Tried it, didn't fit	6	**4%**
Tried it, didn't work as intended	1	**1%**
Other, (please specify:___)	7	**5%**
Don't know	14	**10%**
Refused	1	**1%**
Total	147	**100%**

Q20. Thinking of the items you installed, would you be interested in receiving any more of them from Duke Energy? If so, which ones?

	# of responses	Percent
Bathroom faucet aerator; Night lights; Energy efficient light bulbs	5	**2%**
Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	1	**0%**
Energy efficient light bulbs	42	**16%**
Energy efficient light bulbs; Insulator Gaskets	8	**3%**
Insulator Gaskets	1	**0%**
Kitchen faucet aerator	1	**0%**
Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs	1	**0%**
Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs	5	**2%**
Kitchen faucet aerator; Night lights	1	**0%**
Kitchen faucet aerator; Night lights; Energy efficient light bulbs	3	**1%**
Night lights	12	**5%**
Night lights; Energy efficient light bulbs	87	**34%**
Night lights; Energy efficient light bulbs; Insulator Gaskets	13	**5%**
Night lights; Insulator Gaskets	3	**1%**
Showerhead	3	**1%**
Showerhead; Bathroom faucet aerator; Energy efficient light bulbs; Insulator Gaskets	1	**0%**
Showerhead; Bathroom faucet aerator; Night lights; Energy efficient light bulbs	2	**1%**
Showerhead; Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	1	**0%**
Showerhead; Energy efficient light bulbs	8	**3%**
Showerhead; Energy efficient light bulbs; Insulator Gaskets	1	**0%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs	2	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs; Insulator Gaskets	1	**0%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night lights	1	**0%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs	12	**5%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	7	**3%**
Showerhead; Kitchen faucet aerator; Energy efficient light bulbs	2	**1%**
Showerhead; Kitchen faucet aerator; Night lights; Energy efficient light bulbs	4	**2%**
Showerhead; Night lights	4	**2%**
Showerhead; Night lights; Energy efficient light bulbs	12	**5%**
Showerhead; Night lights; Energy efficient light bulbs; Insulator Gaskets	3	**1%**
No, I am not interested in receiving any more of the items	7	**3%**
Don't know	4	**2%**
Refused	0	**0%**

	# of responses	Percent
Total	258	100%

Q21. What would be your preferred way to request these additional items?

	# of responses	Percent
Internet	177	72%
Internet; Pre-paid postcard	23	9%
Internet; Pre-paid postcard; Other	1	0%
Internet; Telephone	6	2%
Internet; Telephone; Pre-paid postcard	7	3%
Pre-paid postcard	20	8%
Pre-paid postcard; Other	1	0%
Telephone	5	2%
Other	3	1%
Don't know	4	2%
Refused	0	0%
Total	247	100%

Q22. On average, what is the typical shower length in your household?

	# of responses	Percent
One minute or less	0	0%
Two to four minutes	4	3%
Five to eight minutes	44	38%
Nine to twelve minutes	24	21%
Thirteen to fifteen minutes	24	21%
Sixteen to twenty minutes	13	11%
Twenty-one to thirty minutes	5	4%
More than thirty minutes	2	2%
Don't know	1	1%
Refused	0	0%
Total	117	100%

Q23. Thinking of the efficient showerhead currently installed on your home: on average, how many showers per day are taken in this shower?

	Fewer than 1	1	2	3	4	5	6	7	8	Don't know	Refused	Total
# of responses	1	18	47	24	14	7	4	1	1	0	0	117
Percent	1%	15%	40%	21%	12%	6%	3%	1%	1%	0%	0%	100%

Q24. You said you installed the night light. Did the night light replace an existing night light?

	Yes	No	Don't Know	Refused	Total
# of responses	121	103	0	0	224

	Yes	No	Don't Know	Refused	Total
Percent	**54%**	**46%**	**0%**	**0%**	**100%**

Q25. Did the old nightlight have a bulb that you could take out and replace once it burned out?

	Yes	No	Don't Know	Refused	Total
# of responses	74	38	9	0	121
Percent	**61%**	**31%**	**7%**	**0%**	**100%**

Q26. You said you installed at least one of the energy efficient lights. What type of bulb(s) did you replace with the energy efficient lightbulbs?

	All incandescent	All halogen	All CFL	All LED	Some combination	Don't Know	Refused	Total
# of responses	111	15	74	33	4	16	0	253
Percent	**44%**	**6%**	**29%**	**13%**	**2%**	**6%**	**0%**	**100%**

Q27. In what rooms did you install the energy efficient lightbulbs that were included in the kit?

	# of responses	Percent
Bathroom	17	**7%**
Bathroom; Hallway	5	**2%**
Bedroom	25	**10%**
Bedroom; Basement	1	**0%**
Bedroom; Bathroom	12	**5%**
Bedroom; Den	1	**0%**
Bedroom; Garage	1	**0%**
Bedroom; Hallway	2	**1%**
Bedroom; Kitchen	4	**2%**
Den	1	**0%**
Den; Outdoors	1	**0%**
Dining Room	6	**2%**
Dining Room; Bedroom	6	**2%**
Dining Room; Kitchen	2	**1%**
Garage	1	**0%**
Hallway	3	**1%**
Kitchen	5	**2%**
Kitchen; Bathroom	10	**4%**
Kitchen; Den	1	**0%**
Kitchen; Hallway	1	**0%**
Living Room	41	**16%**
Living Room; Bathroom	7	**3%**
Living Room; Bedroom	51	**20%**
Living Room; Den	4	**2%**
Living Room; Dining Room	21	**8%**
Living Room; Hallway	1	**0%**
Living Room; Kitchen	13	**5%**
Living Room; Other area	1	**0%**
Don't know	8	**3%**
Refused	1	**0%**
Total	253	**100%**

Q28. Have you adjusted the temperature of your water heater based on the Hot Water Gauge Card included in your kit?

	Yes	No	Don't recall seeing the Hot Water Gauge Card	Don't Know	Refused	Total
# of responses	45	168	77	9	1	300
Percent	15%	56%	26%	3%	0%	100%

Q29. Do you know what the old temperature setting on your hot water heater was?

	Yes	No	Total
# of responses	12	33	45
Percent	27%	73%	100%

Q30. And what was the new temperature setting you set your hot water heater to?

	Provided response	Don't Know	Total
# of responses	12	33	45
Percent	27%	73%	100%

Q31. Is the new water heater temperature setting still in place?

	Yes	No	Don't Know	Refused	Total
# of responses	35	3	7	0	45
Percent	78%	7%	16%	0%	100%

Q32. Why did you change the water heater temperature a second time?

No responses given

Q33. What is the fuel type of your water heater?

	Electricity	Natural Gas	Other	Don't Know	Refused	Total
# of responses	181	110	0	8	1	300
Percent	60%	37%	0%	3%	0%	100%

Q34. How old is your water heater?

	Less than 5 years old	5 to 9 years old	10 to 15 years old	More than 15 years old	Don't Know	Refused	Total
# of responses	95	70	45	26	64	0	300
Percent	32%	23%	15%	9%	21%	0%	100%

Q35. If you had not received the free efficiency items in the kit, how likely is is that you would have purchased and installed any of these same items within the next six months?

Q35a. Showerhead

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	51	6	6	6	10	10	3	4	1	3	15	2	0	117
Percent	**44%**	**5%**	**5%**	**5%**	**9%**	**9%**	**3%**	**3%**	**1%**	**3%**	**13%**	**2%**	**0%**	**100%**

Q35b. Kitchen faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	50	7	5	6	6	8	4	3	2	1	10	1	0	103
Percent	**49%**	**7%**	**5%**	**6%**	**6%**	**8%**	**4%**	**3%**	**2%**	**1%**	**10%**	**1%**	**0%**	**100%**

Q35c. Bathroom faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	56	8	6	2	5	7	6	3	4	3	10	1	0	111
Percent	**50%**	**7%**	**5%**	**2%**	**5%**	**6%**	**5%**	**3%**	**4%**	**3%**	**9%**	**1%**	**0%**	**100%**

Q35d. Night light

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	84	11	10	9	6	26	10	18	10	7	29	4	0	224
Percent	**38%**	**5%**	**4%**	**4%**	**3%**	**12%**	**4%**	**8%**	**4%**	**3%**	**13%**	**2%**	**0%**	**100%**

Q35e. Energy efficient light bulb(s)

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	46	5	4	9	4	21	16	21	22	13	89	3	0	253
Percent	**18%**	**2%**	**2%**	**4%**	**2%**	**8%**	**6%**	**8%**	**9%**	**5%**	**35%**	**1%**	**0%**	**100%**

Q35f. Insulator gaskets for light switches and electricity outlets

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	51	8	2	3	2	9	1	5	2	2	6	1	0	92
Percent	**55%**	**9%**	**2%**	**3%**	**2%**	**10%**	**1%**	**5%**	**2%**	**2%**	**7%**	**1%**	**0%**	**100%**

Q36. If you had not received them for free in the kit, how many LED light bulbs would you have purchased?

	One	Two	Don't Know	Refused	Total
# of responses	1	53	43	0	97
Percent	1%	55%	44%	0%	100%

Q37. Now, thinking about the water savings items that were provided in the kit - using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how influential were the following factors on your decision to install the water saving items from the kit? How influential was...

Q37a. The fact that the items were free

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	9	1	0	1	2	11	9	9	15	13	98	0	2	0	170
Percent	5%	1%	0%	1%	1%	6%	5%	5%	9%	8%	58%	0%	1%	0%	100%

Q37b. The fact that the items were mailed to your house

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	4	0	1	0	2	9	5	11	15	12	108	0	3	0	170
Percent	2%	0%	1%	0%	1%	5%	3%	6%	9%	7%	64%	0%	2%	0%	100%

Q37c. Information in the kit about how the items would save energy

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	4	1	2	4	2	10	5	9	17	17	98	0	1	0	170
Percent	2%	1%	1%	2%	1%	6%	3%	5%	10%	10%	58%	0%	1%	0%	100%

Q37d. Information that your child brought home from school

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	15	0	3	2	3	10	8	13	19	15	77	3	2	0	170
Percent	9%	0%	2%	1%	2%	6%	5%	8%	11%	9%	45%	2%	1%	0%	100%

Q37e. Other information or advertisements from Duke Energy, including its website

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	14	1	3	4	5	21	8	14	15	13	70	1	1	0	170
Percent	8%	1%	2%	2%	3%	12%	5%	8%	9%	8%	41%	1%	1%	0%	100%

Q38. Using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how influential were the following factors in your decision to install the lightbulbs from the kit? How influential was...

Q38a. The fact that the items were free

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	9	1	1	1	5	16	7	11	10	20	172	0	0	0	253
Percent	4%	0%	0%	0%	2%	6%	3%	4%	4%	8%	68%	0%	0%	0%	100%

Q38b. The fact that the items were mailed to your house

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	5	0	1	1	1	16	4	11	17	17	179	0	0	1	253
Percent	2%	0%	0%	0%	0%	6%	2%	4%	7%	7%	71%	0%	0%	0%	100%

Q38c. Information in the kit about how the items would save energy

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	14	0	1	3	6	15	13	21	18	20	141	0	1	0	253
Percent	6%	0%	0%	1%	2%	6%	5%	8%	7%	8%	56%	0%	0%	0%	100%

Q38d. Information that your child brought home from school

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	20	1	1	4	11	20	13	19	25	19	111	5	4	0	253
Percent	8%	0%	0%	2%	4%	8%	5%	8%	10%	8%	44%	2%	2%	0%	100%

Q38e. Other information or advertisements from Duke Energy, including its website

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	26	3	2	5	9	28	19	23	16	19	94	4	4	1	253
Percent	10%	1%	1%	2%	4%	11%	8%	9%	6%	8%	37%	2%	2%	0%	100%

Q39. Since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy, has your child adopted any new behaviors to help save energy in your home? This would only include new energy saving behaviors that your child adopted since receiving the kit.

	# of responses	Percent
Not applicable - no new behaviors	67	**22%**
Taking shorter showers	6	**2%**
Turning off electronics when not using them	13	**4%**
Turning off electronics when not using them; Taking shorter showers	3	**1%**
Turning off lights when not in a room	54	**18%**
Turning off lights when not in a room; Taking shorter showers	11	**4%**
Turning off lights when not in a room; Turning off electronics when not using them	83	**28%**
Turning off lights when not in a room; Turning off electronics when not using them; Other	2	**1%**
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers	42	**14%**
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers; Other	1	**0%**
Other	6	**2%**
Don't know	12	**4%**
Refused	0	**0%**
Total	300	**100%**

Q39b. Before receiving the kit, was your child already...

39b.2) Turning off lights when not in a room

	Yes	No	Don't Know	Refused	Total
# of responses	65	124	4	0	193
Percent	**34%**	**64%**	**2%**	**0%**	**100%**

39b.3) Turning off electronics when not using them

	Yes	No	Don't Know	Refused	Total
# of responses	40	99	5	0	144
Percent	**28%**	**69%**	**3%**	**0%**	**100%**

39b.4) Taking shorter showers

	Yes	No	Don't Know	Refused	Total
# of responses	18	45	0	0	63
Percent	**29%**	**71%**	**0%**	**0%**	**100%**

39b.5) "Other" reasons

	Yes	No	Don't Know	Refused	Total
# of responses	3	4	2	0	9
Percent	**33%**	**44%**	**22%**	**0%**	**100%**

Q40. Since receiving your energy kit from Duke Energy, have you adopted or increased any behaviors to help save energy in your home?

	# of responses	Percent
Changing thermostat settings so heating or cooling system uses less energy	12	**4%**
Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers; Turning water heat thermostat down	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	4	**1%**
Changing thermostat settings so heating or cooling system uses less energy; Turning water heat thermostat down	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning Taking shorter showers	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning Turning off electronics when not using them	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	1	**0%**
Taking shorter showers	3	**1%**
Turning off air conditioning when not home	3	**1%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	1	**0%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Turning water heat thermostat down	1	**0%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	1	**0%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers	2	**1%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	1	**0%**
Turning off electronics when not using them	2	**1%**
Turning off electronics when not using them; Taking shorter showers	1	**0%**
Turning off electronics when not using them; Turning water heat thermostat down	1	**0%**
Turning off furnace when not home	1	**0%**
Turning off furnace when not home; Turning off air conditioning when not home	1	**0%**

	# of responses	Percent
Turning off lights when not in a room	21	7%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy	10	3%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	2	1%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	14	5%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	5	2%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Turning water heat thermostat down	2	1%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	5	2%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Other	1	0%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers	1	0%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	15	5%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	12	4%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	3	1%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	3	1%
Turning off lights when not in a room; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	3	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	3	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	5	2%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Other	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	3	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Turning off electronics when not using them	4	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Taking shorter showers	1	0%

	# of responses	Percent
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	2	1%
Turning off lights when not in a room; Turning off electronics when not using them	9	3%
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	3	1%
Turning off lights when not in a room Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	5	2%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	6	2%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	4	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	8	3%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down; Other	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Using fans instead of air conditioning	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Using fans instead of air conditioning	1	0%
Turning off lights when not in a room; Using fans instead of air conditioning; Turning off electronics when not using them	2	1%
Turning off lights when not in a room; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%

	# of responses	Percent
Turning water heat thermostat down	2	**1%**
Using fans instead of air conditioning	2	**1%**
Using fans instead of air conditioning; Turning off electronics when not using them	3	**1%**
Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	2	**1%**
Not applicable - no new behaviors	55	**18%**
Other	3	**1%**
Don't know	6	**2%**
Refused	1	**0%**
Total	300	**100%**

Q40b. Before receiving the kit, were you already...

40b.2) Turning off lights when not in a room

	Yes	No	Don't Know	Refused	Total
# of responses	137	45	3	0	185
Percent	**74%**	**24%**	**2%**	**0%**	**100%**

40b.3) Turning off furnace when not home

	Yes	No	Don't Know	Refused	Total
# of responses	27	18	1	0	46
Percent	**59%**	**39%**	**2%**	**0%**	**100%**

40b.4) Turning off air conditioning when not home

	Yes	No	Don't Know	Refused	Total
# of responses	45	32	0	0	77
Percent	**58%**	**42%**	**0%**	**0%**	**100%**

40b.5) Changing thermostat settings so heating or cooling system uses less energy

	Yes	No	Don't Know	Refused	Total
# of responses	84	75	1	0	160
Percent	**53%**	**47%**	**1%**	**0%**	**100%**

40b.6) Using fans instead of air conditioning

	Yes	No	Don't Know	Refused	Total
# of responses	66	38	2	0	106
Percent	62%	36%	2%	0%	100%

40b.7) Turning off electronics when not using them

	Yes	No	Don't Know	Refused	Total
# of responses	83	62	2	0	147
Percent	56%	42%	1%	0%	100%

40b.8) Taking shorter showers

	Yes	No	Don't Know	Refused	Total
# of responses	20	49	1	0	70
Percent	29%	70%	1%	0%	100%

40b.9) Turning water heat thermostat down

	Yes	No	Don't Know	Refused	Total
# of responses	9	19	1	0	29
Percent	31%	66%	3%	0%	100%

40b.10) Other

	Yes	No	Don't Know	Refused	Total
# of responses	5	1	0	0	6
Percent	83%	17%	0%	0%	100%

Q41. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did Duke Energy's kit and materials on saving energy have on this change of energy using behaviors?

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	7	4	2	5	7	24	20	28	35	21	79	3	0	235
Percent	3%	2%	1%	2%	3%	10%	9%	12%	15%	9%	34%	1%	0%	100%

Q42. Since receiving your energy kit from Duke Energy, have you purchased and installed any other products or made any improvements to your home to help save energy?

	Yes	No	Don't Know	Refused	Total
# of responses	103	173	24	0	300
Percent	**34%**	**58%**	**8%**	**0%**	**100%**

Q43. What products have you purchased and installed to help save energy in your home?

	# of responses	Percent
Efficient heating or cooling equipment	1	**1%**
Efficient heating or cooling equipment; Insulation; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Efficient heating or cooling equipment; LEDs and/or CFLs	1	**1%**
Efficient heating or cooling equipment; Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Efficient windows; Insulation; LEDs and/or CFLs	2	**2%**
Efficient windows; LEDs and/or CFLs	1	**1%**
Efficient windows; Other	1	**1%**
Energy efficient appliances	4	**4%**
Energy efficient appliances; Efficient heating or cooling equipment	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; Efficient windows; Insulation; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; Efficient windows LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; Efficient windows; Products to seal air leaks in your home; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; Insulation; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; LEDs and/or CFLs	5	**5%**
Energy efficient appliances; Efficient heating or cooling equipment; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient windows; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient windows; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Efficient windows; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient windows; Products to seal air leaks in your home; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Insulation	1	**1%**
Energy efficient appliances; Insulation; LEDs and/or CFLs; Energy efficient water heater	2	**2%**
Energy efficient appliances; Insulation; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; LEDs and/or CFLs	11	**11%**
Energy efficient appliances; LEDs and/or CFLs; Energy efficient water heater	3	**3%**
Energy efficient appliances; LEDs and/or CFLs; Other	2	**2%**
Energy efficient appliances; Other	1	**1%**
Energy efficient appliances; Products to seal air leaks in your home; LEDs and/or CFLs	3	**3%**

	# of responses	Percent
Energy efficient appliances; Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Products to seal ducts; LEDs and/or CFLs	2	**2%**
Energy efficient water heater	1	**1%**
Insulation	1	**1%**
Insulation; LEDs and/or CFLs	3	**3%**
Insulation; Products to seal air leaks in your home; LEDs and/or CFLs	2	**2%**
LEDs and/or CFLs	26	**25%**
LEDs and/or CFLs; Energy efficient water heater	3	**3%**
Products to seal air leaks in your home	4	**4%**
Products to seal air leaks in your home; LEDs and/or CFLs	4	**4%**
Products to seal air leaks in your home; LEDs and/or CFLs; Other	1	**1%**
Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
None - no other actions taken	1	**1%**
Other	2	**2%**
Total	103	**100%**

Q44. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

Q44.1) Buy energy efficient appliances

	Yes	No	Don't Know	Refused	Total
# of responses	5	40	1	0	46
Percent	**11%**	**87%**	**2%**	**0%**	**100%**

Q44.2) Buy efficient heating or cooling equipment

	Yes	No	Don't Know	Refused	Total
# of responses	3	12	0	0	15
Percent	**20%**	**80%**	**0%**	**0%**	**100%**

Q44.3) Buy efficient windows

	Yes	No	Don't Know	Refused	Total
# of responses	1	10	0	0	11
Percent	**9%**	**91%**	**0%**	**0%**	**100%**

Q44.4) Buy additional insulation

	Yes	No	Don't Know	Refused	Total
# of responses	0	15	0	0	15
Percent	0%	100%	0%	0%	100%

Q44.5) Products to seal air leaks in your home

	Yes	No	Don't Know	Refused	Total
# of responses	0	20	2	0	22
Percent	0%	91%	9%	0%	100%

Q44.6) Products to seal ducts

	Yes	No	Don't Know	Refused	Total
# of responses	0	6	0	0	6
Percent	0%	100%	0%	0%	100%

Q44.7) Buy LEDs and/or CFLs

	Yes	No	Don't Know	Refused	Total
# of responses	11	69	5	0	85
Percent	13%	81%	6%	0%	100%

Q44.8) Install an energy efficient water heater

	Yes	No	Don't Know	Refused	Total
# of responses	0	13	1	0	14
Percent	0%	93%	7%	0%	100%

Q44.96) "Other" [Q44 open-ended question]

	Yes	No	Don't Know	Refused	Total
# of responses	1	6	0	0	7
Percent	14%	86%	0%	0%	100%

Q45. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the Duke Energy schools program have on your decision to...

Q45.1) Buy energy efficient appliances

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	10	0	3	1	0	10	3	0	3	2	14	0	0	46
Percent	22%	0%	7%	2%	0%	22%	7%	0%	7%	4%	30%	0%	0%	100%

Q45.2) Buy efficient heating or cooling equipment

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	7	0	0	0	0	0	0	1	1	0	6	0	0	15
Percent	47%	0%	0%	0%	0%	0%	0%	7%	7%	0%	40%	0%	0%	100%

Q45.3) Buy efficient windows

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	1	0	0	0	1	0	1	1	1	3	0	0	11
Percent	27%	9%	0%	0%	0%	9%	0%	9%	9%	9%	27%	0%	0%	100%

Q45.4) Buy additional insulation

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	4	1	2	0	0	3	1	1	2	0	1	0	0	15
Percent	27%	7%	13%	0%	0%	20%	7%	7%	13%	0%	7%	0%	0%	100%

Q45.5) Products to seal air leaks in your home

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	0	0	0	0	5	4	2	0	1	7	0	0	22
Percent	14%	0%	0%	0%	0%	23%	18%	9%	0%	5%	32%	0%	0%	100%

Q45.6) Products to seal ducts

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	0	0	0	0	2	0	0	0	0	1	0	0	6
Percent	50%	0%	0%	0%	0%	33%	0%	0%	0%	0%	17%	0%	0%	100%

Q45.7) Buy LEDs and/or CFLs

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	13	2	2	2	1	6	4	10	8	6	31	0	0	85
Percent	15%	2%	2%	2%	1%	7%	5%	12%	9%	7%	36%	0%	0%	100%

Q45.8)) Install an energy efficient water heater

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	7	0	1	0	0	2	0	0	0	1	3	0	0	14
Percent	50%	0%	7%	0%	0%	14%	0%	0%	0%	7%	21%	0%	0%	100%

Q45.96) [Q45 open-ended question]

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	2	0	0	0	0	1	0	1	1	1	1	0	0	7
Percent	29%	0%	0%	0%	0%	14%	0%	14%	14%	14%	14%	0%	0%	100%

Q46. What kinds of appliance(s) did you buy?

	# of responses	Percent
Clothes dryer	1	3%
Clothes washer	2	6%
Clothes washer; Clothes dryer	1	3%
Clothes washer; Clothes dryer; Microwave	1	3%
Clothes washer; Clothes dryer; Oven	1	3%
Dishwasher	3	8%
Dishwasher; Clothes washer; Clothes dryer	1	3%
Dishwasher; Clothes washer; Microwave	1	3%
Dishwasher; Clothes washer; Oven	1	3%
Microwave	1	3%
Oven	2	6%
Refrigerator	2	6%
Refrigerator; Clothes dryer	1	3%
Refrigerator; Clothes washer; Clothes dryer; Oven; Microwave	1	3%
Refrigerator; Dishwasher; Clothes washer; Clothes dryer; Microwave	1	3%
Refrigerator; Dishwasher; Clothes washer; Clothes dryer; Oven; Microwave	7	19%
Refrigerator; Dishwasher; Oven	1	3%
Refrigerator; Microwave	1	3%
Refrigerator; Oven	1	3%
Refrigerator; Stand-alone Freezer; Clothes washer; Clothes dryer; Microwave	1	3%
Refrigerator; Stand-alone Freezer; Dishwasher; Oven; Microwave	2	6%
Stand-alone Freezer; Clothes washer; Clothes dryer	2	6%
Other	1	3%
Don't know	0	0%

	# of responses	Percent
Refused	0	**0%**
Total	36	**100%**

Q47. Was the [Q46 appliance] an ENERGY STAR or high efficiency model?

Q47.1) Refrigerator

	Yes	No	Don't Know	Refused	Total
# of responses	16	0	2	0	18
Percent	**89%**	**0%**	**11%**	**0%**	**100%**

Q47.2) Stand-alone Freezer

	Yes	No	Don't Know	Refused	Total
# of responses	5	0	0	0	5
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q47.3) Dishwasher

	Yes	No	Don't Know	Refused	Total
# of responses	16	0	1	0	17
Percent	**94%**	**0%**	**6%**	**0%**	**100%**

Q47.4) Clothes washer

	Yes	No	Don't Know	Refused	Total
# of responses	19	0	1	0	20
Percent	**95%**	**0%**	**5%**	**0%**	**100%**

Q47.5) Clothes dryer

	Yes	No	Don't Know	Refused	Total
# of responses	17	0	1	0	18
Percent	**94%**	**0%**	**6%**	**0%**	**100%**

Q47.6) Oven

	Yes	No	Don't Know	Refused	Total
# of responses	13	0	3	0	16
Percent	**81%**	**0%**	**19%**	**0%**	**100%**

Q47.7) Microwave

	Yes	No	Don't Know	Refused	Total
# of responses	13	1	2	0	16
Percent	**81%**	**6%**	**13%**	**0%**	**100%**

Q47.96) Other:

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q48. Does the new clothes dryer use natural gas?

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	2	15	1	0	18
Percent	**11%**	**83%**	**6%**	**0%**	**100%**

Q49. What type of heating or cooling equipment did you buy?

	# of responses	Percent
Central air conditioner	2	**25%**
Central air conditioner; Air source heat pump; Geothermal heat pump; Furnace; WIFI enabled thermostat	1	**13%**
Central air conditioner; Furnace; WIFI enabled thermostat	1	**13%**
WIFI enabled thermostat	2	**25%**
Window/room air conditioner unit; Other	1	**13%**
Don't know	1	**13%**
Refused	0	**0%**
Total	8	**100%**

Q50. Does the new [Q53 equipment] use natural gas?

Q50.6) Boiler

No responses given

Q50.7) Furnace

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	0	1	1	0	2
Percent	**0%**	**50%**	**50%**	**0%**	**100%**

Q51. Was the heating or cooling equipment an ENERGY STAR or high-efficiency model?

Q51.1) Central air conditioner

	Yes	No	Don't Know	Refused	Total
# of responses	4	0	0	0	4
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.2) Window/room air conditioner unit

No responses given

Q51.3) Wall air conditioner unit

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.4) Air source heat pump

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.5) Geothermal heat pump

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.6) Boiler

No responses given

Q51.7) Furnace

	Yes	No	Don't Know	Refused	Total
# of responses	2	0	0	0	2
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.96) Other:

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	100%	0%	0%	0%	100%

Q52. How many windows did you install?

	1	2	3	4	5	6	7	8	9	10	11	Don't know	Refused	Total
# of responses	0	1	1	0	0	1	0	1	1	1	1	1	0	8
Percent	0%	13%	13%	0%	0%	13%	0%	13%	13%	13%	13%	13%	0%	100%

Q53. Did you add insulation to your attic, walls, or below the floor?

	Attic	Attic; Walls; Below the floor	Walls	Below the floor	Don't Know	Refused	Total
# of responses	4	1	3	2	1	0	11
Percent	36%	9%	27%	18%	9%	0%	100%

Q54. Approximately what proportion of the [Q53 location] space did you add insulation?

Q54.1) Attic

	15%	40%	100%	Don't Know	Refused	Total
# of responses	1	1	1	2	0	5
Percent	20%	20%	20%	40%	0%	100%

Q54.2) Walls

	Don't Know	Refused	Total
# of responses	3	0	3
Percent	100%	0%	100%

Q54.3) Below the floor

	100%	Don't Know	Refused	Total
# of responses	1	3	0	4
Percent	25%	75%	0%	100%

Q55. How many LEDs and CFLs did you install in your property?

	3	4	5	6	8	10	11	12	14	15	18	20	25	30	70	Don't know	Refused	Total
# of responses	1	3	7	7	7	15	1	2	1	5	1	6	2	2	1	11	0	72
Percent	**1%**	**4%**	**10%**	**10%**	**10%**	**21%**	**1%**	**3%**	**1%**	**7%**	**1%**	**8%**	**3%**	**3%**	**1%**	**15%**	**0%**	**100%**

Q56. You said that you installed [Q55 response] LED and CFL bulbs on your propert. Is this the correct number?

	Yes, this is the correct number of LED and CFL bulbs I installed	No, the correct number is:	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q57. Does the new water heater use natural gas?

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	1	5	1	0	7
Percent	**14%**	**71%**	**14%**	**0%**	**100%**

Q58. Which of the following water heaters did you purchase?

	A traditional water heater	A tankless water heater	A solar water heater	Other	Don't know	Refused	Total
# of responses	4	2	0	0	1	0	7
Percent	**57%**	**29%**	**0%**	**0%**	**14%**	**0%**	**100%**

Q59. Is the new water heater an ENERGY STAR model?

	Yes	No	Don't Know	Refused	Total
# of responses	7	0	0	0	7
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q60. Which of the following types of housing units would you say best describes your home? Is it...

	Single-family detached home	Single-family attached home (such as a townhouse or condo)	Duplex, triplex, or quadplex	Apartment or condominium with 5 units or more	Manufactured or mobile home	Other	Don't know	Refused	Total
# of responses	220	16	5	34	23	0	1	1	300
Percent	**73%**	**5%**	**2%**	**11%**	**8%**	**0%**	**0%**	**0%**	**100%**

Q61. How many showers are in your home? Please include both stand-up showers and bathtubs with showerheads.

	1	2	3	4	5 or more	Don't know	Refused	Total
# of responses	70	169	42	14	4	0	1	300
Percent	**23%**	**56%**	**14%**	**5%**	**1%**	**0%**	**0%**	**100%**

Q62. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?

	Less than 500 sq. ft.	500 to under 1,000 sq. ft.	1,000 to under 1,500 sq. ft.	1,500 to under 2,000 sq. ft.	2,000 to under 2,500 sq. ft.	2,500 to under 3,000 sq. ft.	Greater than 3,000 sq. ft.	Don't know	Refused	Total
# of responses	2	32	75	64	30	39	35	22	1	300
Percent	**1%**	**11%**	**25%**	**21%**	**10%**	**13%**	**12%**	**7%**	**0%**	**100%**

Q63. Do you or members of your household own your home, or do you rent it?

	Own/Buying	Rent/Lease	Occupy Rent-free	Don't know	Refused	Total
# of responses	206	90	2	0	2	300
Percent	**69%**	**30%**	**1%**	**0%**	**1%**	**100%**

Q64. Including yourself, how many people currently live in your home year-round?

	I live by myself	Two people	Three people	Four people	Five people	Six people	Seven people	Eight or more people	Don't know	Refused	Total
# of responses	13	55	66	98	32	24	6	2	0	4	300
Percent	**4%**	**18%**	**22%**	**33%**	**11%**	**8%**	**2%**	**1%**	**0%**	**1%**	**100%**

Q65. What was your total annual household income for 2020, before taxes?

	# of responses	Percent
Under $15,000	16	**5%**
15 to under $25,000	28	**9%**
25 to under $35,000	33	**11%**
35 to under $50,000	45	**15%**
50 to under $75,000	47	**16%**
75 to under $100,000	34	**11%**
100 to under $150,000	22	**7%**

	# of responses	Percent
150 to under $200,000	9	**3%**
$200,000 or more	17	**6%**
Don't know	5	**2%**
Prefer not to say	44	**15%**
Total	300	**100%**
Under $15,000	16	**5%**

Q66. In what year were you born?

	# of responses	Percent
1940	1	**0.3%**
1945	1	**0.3%**
1947	2	**0.7%**
1948	2	**0.7%**
1949	1	**0.3%**
1951	1	**0.3%**
1952	1	**0.3%**
1954	4	**1.3%**
1955	3	**1.0%**
1956	1	**0.3%**
1957	2	**0.7%**
1958	4	**1.3%**
1959	1	**0.3%**
1960	2	**0.7%**
1961	4	**1.3%**
1962	2	**0.7%**
1963	6	**2.0%**
1964	2	**0.7%**
1966	5	**1.7%**
1967	2	**0.7%**
1968	6	**2.0%**
1969	11	**3.7%**
1970	7	**2.3%**
1971	9	**3.0%**
1972	4	**1.3%**
1973	5	**1.7%**
1974	11	**3.7%**
1975	7	**2.3%**
1976	2	**0.7%**
1977	16	**5.3%**
1978	11	**3.7%**
1979	15	**5.0%**
1980	12	**4.0%**
1981	4	**1.3%**
1982	8	**2.7%**
1983	10	**3.3%**
1984	8	**2.7%**
1985	11	**3.7%**
1986	11	**3.7%**
1987	8	**2.7%**
1988	8	**2.7%**

	# of responses	Percent
1989	8	**2.7%**
1990	2	**0.7%**
1991	4	**1.3%**
1992	3	**1.0%**
1993	2	**0.7%**
1994	5	**1.7%**
1996	2	**0.7%**
Don't know	1	**0.3%**
Prefer not to say	42	**14.0%**
Total	300	**100%**

Q67. What is the highest level of education achieved among those living in your household?

	# of responses	Percent
Less than high school	3	**1%**
Some high school	3	**1%**
High school graduate or equivalent	42	**14%**
Trade or technical school	9	**3%**
Some college (including Associate's degree)	94	**31%**
College degree (Bachelor's degree)	73	**24%**
Some graduate school	6	**2%**
Graduate degree, professional degree	51	**17%**
Doctorate	10	**3%**
Don't know	0	**0%**
Prefer not to say	9	**3%**
Total	300	**100%**

Q68. Lastly, did the COVID-19 pandemic, or government or organizational response to it, offer any challenges to you regarding your participation in this program? If so, what challenges, and how do you think they might best be addressed moving forward?

	Yes	No	Don't Know	Refused	Total
# of responses	9	251	40	0	300
Percent	**3%**	**84%**	**13%**	**0%**	**100%**

F.4 Student Parent Survey - DEP

Q1. This kit included light bulbs, a showerhead, and other items that help you save energy in your home. Do you recall receiving this kit?

	Yes	No	Don't Know	Total
# of responses	215	0	0	215
Percent	**100%**	**0%**	**0%**	**100%**

Q1.1) Were you aware of this program, prior to your child's involvement, due to your work at an elementary, middle or high school?

	Yes	No	Don't Know	Total
# of responses	0	215	0	215
Percent	**0%**	**100%**	**0%**	**100%**

Q2. Before today, did you know the kit you received was sponsored by Duke Energy?

	Yes	No	Don't Know	Total
# of responses	195	18	2	215
Percent	**91%**	**8%**	**1%**	**100%**

Q3. How did you learn that the kit was sponsored by Duke Energy?

	# of responses	Percent
Classroom materials brought home by child	40	**21%**
Classroom materials brought home by child; Information material included in/on the kit	27	**14%**
Classroom materials brought home by child; Information material included in/on the kit; Other	2	**1%**
Classroom materials brought home by child; My child's teacher/school	8	**4%**
Classroom materials brought home by child; My child's teacher/school; Information material included in/on the kit	11	**6%**
Information material included in/on the kit	55	**28%**
Information material included in/on the kit; Other	2	**1%**
My child's teacher/school	27	**14%**
My child's teacher/school; Information material included in/on the kit	6	**3%**
My child's teacher/school; Other	1	**1%**
Other	11	**6%**
Don't know	5	**3%**
Refused	0	**0%**
Total	195	**100%**

Q4. How did you hear about the opportunity to receive the kit from Duke Energy?

	# of responses	Percent
After hours event at my child's school	1	**0%**
Classroom materials brought home by child	93	**43%**
Classroom materials brought home by child; Email from my child's teacher/school	10	**5%**
Classroom materials brought home by child; Email from my child's teacher/school; Saw a poster at my child's school	1	**0%**
Classroom materials brought home by child; Email from my child's teacher/school; School website or school web portal	2	**1%**
Classroom materials brought home by child; Other	1	**0%**
Classroom materials brought home by child; Saw a poster at my child's school	1	**0%**
Classroom materials brought home by child; School newsletter	4	**2%**
Classroom materials brought home by child; School newsletter; Email from my child's teacher/school	9	**4%**
Classroom materials brought home by child; School newsletter; Email from my child's teacher/school; School website or school web portal	1	**0%**
Classroom materials brought home by child; School newsletter; Email from my child's teacher/school; School website or school web portal; After hours event at my child's school	1	**0%**
Classroom materials brought home by child; School newsletter; Saw a poster at my child's school	1	**0%**
Classroom materials brought home by child; School newsletter; School website or school web portal	2	**1%**
Classroom materials brought home by child; School newsletter; School website or school web portal; Other	1	**0%**
Classroom materials brought home by child; School website or school web portal	7	**3%**
Classroom materials brought home by child; School website or school web portal; Other	1	**0%**
Classroom materials brought home by child; School website or school web portal; Saw a poster at my child's school	1	**0%**
Email from my child's teacher/school	13	**6%**
Email from my child's teacher/school; In-person conversations with my child's teacher	1	**0%**
Email from my child's teacher/school; School website or school web portal	1	**0%**
In-person conversations with my child's teacher	1	**0%**
School newsletter	8	**4%**
School newsletter; Email from my child's teacher/school	2	**1%**
School newsletter; School website or school web portal	1	**0%**
School website or school web portal	10	**5%**
Other	19	**9%**
Don't know	22	**10%**
Refused	0	**0%**
Total	215	**100%**

Q4b. How did you request your kit?

	Program's website	Sign-up form in the classroom materials my child brought home	By calling the toll-free number	Via the "Kilowatt Krush" app on my smartphone	Don't know	Refused	Total
# of responses	136	49	8	1	21	0	215
Percent	**63%**	**23%**	**4%**	**0%**	**10%**	**0%**	**100%**

Q4c. Has your child used the "Kilowatt Krush" app on any smartphone in your household?

	Yes	No	Don't Know	Refused	Total
# of responses	21	160	34	0	215
Percent	**10%**	**74%**	**16%**	**0%**	**100%**

Q4d. About how often would you say that your child uses the "Kilowatt Krush" app?

	They used it once	They used it a few times	They use it daily	They use it weekly	Other	Don't know	Refused	Total
# of responses	4	12	1	3	1	1	0	22
Percent	**18%**	**55%**	**5%**	**14%**	**5%**	**5%**	**0%**	**100%**

Q4e. Have you noticed your child engaging in energy saving behaviors you can attribute to their use of the "Kilowatt Krush" app?

	Yes	No	Don't Know	Total
# of responses	13	9	0	22
Percent	**59%**	**41%**	**0%**	**100%**

Q4f. Do you have any feedback that might help improve the "Kilowatt Krush" app?

	Yes	No	Don't Know	Refused	Total
# of responses	2	17	3	0	22
Percent	**9%**	**77%**	**14%**	**0%**	**100%**

Q5. Did you read any of the Energy Savers booklet that came in the kit?

	Yes	No	Don't Know	Refused	Total
# of responses	158	41	16	0	215
Percent	**73%**	**19%**	**7%**	**0%**	**100%**

Q6. On a scale from 0 to 10 where 0 is not at all helpful and 10 is very helpful, how helpful was the Energy Savers booklet in identifying ways your household could save energy at home?

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	0	3	1	6	14	11	36	27	15	45	0	0	158
Percent	**0%**	**0%**	**2%**	**1%**	**4%**	**9%**	**7%**	**23%**	**17%**	**9%**	**28%**	**0%**	**0%**	**100%**

Q7. What might have made the information more helpful?

	Provided response	Don't Know	Refused	Total
# of responses	10	24	1	35
Percent	**39%**	**69%**	**3%**	**100%**

Q8. In addition to sending the energy saving kits, Duke Energy sponsored a program about energy and energy efficiency at your child's school, which included classroom materials and in in-school performance by the National Theatre for Children. Were you aware of the program before today?

	Yes	No	Don't Know	Refused	Total
# of responses	39	163	13	0	215
Percent	**18%**	**76%**	**6%**	**0%**	**100%**

Q9. From who or where did you hear about this program?

	From a teacher/school administrator	From my child/children	From my child/children; From a teacher/school administrator	On Duke Energy Website	Other	Don't know	Refused	Total
# of responses	7	18	9	4	1	0	0	39
Percent	**18%**	**46%**	**23%**	**10%**	**3%**	**0%**	**0%**	**100%**

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later?

	Yes	No	Don't Know	Refused	Total
# of responses	197	18	0	0	215
Percent	**92%**	**8%**	**0%**	**0%**	**100%**

Q11. Which of the items did you install, even if they were taken out later?

Q11a. Showerhead

	Yes	No	Don't Know	Refused	Total
# of responses	118	76	2	1	197
Percent	**60%**	**39%**	**1%**	**1%**	**100%**

Q11b. Kitchen faucet aerator

	Yes	No	Don't Know	Refused	Total
# of responses	97	94	5	1	197
Percent	**49%**	**48%**	**3%**	**1%**	**100%**

Q11c. Bathroom faucet aerator

	Yes	No	Don't Know	Refused	Total
# of responses	95	95	6	1	197
Percent	**48%**	**48%**	**3%**	**1%**	**100%**

Q11d. Night light

	Yes	No	Don't Know	Refused	Total
# of responses	172	18	6	1	197
Percent	**87%**	**9%**	**3%**	**1%**	**100%**

Q11e. Energy efficient light bulb(s)

	Yes	No	Don't Know	Refused	Total
# of responses	187	8	2	0	197
Percent	**95%**	**4%**	**1%**	**0%**	**100%**

Q11f. Insulator gaskets for light switches and electricity outlets

	Yes	No	Don't Know	Refused	Total
# of responses	67	116	14	0	197
Percent	**34%**	**59%**	**7%**	**0%**	**100%**

Q12. In addition to the night light, there were two LED light bulbs in the kit. Did you install one or both LED light bulbs in the kit?

	I installed both LEDs	I installed only one LED bulb	Don't Know	Refused	Total
# of responses	165	18	3	1	187
Percent	**88%**	**10%**	**2%**	**1%**	**100%**

Q13. How many of the light switch and electric outlet gasket insulators from the kit did you, or someone else, install in your home?

	None	1	2	3	4	5	6	7	8	9	10	11	12	Don't know	Refused	Total
# of responses	1	6	16	7	10	4	4	1	2	1	1	0	4	10	0	67
Percent	**1%**	**9%**	**24%**	**10%**	**15%**	**6%**	**6%**	**1%**	**3%**	**1%**	**1%**	**0%**	**6%**	**15%**	**0%**	**100%**

Q14. Overall, how satisfied are you with the item[s] you installed? Please use 0 to 10 scales, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...?

Q14a. Showerhead

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	2	1	1	4	3	8	16	15	65	2	0	118
Percent	**1%**	**0%**	**2%**	**1%**	**1%**	**3%**	**3%**	**7%**	**14%**	**13%**	**55%**	**2%**	**0%**	**100%**

Q14b. Kitchen faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	3	0	2	5	2	10	11	6	55	1	1	97
Percent	**1%**	**0%**	**3%**	**0%**	**2%**	**5%**	**2%**	**10%**	**11%**	**6%**	**57%**	**1%**	**1%**	**100%**

Q14c. Bathroom faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	5	0	1	5	3	9	14	8	45	3	1	95
Percent	**1%**	**0%**	**5%**	**0%**	**1%**	**5%**	**3%**	**9%**	**15%**	**8%**	**47%**	**3%**	**1%**	**100%**

Q14d. Night light

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	2	0	2	3	4	7	18	20	114	1	0	172
Percent	**1%**	**0%**	**1%**	**0%**	**1%**	**2%**	**2%**	**4%**	**10%**	**12%**	**66%**	**1%**	**0%**	**100%**

Q14e. Energy efficient light bulb(s)

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	0	1	0	0	1	7	7	11	27	132	1	0	187
Percent	**0%**	**0%**	**1%**	**0%**	**0%**	**1%**	**4%**	**4%**	**6%**	**14%**	**71%**	**1%**	**0%**	**100%**

Q14f. Insulator gaskets for light switches and electricity outlets

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	0	2	0	1	3	3	4	8	9	33	4	0	67
Percent	**0%**	**0%**	**3%**	**0%**	**1%**	**4%**	**4%**	**6%**	**12%**	**13%**	**49%**	**6%**	**0%**	**100%**

Q14.1 Can you please explain any dissatisfaction you had with the [X item]

Q14.1a) Showerhead

Open-ended response type; no tabulation available

Q14.1b) Kitchen faucet aerator

Open-ended response type; no tabulation available

Q14.1c) Bathroom faucet aerator

Open-ended response type; no tabulation available

Q14.1d) Night light

Open-ended response type; no tabulation available

Q14.1e) Energy efficient light bulb(s)

Open-ended response type; no tabulation available

Q14.1f) Insulator gaskets for light switches and electricity outlets

Open-ended response type; no tabulation available

Q15. Have you since uninstalled any of the items from the kit that you had previously installed?

	Yes	No	Don't Know	Refused	Total
# of responses	28	160	8	0	196
Percent	**14%**	**82%**	**4%**	**0%**	**100%**

Q16. Which of the items did you uninstall?

	# of responses	Percent
Bathroom faucet aerator	2	7%
Bathroom faucet aerator; Night light	1	3%
Energy efficient light bulbs	3	3%
Insulator Gaskets	1	10%
Kitchen faucet aerator	2	3%
Kitchen faucet aerator; Bathroom faucet aerator	2	7%
Kitchen faucet aerator; Insulator Gaskets	1	7%
Night light	2	3%
Night light; Energy efficient light bulbs	1	7%
Showerhead	8	3%
Showerhead; Bathroom faucet aerator	1	28%
Showerhead; Energy efficient light bulbs	1	3%
Showerhead; Kitchen faucet aerator	1	3%
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator	1	3%
Showerhead; Kitchen faucet aerator; Insulator Gaskets	1	3%
Don't know	1	3%
Refused	0	0%
Total	29	100%

Q17. Why were those items uninstalled? Let's start with...

Q17a. Showerhead

	It was broken	It was broken; I didn't like how it looked	I didn't like how it worked	I didn't like how it worked; Other	I didn't like how it looked	Other	Don't know	Refused	Total
# of responses	0	1	7	1	0	4	0	0	13
Percent	0%	8%	54%	8%	0%	31%	0%	0%	100%

Q17b. Kitchen faucet aerator

	It was broken	I didn't like how it worked	I didn't like how it worked; Other	I didn't like how it looked	Other	Don't know	Refused	Total
# of responses	0	4	1	0	3	0	0	8
Percent	0%	50%	13%	0%	38%	0%	0%	100%

Q17c. Bathroom faucet aerator

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	5	0	2	0	0	7
Percent	0%	71%	0%	29%	0%	0%	100%

Q17d. Night light

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	2	1	0	0	0	3
Percent	**0%**	**67%**	**33%**	**0%**	**0%**	**0%**	**100%**

Q17e. Energy efficient light bulb(s)

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	1	1	2	0	0	4
Percent	**0%**	**25%**	**25%**	**50%**	**0%**	**0%**	**100%**

Q17f. Insulator gaskets for light switches and electricity outlets

	It was broken	I didn't like how it worked	I didn't like how it looked	Other	Don't Know	Refused	Total
# of responses	0	2	1	0	0	0	3
Percent	**0%**	**67%**	**33%**	**0%**	**0%**	**0%**	**100%**

Q18. You said you haven't installed [X items]. Which of those items did you plan to install in the next three months?

	# of responses	Percent
Bathroom faucet aerator	11	**6%**
Bathroom faucet aerator; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Bathroom faucet aerator; Insulator Gaskets	3	**2%**
Bathroom faucet aerator; Night light	1	**1%**
Energy efficient light bulbs	4	**2%**
Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Insulator Gaskets	21	**11%**
Kitchen faucet aerator	4	**2%**
Kitchen faucet aerator; Bathroom faucet aerator	5	**3%**
Kitchen faucet aerator; Bathroom faucet aerator; Insulator Gaskets	4	**2%**
Kitchen faucet aerator; Bathroom faucet aerator; Night light	1	**1%**
Kitchen faucet aerator; Bathroom faucet aerator; Night light; Energy efficient light bulbs	1	**1%**
Kitchen faucet aerator; Bathroom faucet aerator; Night light; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Kitchen faucet aerator; Insulator Gaskets	1	**1%**
Kitchen faucet aerator; Night light	1	**1%**
Night light	5	**3%**
Night light; Energy efficient light bulbs	5	**3%**
Night light; Insulator Gaskets	1	**1%**
Showerhead	14	**8%**
Showerhead; Bathroom faucet aerator	1	**1%**
Showerhead; Bathroom faucet aerator; Insulator Gaskets	1	**1%**
Showerhead; Insulator Gaskets	1	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Insulator Gaskets	1	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night light; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Showerhead; Night light; Energy efficient light bulbs	1	**1%**

	# of responses	Percent
Don't know	92	**50%**
Refused	2	**1%**
Total	185	**100%**

Q19. What's preventing you from installing them? Let's start with...

Q19a. Showerhead

	# of responses	Percent
Already have efficient showerhead	20	**27%**
Already have efficient showerhead; Other; (please specify:___)	3	**4%**
Current one is still working	17	**23%**
Current one is still working; Already have efficient showerhead	4	**5%**
Current one is still working; Takes too much time to install/No time/Too busy	1	**1%**
Current one is still working; Too difficult to install it; don't know how to do it	1	**1%**
Didn't know what that was; Haven't gotten around to it	1	**1%**
Don't have the items any longer (threw away; gave away)	2	**3%**
Don't have the tools I need; Don't have the items any longer (threw away; gave away)	1	**1%**
Haven't gotten around to it	6	**8%**
Haven't gotten around to it; Current one is still working	1	**1%**
Haven't gotten around to it; Too difficult to install it; don't know how to do it; Don't have the tools I need	1	**1%**
Takes too much time to install/No time/Too busy	2	**3%**
Too difficult to install it; don't know how to do it	2	**3%**
Tried it; didn't fit	4	**5%**
Tried it; didn't fit; Already have efficient showerhead	1	**1%**
Tried it; didn't fit; Current one is still working	1	**1%**
Tried it; didn't fit; Takes too much time to install/No time/Too busy; Too difficult to install it; don't know how to do it; Don't have the tools I need	1	**1%**
Tried it; didn't work as intended	1	**1%**
Other; (please specify:___)	4	**5%**
Don't know	0	**0%**
Refused	0	**0%**
Total	74	**100%**

Q19b. Kitchen faucet aerator

	# of responses	Percent
Already have efficient kitchen faucet aerator	13	**14%**
Current one is still working	20	**22%**
Current one is still working; Already have efficient kitchen faucet aerator	1	**1%**
Didn't know what that was	3	**3%**
Didn't know what that was; Haven't gotten around to it	2	**2%**
Don't have the items any longer (threw away, gave away)	3	**3%**
Don't know	4	**4%**
Haven't gotten around to it	8	**9%**
Haven't gotten around to it; Current one is still working	1	**1%**
Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it; Don't have the tools I need	2	**2%**
Takes too much time to install/No time/Too busy	1	**1%**
Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it	1	**1%**
Too difficult to install it, don't know how to do it	4	**4%**
Too difficult to install it, don't know how to do it; Don't have the tools I need; Already have efficient kitchen faucet aerator	1	**1%**

	# of responses	Percent
Tried it, didn't fit	17	**18%**
Tried it, didn't fit; Already have efficient kitchen faucet aerator	1	**1%**
Tried it, didn't work as intended	1	**1%**
Other, (please specify:___)	9	**10%**
Don't know	0	**0%**
Refused	0	**0%**
Total	92	**100%**

Q19c. Bathroom faucet aerator

	# of responses	Percent
Already have efficient bathroom faucet aerators	10	**12%**
Current one is still working	13	**16%**
Current one is still working; Too difficult to install it; don't know how to do it; Don't have the tools I need	1	**1%**
Didn't know what that was	4	**5%**
Didn't know what that was; Current one is still working; Don't have the items any longer (threw away; gave away)	1	**1%**
Didn't know what that was; Haven't gotten around to it	3	**4%**
Didn't know what that was; Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it; don't know how to do it; Don't have the tools I need	1	**1%**
Didn't know what that was; Too difficult to install it; don't know how to do it	1	**1%**
Don't have the items any longer (threw away; gave away)	3	**4%**
Don't know	7	**9%**
Haven't gotten around to it	6	**7%**
Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it; don't know how to do it; Don't have the tools I need	1	**1%**
Takes too much time to install/No time/Too busy; Too difficult to install it; don't know how to do it	1	**1%**
Too difficult to install it; don't know how to do it	5	**6%**
Too difficult to install it; don't know how to do it; Don't have the tools I need; Already have efficient bathroom faucet aerators	1	**1%**
Tried it; didn't fit	13	**16%**
Tried it; didn't fit; Current one is still working	1	**1%**
Tried it; didn't fit Too difficult to install it; don't know how to do it	1	**1%**
Other; (please specify:___)	8	**10%**
Don't know	0	**0%**
Refused	0	**0%**
Total	81	**100%**

Q19d. Night light

	# of responses	Percent
Current one is still working	1	**6%**
Didn't know what that was	2	**11%**
Didn't know what that was; Haven't gotten around to it	1	**6%**
Haven't gotten around to it	3	**17%**
Tried it, didn't fit	1	**6%**
Other, (please specify:___)	8	**44%**
Don't know	2	**11%**
Refused	0	**0%**
Total	18	**100%**

Q19e. Energy efficient light bulb(s)

	# of responses	Percent
Already have LEDs	3	**27%**
Current one is still working	2	**18%**
Didn't know what that was; Haven't gotten around to it	1	**9%**
Haven't gotten around to it	2	**18%**
Tried it, didn't fit	2	**18%**
Other, (please specify:___)	0	**0%**
Don't know	0	**0%**
Refused	1	**9%**
Total	11	**100%**

Q19f. Insulator gaskets

	# of responses	Percent
Current one is still working	14	**14%**
Didn't know what that was	21	**22%**
Didn't know what that was; Haven't gotten around to it	1	**1%**
Didn't know what that was; Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Didn't know what that was; Haven't gotten around to it; Too difficult to install it, don't know how to do it	1	**1%**
Don't have the items any longer (threw away, gave away)	4	**4%**
Haven't gotten around to it	15	**15%**
Haven't gotten around to it; Takes too much time to install/No time/Too busy	1	**1%**
Haven't gotten around to it; Takes too much time to install/No time/Too busy; Too difficult to install it, don't know how to do it; Don't have the tools I need	1	**1%**
Takes too much time to install/No time/Too busy	3	**3%**
Too difficult to install it, don't know how to do it	10	**10%**
Tried it, didn't fit	5	**5%**
Tried it, didn't fit; Current one is still working	1	**1%**
Other, (please specify:___)	8	**8%**
Don't know	11	**11%**
Refused	0	**0%**
Total	97	**100%**

Q20. Thinking of the items you installed, would you be interested in receiving any more of them from Duke Energy? If so, which ones?

	# of responses	Percent
Bathroom faucet aerator	2	**1%**
Bathroom faucet aerator; Night lights	1	**1%**
Bathroom faucet aerator; Night lights; Energy efficient light bulbs	5	**3%**
Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Energy efficient light bulbs	33	**17%**
Energy efficient light bulbs; Insulator Gaskets	3	**2%**
Insulator Gaskets	2	**1%**
Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs	1	**1%**
Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs	3	**2%**
Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	3	**2%**
Kitchen faucet aerator; Bathroom faucet aerator; Night lights Insulator Gaskets	1	**1%**

	# of responses	Percent
Kitchen faucet aerator; Night lights; Energy efficient light bulbs	5	**3%**
Night lights	9	**5%**
Night lights; Energy efficient light bulbs	51	**26%**
Night lights; Energy efficient light bulbs; Insulator Gaskets	7	**4%**
Night lights; Insulator Gaskets	3	**2%**
Showerhead	2	**1%**
Showerhead; Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Showerhead; Energy efficient light bulbs	6	**3%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator	1	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs	2	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs	10	**5%**
Showerhead; Kitchen faucet aerator; Bathroom faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	4	**2%**
Showerhead; Kitchen faucet aerator; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Showerhead; Kitchen faucet aerator; Night lights	1	**1%**
Showerhead; Kitchen faucet aerator; Night lights; Energy efficient light bulbs	2	**1%**
Showerhead; Kitchen faucet aerator; Night lights; Energy efficient light bulbs; Insulator Gaskets	1	**1%**
Showerhead; Night lights	3	**2%**
Showerhead; Night lights; Energy efficient light bulbs	13	**7%**
Showerhead; Night lights; Energy efficient light bulbs; Insulator Gaskets	3	**2%**
No, I am not interested in receiving any more of the items	8	**4%**
Don't know	7	**4%**
Refused	0	**0%**
Total	196	**100%**

Q21. What would be your preferred way to request these additional items?

	# of responses	Percent
Internet	128	**71%**
Internet; Other	1	**1%**
Internet; Pre-paid postcard	22	**12%**
Internet; Pre-paid postcard; Other	1	**1%**
Internet; Telephone	4	**2%**
Internet; Telephone; Pre-paid postcard	2	**1%**
Internet; Telephone; Pre-paid postcard; Other	1	**1%**
Pre-paid postcard	11	**6%**
Telephone	5	**3%**
Telephone; Pre-paid postcard; Other	1	**1%**
Other	2	**1%**
Don't know	2	**1%**
Refused	1	**1%**
Total	181	**100%**

Q22. On average, what is the typical shower length in your household?

	# of responses	Percent
One minute or less	0	**0%**
Two to four minutes	7	**7%**
Five to eight minutes	38	**36%**
Nine to twelve minutes	33	**31%**
Thirteen to fifteen minutes	15	**14%**
Sixteen to twenty minutes	7	**7%**
Twenty-one to thirty minutes	4	**4%**
More than thirty minutes	0	**0%**
Don't know	1	**1%**
Refused	0	**0%**
Total	105	**100%**

Q23. Thinking of the efficient showerhead currently installed on your home: on average, how many showers per day are taken in this shower?

	Fewer than 1	1	2	3	4	5	6	7	8	Don't know	Refused	Total
# of responses	3	13	42	21	11	6	4	3	1	1	0	105
Percent	**3%**	**12%**	**40%**	**20%**	**10%**	**6%**	**4%**	**3%**	**1%**	**1%**	**0%**	**100%**

Q24. You said you installed the night light. Did the night light replace an existing night light?

	Yes	No	Don't Know	Refused	Total
# of responses	92	76	0	0	168
Percent	**55%**	**45%**	**0%**	**0%**	**100%**

Q25. Did the old nightlight have a bulb that you could take out and replace once it burned out?

	Yes	No	Don't Know	Refused	Total
# of responses	64	24	4	0	92
Percent	**70%**	**26%**	**4%**	**0%**	**100%**

Q26. You said you installed at least one of the energy efficient lights. What type of bulb(s) did you replace with the energy efficient lightbulbs?

	All incandescent	All halogen	All CFL	All LED	Some combination	Don't Know	Refused	Total
# of responses	90	14	36	22	3	17	0	182
Percent	**49%**	**8%**	**20%**	**12%**	**2%**	**9%**	**0%**	**100%**

Q27. In what rooms did you install the energy efficient lightbulbs that were included in the kit?

	# of responses	Percent
Bathroom	5	**3%**
Bathroom; Den	1	**1%**
Bathroom; Other area	1	**1%**
Bedroom	24	**13%**
Bedroom; Bathroom	6	**3%**
Bedroom; Den	2	**1%**
Bedroom; Garage	1	**1%**
Bedroom; Hallway	1	**1%**
Bedroom; Kitchen	5	**3%**
Den	4	**2%**
Dining Room	6	**3%**
Dining Room; Bedroom	3	**2%**
Dining Room; Kitchen	3	**2%**
Garage	1	**1%**
Hallway	4	**2%**
Kitchen	7	**4%**
Kitchen; Bathroom	7	**4%**
Kitchen; Hallway	1	**1%**
Living Room	41	**23%**
Living Room; Basement	1	**1%**
Living Room; Bathroom	5	**3%**
Living Room; Bedroom	27	**15%**
Living Room; Den	1	**1%**
Living Room; Dining Room	10	**5%**
Living Room; Hallway	1	**1%**
Living Room; Kitchen	7	**4%**
Don't know	7	**4%**
Refused	0	**0%**
Total	182	**100%**

Q28. Have you adjusted the temperature of your water heater based on the Hot Water Gauge Card included in your kit?

	Yes	No	Don't recall seeing the Hot Water Gauge Card	Don't Know	Refused	Total
# of responses	34	122	48	10	1	215
Percent	**16%**	**57%**	**22%**	**5%**	**0%**	**100%**

Q29. Do you know what the old temperature setting on your hot water heater was?

	Yes	No	Total
# of responses	7	27	34
Percent	**21%**	**79%**	**100%**

Q30. And what was the new temperature setting you set your hot water heater to?

	Provided response	Don't Know	Total
# of responses	10	24	34
Percent	**29%**	**71%**	**100%**

Q31. Is the new water heater temperature setting still in place?

	Yes	No	Don't Know	Refused	Total
# of responses	26	3	5	0	34
Percent	**76%**	**9%**	**15%**	**0%**	**100%**

Q32. Why did you change the water heater temperature a second time?

Open-ended response type; no tabulation available

Q33. What is the fuel type of your water heater?

	Electricity	Natural Gas	Other	Don't Know	Refused	Total
# of responses	170	34	2	9	0	215
Percent	**79%**	**16%**	**1%**	**4%**	**0%**	**100%**

Q34. How old is your water heater?

	Less than 5 years old	5 to 9 years old	10 to 15 years old	More than 15 years old	Don't Know	Refused	Total
# of responses	58	62	39	16	40	0	215
Percent	**27%**	**29%**	**18%**	**7%**	**19%**	**0%**	**100%**

Q35. If you had not received the free efficiency items in the kit, how likely is is that you would have purchased and installed any of these same items within the next six months?

Q35a. Showerhead

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	42	7	4	8	7	7	3	4	3	2	15	3	0	105
Percent	40%	7%	4%	8%	7%	7%	3%	4%	3%	2%	14%	3%	0%	100%

Q35b. Kitchen faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	48	5	5	2	4	5	3	1	1	1	12	2	0	89
Percent	54%	6%	6%	2%	4%	6%	3%	1%	1%	1%	13%	2%	0%	100%

Q35c. Bathroom faucet aerator

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	47	5	4	3	4	6	2	2	4	0	9	2	0	88
Percent	53%	6%	5%	3%	5%	7%	2%	2%	5%	0%	10%	2%	0%	100%

Q35d. Night light

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	62	9	6	10	7	23	8	4	9	2	25	3	0	168
Percent	37%	5%	4%	6%	4%	14%	5%	2%	5%	1%	15%	2%	0%	100%

Q35e. Energy efficient light bulb(s)

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	24	3	2	6	7	17	13	14	18	17	56	5	0	182
Percent	13%	2%	1%	3%	4%	9%	7%	8%	10%	9%	31%	3%	0%	100%

Q35f. Insulator gaskets for light switches and electricity outlets

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	34	6	2	4	0	4	3	1	3	0	4	3	0	64
Percent	53%	9%	3%	6%	0%	6%	5%	2%	5%	0%	6%	5%	0%	100%

Q36. If you had not received them for free in the kit, how many LED light bulbs would you have purchased?

	One	Two	Don't Know	Refused	Total
# of responses	3	28	29	0	60
Percent	5%	47%	48%	0%	100%

Q37. Now, thinking about the water savings items that were provided in the kit - using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how influential were the following factors on your decision to install the water saving items from the kit? How influential was...

Q37a. The fact that the items were free

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	7	1	0	4	1	7	7	4	14	10	89	1	1	0	146
Percent	5%	1%	0%	3%	1%	5%	5%	3%	10%	7%	61%	1%	1%	0%	100%

Q37b. The fact that the items were mailed to your house

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	5	1	0	2	3	8	3	2	14	12	93	2	1	0	146
Percent	3%	1%	0%	1%	2%	5%	2%	1%	10%	8%	64%	1%	1%	0%	100%

Q37c. Information in the kit about how the items would save energy

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	7	1	0	1	1	12	6	10	17	20	70	0	1	0	146
Percent	5%	1%	0%	1%	1%	8%	4%	7%	12%	14%	48%	0%	1%	0%	100%

Q37d. Information that your child brought home from school

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	14	1	1	2	5	15	10	10	12	12	56	6	2	0	146
Percent	10%	1%	1%	1%	3%	10%	7%	7%	8%	8%	38%	4%	1%	0%	100%

Q37e. Other information or advertisements from Duke Energy, including its website

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	14	2	2	5	7	20	12	16	5	10	42	7	4	0	146
Percent	10%	1%	1%	3%	5%	14%	8%	11%	3%	7%	29%	5%	3%	0%	100%

Q38. Using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how influential were the following factors in your decision to install the lightbulbs from the kit? How influential was...

Q38a. The fact that the items were free

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	5	1	1	2	1	9	4	7	17	11	122	1	1	0	182
Percent	3%	1%	1%	1%	1%	5%	2%	4%	9%	6%	67%	1%	1%	0%	100%

Q38b. The fact that the items were mailed to your house

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	3	1	0	3	1	4	6	10	11	16	123	2	2	0	182
Percent	2%	1%	0%	2%	1%	2%	3%	5%	6%	9%	68%	1%	1%	0%	100%

Q38c. Information in the kit about how the items would save energy

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	8	3	1	3	0	16	5	20	18	15	88	0	5	0	182
Percent	4%	2%	1%	2%	0%	9%	3%	11%	10%	8%	48%	0%	3%	0%	100%

Q38d. Information that your child brought home from school

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	14	3	0	5	5	24	12	14	18	12	64	5	6	0	182
Percent	8%	2%	0%	3%	3%	13%	7%	8%	10%	7%	35%	3%	3%	0%	100%

Q38e. Other information or advertisements from Duke Energy, including its website

	0	1	2	3	4	5	6	7	8	9	10	N/A	Don't know	Refused	Total
# of responses	22	4	3	3	15	25	11	16	10	11	48	4	10	0	182
Percent	12%	2%	2%	2%	8%	14%	6%	9%	5%	6%	26%	2%	5%	0%	100%

Q39. Since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy, has your child adopted any new behaviors to help save energy in your home? This would only include new energy saving behaviors that your child adopted since receiving the kit.

	# of responses	Percent
Not applicable - no new behaviors	58	**27%**
Taking shorter showers	4	**2%**
Turning off electronics when not using them	10	**5%**
Turning off electronics when not using them; Taking shorter showers	1	**0%**
Turning off lights when not in a room	40	**19%**
Turning off lights when not in a room; Other	1	**0%**
Turning off lights when not in a room; Taking shorter showers	5	**2%**
Turning off lights when not in a room; Taking shorter showers; Other	1	**0%**
Turning off lights when not in a room; Turning off electronics when not using them	51	**24%**
Turning off lights when not in a room; Turning off electronics when not using them; Other	1	**0%**
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers	26	**12%**
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers; Other	1	**0%**
Other	3	**1%**
Don't know	12	**6%**
Refused	1	**0%**
Total	215	**100%**

Q39b. Before receiving the kit, was your child already...

39b.2) Turning off lights when not in a room

	Yes	No	Don't Know	Refused	Total
# of responses	41	84	1	0	126
Percent	**33%**	**67%**	**79%**	**0%**	**100%**

39b.3) Turning off electronics when not using them

	Yes	No	Don't Know	Refused	Total
# of responses	20	66	3	1	90
Percent	**22%**	**73%**	**3%**	**1%**	**100%**

39b.4) Taking shorter showers

	Yes	No	Don't Know	Refused	Total
# of responses	6	32	0	0	38
Percent	**16%**	**84%**	**0%**	**0%**	**100%**

39b.5) "Other" reasons

	Yes	No	Don't Know	Refused	Total

# of responses	2	4	0	1	7
Percent	**29%**	**57%**	**0%**	**14%**	**100%**

Q40. Since receiving your energy kit from Duke Energy, have you adopted or increased any behaviors to help save energy in your home?

	# of responses	Percent
Changing thermostat settings so heating or cooling system uses less energy	9	**4%**
Changing thermostat settings so heating or cooling system uses less energy; Other	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	2	**1%**
Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	2	**1%**
Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Turning water heat thermostat down	1	**0%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	3	**1%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	2	**1%**
Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning water heat thermostat down	1	**0%**
Taking shorter showers	2	**1%**
Taking shorter showers; Turning water heat thermostat down	1	**0%**
Turning off air conditioning when not home	2	**1%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	2	**1%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	**0%**
Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning water heat thermostat down	1	**0%**
Turning off electronics when not using them	2	**1%**
Turning off electronics when not using them; Taking shorter showers	1	**0%**
Turning off furnace when not home; Turning off air conditioning when not home	1	**0%**
Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Turning water heat thermostat down	1	**0%**
Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	1	**0%**
Turning off furnace when not home; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Other	1	**0%**
Turning off lights when not in a room	9	**4%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy	8	**4%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	4	**2%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	9	**4%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	4	**2%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Turning water heat thermostat down	1	**0%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	2	**1%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers	2	**1%**
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers; Turning water heat thermostat down	1	**0%**

	# of responses	Percent
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	7	3%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	5	2%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	2	1%
Turning off lights when not in a room; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Turning water heat thermostat down	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	5	2%
Turning off lights when not in a room; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	2	1%
Turning off lights when not in a room; Turning off air conditioning when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers	3	1%
Turning off lights when not in a room; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Taking shorter showers	1	0%

	# of responses	Percent
Turning off lights when not in a room; Turning off furnace when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy	4	2%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them	2	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning	3	1%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers; Turning water heat thermostat down	4	2%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Changing thermostat settings so heating or cooling system uses less energy; Using fans instead of air conditioning; Turning off electronics when not using them; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Turning off air conditioning when not home; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Turning off lights when not in a room; Turning off furnace when not home; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Turning off lights when not in a room; Turning water heat thermostat down	1	0%
Turning off lights when not in a room; Using fans instead of air conditioning	2	1%
Turning off lights when not in a room; Using fans instead of air conditioning; Taking shorter showers	1	0%
Turning off lights when not in a room; Using fans instead of air conditioning; Turning off electronics when not using them	4	2%
Turning off lights when not in a room; Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	3	1%
Turning water heat thermostat down	1	0%
Using fans instead of air conditioning	4	2%
Using fans instead of air conditioning; Turning off electronics when not using them	1	0%
Using fans instead of air conditioning; Turning off electronics when not using them; Taking shorter showers	1	0%
Not applicable - no new behaviors	38	18%
Other	1	0%
Don't know	3	1%
Refused	0	0%
Total	215	100%

Q40b. Before receiving the kit, were you already...

40b.2) Turning off lights when not in a room

	Yes	No	Don't Know	Refused	Total

# of responses	101	26	1	0	128
Percent	**79%**	**20%**	**78%**	**0%**	**100%**

40b.3) Turning off furnace when not home

	Yes	No	Don't Know	Refused	Total
# of responses	15	18	1	0	34
Percent	**44%**	**53%**	**3%**	**0%**	**100%**

40b.4) Turning off air conditioning when not home

	Yes	No	Don't Know	Refused	Total
# of responses	31	26	0	1	58
Percent	**53%**	**45%**	**0%**	**2%**	**100%**

40b.5) Changing thermostat settings so heating or cooling system uses less energy

	Yes	No	Don't Know	Refused	Total
# of responses	58	52	4	0	114
Percent	**51%**	**46%**	**4%**	**0%**	**100%**

40b.6) Using fans instead of air conditioning

	Yes	No	Don't Know	Refused	Total
# of responses	48	28	0	0	76
Percent	**63%**	**37%**	**0%**	**0%**	**100%**

40b.7) Turning off electronics when not using them

	Yes	No	Don't Know	Refused	Total
# of responses	49	41	2	0	92
Percent	**53%**	**45%**	**2%**	**0%**	**100%**

40b.8) Taking shorter showers

	Yes	No	Don't Know	Refused	Total
# of responses	20	43	0	0	63
Percent	**32%**	**68%**	**1%**	**0%**	**100%**

40b.9) Turning water heat thermostat down

	Yes	No	Don't Know	Refused	Total
# of responses	5	21	0	0	26
Percent	19%	81%	0%	0%	100%

40b.10) Other

	Yes	No	Don't Know	Refused	Total
# of responses	0	3	0	0	3
Percent	0%	100%	0%	0%	100%

Q41. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did Duke Energy's kit and materials on saving energy have on this change of energy using behaviors?

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	0	1	3	4	23	13	36	23	14	49	2	0	171
Percent	2%	0%	1%	2%	2%	13%	8%	21%	13%	8%	29%	1%	0%	100%

Q42. Since receiving your energy kit from Duke Energy, have you purchased and installed any other products or made any improvements to your home to help save energy?

	Yes	No	Don't Know	Refused	Total
# of responses	96	108	11	0	215
Percent	45%	50%	5%	0%	100%

Q43. What products have you purchased and installed to help save energy in your home?

	# of responses	Percent
Efficient heating or cooling equipment	1	1%
Efficient heating or cooling equipment; Insulation	1	1%
Efficient heating or cooling equipment; LEDs and/or CFLs	2	2%
Efficient heating or cooling equipment; LEDs and/or CFLs; Other	1	1%
Efficient heating or cooling equipment; Products to seal air leaks in your home; LEDs and/or CFLs	1	1%
Efficient windows; Insulation; LEDs and/or CFLs	1	1%
Efficient windows; LEDs and/or CFLs	1	1%
Efficient windows; Products to seal air leaks in your home; LEDs and/or CFLs	3	3%
Energy efficient appliances	1	1%
Energy efficient appliances; Efficient heating or cooling equipment; Insulation; Energy efficient water heater	1	1%

	# of responses	Percent
Energy efficient appliances; Efficient heating or cooling equipment; Insulation; Products to seal air leaks in your home; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Efficient heating or cooling equipment; Products to seal air leaks in your home	1	**1%**
Energy efficient appliances; Efficient windows; Insulation; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Efficient windows; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Energy efficient water heater	1	**1%**
Energy efficient appliances; Insulation; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; Insulation; Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Energy efficient appliances; LEDs and/or CFLs	17	**18%**
Energy efficient appliances; LEDs and/or CFLs; Other	1	**1%**
Energy efficient appliances; Products to seal air leaks in your home	2	**2%**
Energy efficient appliances; Products to seal air leaks in your home; LEDs and/or CFLs	2	**2%**
Energy efficient appliances; Products to seal air leaks in your home; LEDs and/or CFLs; Energy efficient water heater	1	**1%**
Energy efficient appliances; Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Insulation	3	**3%**
Insulation; LEDs and/or CFLs	2	**2%**
Insulation; Products to seal air leaks in your home; LEDs and/or CFLs	1	**1%**
Insulation; Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
Insulation; Products to seal ducts; Energy efficient water heater	1	**1%**
LEDs and/or CFLs	23	**24%**
LEDs and/or CFLs; Other	1	**1%**
Products to seal air leaks in your home	2	**2%**
Products to seal air leaks in your home; LEDs and/or CFLs	9	**9%**
Products to seal air leaks in your home; Products to seal ducts; LEDs and/or CFLs	1	**1%**
None - no other actions taken	1	**1%**
Other	5	**5%**
Total	96	**100%**

Q44. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

Q44.1) Buy energy efficient appliances

	Yes	No	Don't Know	Refused	Total
# of responses	1	32	2	0	35
Percent	**3%**	**91%**	**6%**	**0%**	**100%**

Q44.2) Buy efficient heating or cooling equipment

	Yes	No	Don't Know	Refused	Total
# of responses	2	8	1	0	11
Percent	**18%**	**73%**	**9%**	**0%**	**100%**

Q44.3) Buy efficient windows

	Yes	No	Don't Know	Refused	Total
# of responses	0	6	1	0	7
Percent	**0%**	**86%**	**14%**	**0%**	**100%**

Q44.4) Buy additional insulation

	Yes	No	Don't Know	Refused	Total
# of responses	1	14	0	0	15
Percent	**7%**	**93%**	**0%**	**0%**	**100%**

Q44.5) Products to seal air leaks in your home

	Yes	No	Don't Know	Refused	Total
# of responses	2	24	3	0	29
Percent	**7%**	**83%**	**10%**	**0%**	**100%**

Q44.6) Products to seal ducts

	Yes	No	Don't Know	Refused	Total
# of responses	0	5	0	0	5
Percent	**0%**	**100%**	**0%**	**0%**	**100%**

Q44.7) Buy LEDs and/or CFLs

	Yes	No	Don't Know	Refused	Total
# of responses	5	65	6	0	76
Percent	**7%**	**86%**	**8%**	**0%**	**100%**

Q44.8) Install an energy efficient water heater

	Yes	No	Don't Know	Refused	Total
# of responses	2	3	1	0	6
Percent	**33%**	**50%**	**17%**	**0%**	**100%**

Q44.96) "Other" [Q44 open-ended question]

	Yes	No	Don't Know	Refused	Total
# of responses	3	4	1	0	8
Percent	38%	50%	13%	0%	100%

Q45. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the Duke Energy schools program have on your decision to...

Q45.1) Buy energy efficient appliances

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	9	0	1	1	1	3	0	3	4	3	10	0	0	35
Percent	26%	0%	3%	3%	3%	9%	0%	9%	11%	9%	29%	0%	0%	100%

Q45.2) Buy efficient heating or cooling equipment

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	5	0	0	0	0	1	0	0	2	1	2	0	0	11
Percent	45%	0%	0%	0%	0%	9%	0%	0%	18%	9%	18%	0%	0%	100%

Q45.3) Buy efficient windows

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	0	0	0	0	1	0	1	0	1	1	0	0	7
Percent	43%	0%	0%	0%	0%	14%	0%	14%	0%	14%	14%	0%	0%	100%

Q45.4) Buy additional insulation

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	4	0	0	0	1	1	2	0	1	2	4	0	0	15
Percent	27%	0%	0%	0%	7%	7%	13%	0%	7%	13%	27%	0%	0%	100%

Q45.5) Products to seal air leaks in your home

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	6	1	0	1	0	3	3	2	1	3	8	1	0	29
Percent	21%	3%	0%	3%	0%	10%	10%	7%	3%	10%	28%	3%	0%	100%

Q45.6) Products to seal ducts

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	0	0	0	0	0	1	0	0	1	1	1	0	0	5
Percent	**20%**	**0%**	**0%**	**0%**	**0%**	**20%**	**0%**	**0%**	**20%**	**20%**	**20%**	**0%**	**0%**	**100%**

Q45.7) Buy LEDs and/or CFLs

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	12	0	0	2	2	10	5	12	8	8	17	0	0	76
Percent	**16%**	**0%**	**0%**	**3%**	**3%**	**13%**	**7%**	**16%**	**11%**	**11%**	**22%**	**0%**	**0%**	**100%**

Q45.8)) Install an energy efficient water heater

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	1	0	0	0	0	1	0	1	0	0	3	0	0	6
Percent	**17%**	**0%**	**0%**	**0%**	**0%**	**17%**	**0%**	**17%**	**0%**	**0%**	**50%**	**0%**	**0%**	**100%**

Q45.96) [Q45 open-ended question]

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Refused	Total
# of responses	3	0	3	0	0	1	0	0	1	0	0	0	0	8
Percent	**38%**	**0%**	**38%**	**0%**	**0%**	**13%**	**0%**	**0%**	**13%**	**0%**	**0%**	**0%**	**0%**	**100%**

Q46. What kinds of appliance(s) did you buy?

	# of responses	Percent
Clothes dryer	1	**4%**
Clothes washer; Clothes dryer	2	**8%**
Clothes washer; Microwave	1	**4%**
Dishwasher	2	**8%**
Dishwasher; Microwave	2	**8%**
Microwave	2	**8%**
Oven	2	**8%**
Refrigerator	3	**12%**
Refrigerator; Clothes washer	1	**4%**
Refrigerator; Clothes washer; Clothes dryer	1	**4%**
Refrigerator; Clothes washer; Clothes dryer; Oven; Microwave	1	**4%**
Refrigerator; Dishwasher; Clothes washer; Clothes dryer; Oven; Microwave	1	**4%**
Refrigerator; Dishwasher; Clothes washer; Oven; Microwave	1	**4%**
Refrigerator; Microwave	1	**4%**
Refrigerator; Stand-alone Freezer; Clothes washer; Clothes dryer; Microwave	1	**4%**
Refrigerator; Stand-alone Freezer; Clothes washer; Clothes dryer; Oven	1	**4%**
Refrigerator; Stand-alone Freezer; Microwave	1	**4%**
Other	2	**8%**
Don't know	0	**0%**
Refused	0	**0%**
Total	26	**100%**

Q47. Was the [Q46 appliance] an ENERGY STAR or high efficiency model?

Q47.1) Refrigerator

	Yes	No	Don't Know	Refused	Total
# of responses	12	0	0	0	12
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q47.2) Stand-alone Freezer

	Yes	No	Don't Know	Refused	Total
# of responses	3	0	0	0	3
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q47.3) Dishwasher

	Yes	No	Don't Know	Refused	Total
# of responses	5	0	1	0	6
Percent	**83%**	**0%**	**17%**	**0%**	**100%**

Q47.4) Clothes washer

	Yes	No	Don't Know	Refused	Total
# of responses	10	0	0	0	10
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q47.5) Clothes dryer

	Yes	No	Don't Know	Refused	Total
# of responses	8	0	0	0	8
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q47.6) Oven

	Yes	No	Don't Know	Refused	Total
# of responses	6	0	0	0	6
Percent	**0%**	**0%**	**0%**	**0%**	**100%**

Q47.7) Microwave

	Yes	No	Don't Know	Refused	Total
# of responses	8	1	2	0	11
Percent	**73%**	**9%**	**18%**	**0%**	**100%**

Q47.96) Other:

	Yes	No	Don't Know	Refused	Total
# of responses	2	0	0	0	2
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q48. Does the new clothes dryer use natural gas?

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	0	7	1	0	8
Percent	**0%**	**88%**	**13%**	**0%**	**100%**

Q49. What type of heating or cooling equipment did you buy?

	# of responses	Percent
Central air conditioner	1	**17%**
Central air conditioner; Furnace; WIFI enabled thermostat	1	**17%**
Central air conditioner; WIFI enabled thermostat	1	**17%**
Other	1	**17%**
WIFI enabled thermostat	1	**17%**
Window/room air conditioner unit	1	**17%**
Don't know	0	**0%**
Refused	0	**0%**
Total	6	**100%**

Q50. Does the new [Q53 equipment] use natural gas?

Q50.6) Boiler

No responses given

Q50.7) Furnace

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	0	1	0	0	1
Percent	**0%**	**100%**	**0%**	**0%**	**100%**

Q51. Was the heating or cooling equipment an ENERGY STAR or high-efficiency model?

Q51.1) Central air conditioner

	Yes	No	Don't Know	Refused	Total
# of responses	3	0	0	0	3
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.2) Window/room air conditioner unit

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.3) Wall air conditioner unit

No responses given

Q51.4) Air source heat pump

No responses given

Q51.5) Geothermal heat pump

No responses given

Q51.6) Boiler

No responses given

Q51.7) Furnace

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q51.96) Other:

	Yes	No	Don't Know	Refused	Total
# of responses	1	0	0	0	1
Percent	**100%**	**0%**	**0%**	**0%**	**100%**

Q52. How many windows did you install?

	1	2	3	4	5	6	7	8	9	10	18	Don't know	Refused	Total
# of responses	0	1	1	1	0	0	0	0	0	0	1	0	0	4
Percent	**0%**	**25%**	**25%**	**25%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**25%**	**0%**	**0%**	**100%**

Q53. Did you add insulation to your attic, walls, or below the floor?

	Attic	Walls	Below the floor	Walls; Below the floor	Don't Know	Refused	Total
# of responses	3	0	5	1	2	0	11
Percent	**27%**	**0%**	**45%**	**9%**	**18%**	**0%**	**100%**

Q54. Approximately what proportion of the [Q53 location] space did you add insulation?

Q54.1) Attic

	50%	Don't Know	Refused	Total
# of responses	2	1	0	3
Percent	**67%**	**33%**	**0%**	**100%**

Q54.2) Walls

	50%	Don't Know	Refused	Total
# of responses	1	0	0	2
Percent	100%	0%	0%	100%

Q54.3) Below the floor

	10%	35%	50%	75%	Don't Know	Refused	Total
# of responses	1	1	2	1	1	0	6
Percent	17%	17%	33%	17%	17%	0%	100%

Q55. How many LEDs and CFLs did you install in your property?

	2	4	5	6	7	8	9	10	11	12	15	16	20	25	30	40	50	Don't know	Refused	Total
# of responses	3	8	7	8	1	5	1	8	1	1	2	1	5	1	4	1	1	6	0	64
Percent	5%	13%	11%	13%	2%	8%	2%	13%	2%	2%	3%	2%	8%	2%	6%	2%	2%	9%	0%	100%

Q56. You said that you installed [Q55 response] LED and CFL bulbs on your propert. Is this the correct number?

No responses given

Q57. Does the new water heater use natural gas?

	Yes - it uses natural gas	No - it does not use natural gas	Don't Know	Refused	Total
# of responses	1	4	0	0	5
Percent	20%	80%	0%	0%	100%

Q58. Which of the following water heaters did you purchase?

	A traditional water heater	A tankless water heater	A solar water heater	Other	Don't know	Refused	Total
# of responses	4	1	0	0	0	0	5
Percent	80%	20%	0%	0%	0%	0%	100%

Q59. Is the new water heater an ENERGY STAR model?

	Yes	No	Don't Know	Refused	Total
# of responses	4	0	1	0	5
Percent	80%	0%	20%	0%	100%

Q60. Which of the following types of housing units would you say best describes your home? Is it...

	Single-family detached home	Single-family attached home (such as a townhouse or condo)	Duplex, triplex, or quadplex	Apartment or condominium with 5 units or more	Manufactured or mobile home	Other	Don't know	Refused	Total
# of responses	147	13	6	17	29	1	2	0	215
Percent	68%	6%	3%	8%	13%	0%	1%	0%	100%

Q61. How many showers are in your home? Please include both stand-up showers and bathtubs with showerheads.

	1	2	3	4	5 or more	Don't know	Refused	Total
# of responses	41	114	43	9	7	1	0	215
Percent	19%	53%	20%	4%	3%	0%	0%	100%

Q62. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?

	Less than 500 sq. ft.	500 to under 1,000 sq. ft.	1,000 to under 1,500 sq. ft.	1,500 to under 2,000 sq. ft.	2,000 to under 2,500 sq. ft.	2,500 to under 3,000 sq. ft.	Greater than 3,000 sq. ft.	Don't know	Refused	Total
# of responses	3	21	52	39	31	21	25	23	0	215
Percent	1%	10%	24%	18%	14%	10%	12%	11%	0%	100%

Q63. Do you or members of your household own your home, or do you rent it?

	Own/Buying	Rent/Lease	Occupy Rent-free	Don't know	Refused	Total
# of responses	153	58	2	1	1	215
Percent	71%	27%	1%	0%	0%	100%

Q64. Including yourself, how many people currently live in your home year-round?

	I live by myself	Two people	Three people	Four people	Five people	Six people	Seven people	Eight or more people	Don't know	Refused	Total
# of responses	7	22	64	63	32	17	5	3	0	2	215
Percent	**3%**	**10%**	**30%**	**29%**	**15%**	**8%**	**2%**	**1%**	**0%**	**1%**	**100%**

Q65. What was your total annual household income for 2020, before taxes?

	# of responses	Percent
Under $15,000	10	**5%**
15 to under $25,000	19	**9%**
25 to under $35,000	18	**8%**
35 to under $50,000	28	**13%**
50 to under $75,000	29	**13%**
75 to under $100,000	27	**13%**
100 to under $150,000	23	**11%**
150 to under $200,000	3	**1%**
$200,000 or more	7	**3%**
Don't know	4	**2%**
Prefer not to say	47	**22%**
Total	215	**100%**
Under $15,000	10	**5%**

Q66. In what year were you born?

	# of responses	Percent
1950	1	**0%**
1951	2	**1%**
1956	3	**1%**
1957	2	**1%**
1959	1	**0%**
1960	1	**0%**
1961	2	**1%**
1962	1	**0%**
1963	2	**1%**
1964	2	**1%**
1965	2	**1%**
1966	4	**2%**
1967	1	**0%**
1968	3	**1%**
1969	4	**2%**
1970	5	**2%**
1971	8	**4%**
1972	6	**3%**
1973	5	**2%**
1974	9	**4%**
1975	7	**3%**

	# of responses	Percent
1976	10	**5%**
1977	7	**3%**
1978	8	**4%**
1979	11	**5%**
1980	2	**1%**
1981	10	**5%**
1982	8	**4%**
1983	7	**3%**
1984	11	**5%**
1985	7	**3%**
1986	7	**3%**
1987	4	**2%**
1988	3	**1%**
1989	3	**1%**
1990	2	**1%**
1991	3	**1%**
1992	4	**2%**
1993	1	**0%**
Don't know	3	**1%**
Prefer not to say	33	**15%**
Total	215	**100%**

Q67. What is the highest level of education achieved among those living in your household?

	# of responses	Percent
Less than high school	1	**0%**
Some high school	5	**2%**
High school graduate or equivalent	31	**14%**
Trade or technical school	13	**6%**
Some college (including Associate's degree)	59	**27%**
College degree (Bachelor's degree)	49	**23%**
Some graduate school	4	**2%**
Graduate degree, professional degree	36	**17%**
Doctorate	9	**4%**
Don't know	0	**0%**
Prefer not to say	8	**4%**
Total	215	**100%**

Q68. Lastly, did the COVID-19 pandemic, or government or organizational response to it, offer any challenges to you regarding your participation in this program? If so, what challenges, and how do you think they might best be addressed moving forward?

	Yes	No	Don't Know	Refused	Total
# of responses	7	189	19	0	215
Percent	**3%**	**88%**	**9%**	**0%**	**100%**

EM&V Report for the Duke Energy Small Business Energy Saver Program 2019-2020

Prepared for:

Duke Energy Carolinas and Duke Energy Progress

Submitted by:

Guidehouse Inc.
1375 Walnut St, Suite 100
Boulder, CO 80302
303.728.2500
Guidehouse.com

November 23, 2021

Table of Contents

Contents

1. Evaluation Summary 5
1.1 Program Summary 5
1.2 Evaluation Objectives and Program Level Findings 5
1.3 Evaluation Parameters and Sample Period 9
1.4 Evaluation Considerations and Recommendations 10
2. Program Description 11
2.1 Program Design 11
2.2 Reported Program Participation and Savings 11
2.2.1 Program Summary by Measure 12
2.2.2 Savings by Facility Type 14
3. Impact Evaluation 15
3.1 Impact Results 15
3.2 Impact Evaluation Methodology 20
3.2.1 Deemed Savings Review 20
3.2.2 Sample Design 20
3.2.3 Virtual Verification 21
3.3 Impact Evaluation Findings 23
3.3.1 Deemed Savings Review 24
3.3.2 HVAC Interactive Effects 29
3.3.3 Coincidence Factors 29
3.3.4 Engineering Review (ER) Realization Rate 30
3.3.5 In-Service Rates (ISR) 31
3.1 Verified Realization Rates based on ISR and ER 34
4. Process Evaluation 43
4.1 Process Methodology 43
4.2 Participant Survey 43
4.3 Program Review 44
4.4 Participant Survey Findings 44
4.4.1 Customer Experience 45
4.4.2 Implementation Contractor 46
4.4.3 Program Challenges 47
4.4.4 Program Benefits 48
4.4.5 Suggested Improvements 48
5. Net-to-Gross Analysis 50
5.1 Defining Free Ridership, Spillover, and Net-to-Gross Ratio 50

5.2 Methods for Estimating Free Ridership and Spillover 51
5.2.1 Estimating Free Ridership 51
5.2.2 Estimating Spillover 52
5.2.3 Combining Results across Respondents 53
5.3 Results for Free Ridership, Spillover, and Net-to-Gross 53
5.3.1 Review of Data Collection Efforts for Attribution Analysis 54
5.3.2 Free-Ridership Results 54
5.3.3 Spillover Results 55
5.3.4 Net-to-Gross Ratio 56

6. Conclusions and Recommendations 58

7. Summary Form A-1

8. Measure Level Inputs for Duke Energy Analytics A-2

List of Tables

Table 1-1. SBES Reported, Verified Gross and Verified Net Savings - DEC 7
Table 1-2 SBES Reported, Verified Gross and Verified Net Savings – DEP 8
Table 1-3. Evaluated Parameters 9
Table 1-4. EM&V Sample Period Start and End Dates 9
Table 2-1. Reported Participation and Gross Savings Summary 11
Table 3-1 Reported and Verified Program-Level Impacts 15
Table 3-2 Reported and Verified Lighting Impacts 16
Table 3-3 Reported and Verified HVAC Impacts 16
Table 3-4 Reported and Verified Refrigeration Impacts 17
Table 3-5 Reported and Verified Measure-Level Impacts - DEC 18
Table 3-6 Reported and Verified Measure-Level Impacts – DEP 19
Table 3-7 DEC Expected Sampling Summary 21
Table 3-8 Virtual Verification Response Summary by Measure 23
Table 3-9 Engineering Algorithms for Lighting Measures 28
Table 3-10 HVAC Interactive Effects Multipliers from the NEEP Mid-Atlantic TRM 29
Table 3-11 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis 30
Table 3-12 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM 30
Table 3-13 DEC Engineering Review (ER) Realization Rate 31
Table 3-14 DEP Engineering Review (ER) Realization Rate 31
Table 3-15 Response Summary by Stratum 32
Table 3-16 Verification Energy Realization Rate ISR 33
Table 3-17 Virtual Verification In-Service Rates Findings 33
Table 3-18 Energy Installation Rate by Strata – DEC 35
Table 3-19 Energy Installation Rate by End Use – DEC 35
Table 3-20. Energy Realization Rate by Strata – DEP 35
Table 3-21 Energy Installation Rate by End Use – DEP 36
Table 3-22 Summer Peak Demand Realization Rates by Strata – DEC 38
Table 3-23 Summer Peak Demand Realization Rates by End Use – DEC 38
Table 3-24 Summer Peak Demand Realization Rates by Strata - DEP 38
Table 3-25 Summer Peak Demand Realization Rates by End Use – DEP 39
Table 3-26 Winter Peak Demand Realization Rates by Strata – DEC 39
Table 3-27 Winter Peak Demand Realization Rates by End Use – DEC 39
Table 3-28 Winter Peak Demand Realization Rates by Strata – DEP 39
Table 3-29 Winter Peak Demand Realization Rates by End Use – DEP 40
Table 4-1. Response Status – Process Survey 43
Table 5-1. 2019-2020 Net-to-Gross Results 50
Table 5-2. Participant Survey Completes by Project Type 54
Table 5-3. Inside Spillover by Measure Type 55
Table 5-4. Outside Spillover by Measure Type 56
Table 5-5. SBES Free Ridership, Spillover, and NTG Ratio 56
Table 5-6. DEC SBES Reported, Verified Gross and Verified Net Savings 57
Table 5-7. DEP SBES Reported, Verified Gross and Verified Net Savings 57
Table 8-1 HVAC Interactive Effects Multipliers from the NEEP Mid-Atlantic TRM A-2
Table 8-2 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis A-2
Table 8-3 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM A-3

List of Figures

Figure 1-1 Reported, Verified Gross and Net Energy and Demand Savings - DEC 7
Figure 1-2 Reported, Verified Gross and Net Energy and Demand Savings – DEP 8
Figure 2-1. DEC Reported Gross Energy and Demand Savings by Measure Category............12
Figure 2-2. DEP Reported Gross Energy and Demand Savings by Measure Category............13
Figure 2-3. Reported Energy Savings by Facility Type...14
Figure 3-1 Virtual Verification Platform Example 22
Figure 3-2 Survey Responses by Measure Category 32
Figure 3-3 Responses Driving ISR Results 34
Figure 3-4 Comparison of Energy Savings Realization Rates by Strata - DEC.........................36
Figure 3-5 Comparison of Energy Savings Realization Rates by Strata – DEP 37
Figure 3-6 Comparison of Summer Peak Demand Savings Realization Rates by Strata - DEC40
Figure 3-7 Comparison of Summer Peak Demand Savings Realization Rates by Strata – DEP41
Figure 3-8 Comparison of Winter Peak Demand Savings Realization Rates by Strata - DEC..41
Figure 3-9 Comparison of Winter Peak Demand Savings Realization Rates by Strata – DEP .42
Figure 4-1. Program Satisfaction (n=97)..46
Figure 4-2. Implementer and Contractor Satisfaction (n=97)..47
Figure 4-3:Program Challenges/Drawbacks, (n=97)..47
Figure 4-4:Program Benefits, (n=97) 48
Figure 4-5:Program Improvements 49

1. Evaluation Summary

1.1 Program Summary

The Small Business Energy Saver (SBES) program is a direct install program offered to qualifying commercial customers with an average annual demand of 180 kW or less. Participating customers receive an energy assessment at their facility, and subsequently a set of recommended energy efficient measure retrofits. Customers receive information about the proposed measure installation and project costs including utility incentives of up to 80 percent for lighting and refrigeration, and HVAC measures. Once approved, the direct installation is scheduled and completed with minimal disruption to business operations.

The following measures are currently included in the SBES program:

1. Lighting Measures: LED interior and exterior lighting solutions.
2. Refrigeration Measures: lighting, motors, and controls for refrigeration cases.
3. HVAC Measures: HVAC controls, thermostats, and tune-ups

Lime Energy is the current Implementation Contractor that administers the SBES program in the Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) jurisdictions. Lime Energy provides integrated energy audits, equipment procurement, and payment services to participating customers. Measure installation is performed by Lime Energy or a subcontractor of Lime Energy.

1.2 Evaluation Objectives and Program Level Findings

This evaluation provides an independent assessment of program impacts and performance for participation that occurred between 1/1/2019 and 6/30/2020. Guidehouse used an engineering-based approach to calculate program impacts, similar to previous evaluation cycles with some differences pertaining to data collection activities. Due to the ongoing COVID-19 pandemic, Guidehouse replaced the previous onsite field study activities with virtual verification to collect information necessary for impact calculations.

Evaluation objectives include the following:

1. Impact Evaluation:
    a. Verify deemed savings estimates through review of measure assumptions and calculations.
    b. Perform virtual verification of measure installations and collect data for use in an engineering analysis.
    c. Estimate the amount of observed energy and peak demand savings (both summer and winter) by measure via engineering analysis.

2. Net-to-Gross Analysis:
    a. Assess the Net-to-Gross ratio by addressing spillover and free-ridership via customer online surveys.

3. Process Evaluation:
    a. Conduct phone interviews with program management and implementation contractor(s) and to collect data for use in process analysis.

b. Administer customer online surveys to collect data for use in process analysis. Evaluate the strengths and weaknesses of current program processes and customer perceptions, with special consideration for effects of the COVID-19 pandemic.

By performing both impact and process components of the EM&V effort, Guidehouse provides 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. Guidehouse found that Duke Energy is successfully delivering the SBES Program to customers, participant satisfaction is generally favorable, and the reported measure installations are relatively accurate.

For the evaluation period covered by this report, there were a total of 1,964 projects comprised of roughly 21,909 measures installed through the program in the DEC jurisdiction and a total of 1,583 projects with roughly 16,853 measures installed through the program in the DEP jurisdiction. The program-level evaluation findings are presented in Table 1-1 and Figure 1-1 for DEC, and Table 1-2 and Figure 1-2 for DEP.

Guidehouse found the realization rate for gross energy savings to be 100 and 101 percent for DEC and DEP, respectively, meaning that total verified gross energy savings were found to be similar to the claimed in the tracking database provided by Duke Energy. Virtual impact assessments found the measure installation rate (ISR) to be 96 percent for both jurisdictions, meaning participants self-reported small differences between the measures indicated in the tracking data and those received or currently operating at their facilities. However, the ISR was offset by the addition of HVAC interactive effects during the engineering analysis, which was the main driver for the final realization rate for energy. The realization rate for DEC and DEP jurisdictions' gross demand savings however were found to both be 99 percent for summer coincident peak demand and 98 percent for winter coincident peak demand. The addition of coincidence factors to demand savings calculations is the main driver of the slightly lowered realization rate.

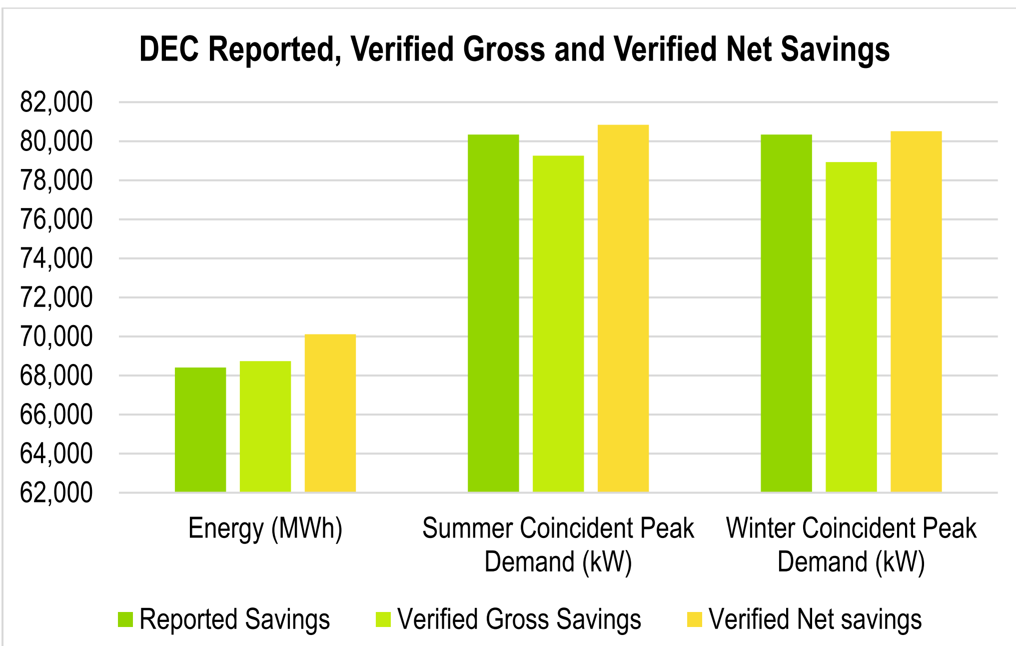
Guidehouse found the net-to-gross (NTG) ratio to be 1.02 for both DEC and DEP jurisdictions, meaning that for every 100 kWh of reported energy savings, 102 kWh can be attributed directly to the program. By multiplying the verified gross energy and demand savings by the NTG ratio, Guidehouse calculated the net energy and demand impacts shown in Table 1-1 for DEC and Table 1-2 for DEP. These findings will be discussed in greater detail throughout this report.

Table 1-1. SBES Reported, Verified Gross and Verified Net Savings - DEC

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	68,413	80,343	80,343
Realization Rate	100%	99%	98%
Verified Gross Savings	68,738	79,256	78,936
Net-to-Gross	102%	102%	102%
Verified Net savings	70,113	80,841	80,515

Source: Guidehouse analysis, values subject to rounding.

Figure 1-1 Reported, Verified Gross and Net Energy and Demand Savings - DEC



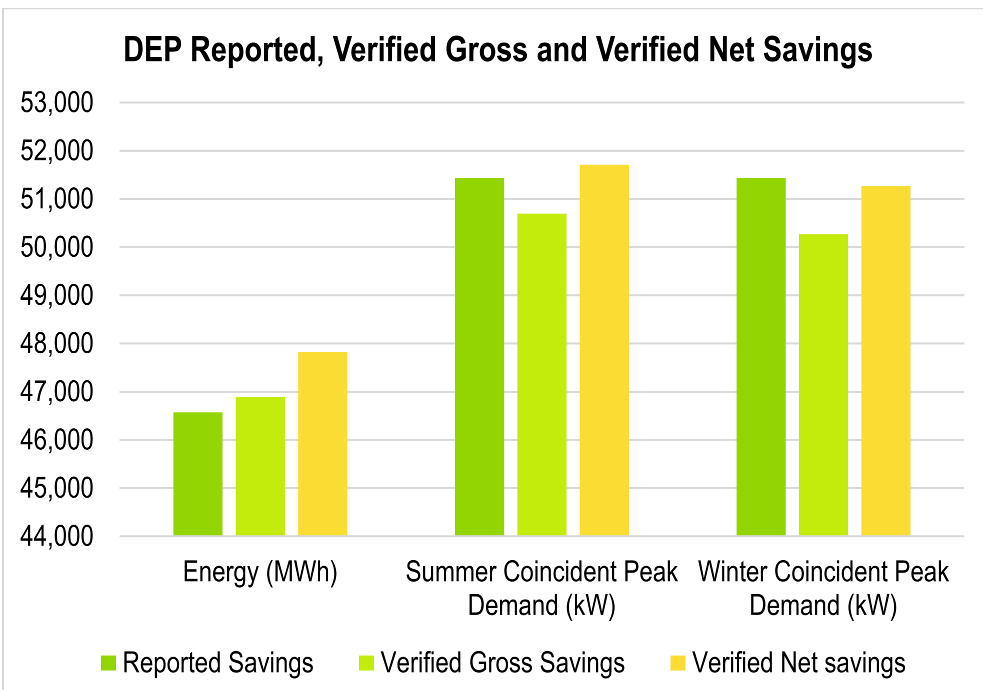
Source: Guidehouse analysis, values subject to rounding.

Table 1-2 SBES Reported, Verified Gross and Verified Net Savings – DEP

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	46,571	51,433	51,433
Realization Rate	101%	99%	98%
Verified Gross Savings	46,889	50,696	50,267
Net-to-Gross	102%	102%	102%
Verified Net savings	47,827	51,710	51,272

Source: Guidehouse analysis, values subject to rounding.

Figure 1-2 Reported, Verified Gross and Net Energy and Demand Savings – DEP



Source: Guidehouse analysis, values subject to rounding.

1.3 Evaluation Parameters and Sample Period

To accomplish the evaluation objectives, Guidehouse performed a variety of research and analysis activities, including:

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

Table 1-3 summarizes the evaluated parameters. The targeted sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 2.5 percent.

Table 1-3. Evaluated Parameters

Evaluated Parameter	Description	Details
In-Service Rates	The percentage of program measures in use as compared to reported	Virtual verification assessments completed by participants
Satisfaction	Customer satisfaction	Process Surveys (Satisfaction with program elements Satisfaction with implementation contractor)
Free Ridership	Fraction of reported savings that would have occurred anyway, even in the absence of the program	NTG surveys
Spillover	Additional, non-reported savings that occurred as a result of participation in the program	NTG surveys

Source: Guidehouse

The evaluation covers program participation from 1/1/2019 and 6/30/2020. Table 1-4 shows the start and end dates of Guidehouse' s sample period for evaluation activities.

Table 1-4. EM&V Sample Period Start and End Dates

Activity	Start Date	End Date
Virtual Verification	2/8/2021	3/05/2021
Process and NTG surveys	2/1/2021	2/26/2021

Source: Guidehouse

1.4 Evaluation Considerations and Recommendations

The evaluation team recommends a few actions for improving the SBES Program, based on insights gained through the evaluation effort. These recommendations are intended to assist Duke Energy with enhancing the program delivery and customer experience, as well as to possibly increase program impacts. Further explanation for each recommendation can be found later in this report.

1. **Consider introducing additional equipment choices in the program.** There were a subset of customers reporting that the program was unable to provide all the energy efficiency equipment they wanted. Duke Energy should consider introducing more equipment choices in the program to include additional outdoor lighting and HVAC measures. This also presents an opportunity for channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.
2. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, indicating that customers were sometimes unclear about the various stages of the program process and did not receive proper communication and guidance from the implementer and/or Duke Energy. Additional education from both Lime Energy and Duke Energy account managers should help customers better understand the program participation process.
3. **Consider using TRM algorithms for HVAC measures.** Lime Energy and Duke Energy developed deemed savings estimates using regional data for HVAC measures. Although the methodology for developing these estimates was accurate, Guidehouse recommends Duke Energy consider using TRM algorithms too and substituting the variables in these algorithms using regional values to estimate savings. This may enhance the transparency of the impact estimates for these measures.
4. **The Program Net-to-Gross Ratio is high**. This indicates that the program is providing a key service to small business customers in helping them manage their energy use.

2. Program Description

2.1 Program Design

The SBES Program is available to qualifying commercial customers with average demand less than 180 kilowatts (kW) demand service. After completing the program application to assess participation eligibility, customers receive a free energy assessment to identify equipment for upgrade. Lime Energy reviews the energy assessment results with the customer, who then chooses which equipment upgrades to perform. Qualified contractors complete the equipment installations at the convenience of the customer.

The SBES Program recognizes that customers with lower savings potential may benefit from a streamlined, one-stop, turnkey delivery model and relatively high incentives to invest in energy efficiency. Additionally, small businesses may lack internal staffing dedicated to energy management and can benefit from energy audits and installations performed by an outside vendor.

The program offers incentives in the form of a discount for the installation of measures, including high-efficiency lighting, refrigeration and HVAC equipment. These incentives increase adoption of efficient technologies beyond what would occur naturally in the market. During the period included in this evaluation, the SBES Program 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 SBES program also achieved program savings from HVAC and refrigeration measures.

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 and the implementation contractor maintain 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, this database contains measure level details that are useful for EM&V activities. Table 2-1 provides a summary of the gross reported energy and demand savings and participation for 2019-2020.

Table 2-1. Reported Participation and Gross Savings Summary

Reported Metrics	DEC	DEP
Projects	1,964	1,583
Measures Installed	21,909	16,853
Gross Annual Energy Savings (MWh)	68,413	46,571
Average Quantity of Measures per Project	11	10
Average Gross Savings Per Project (MWh)	34.83	29.41

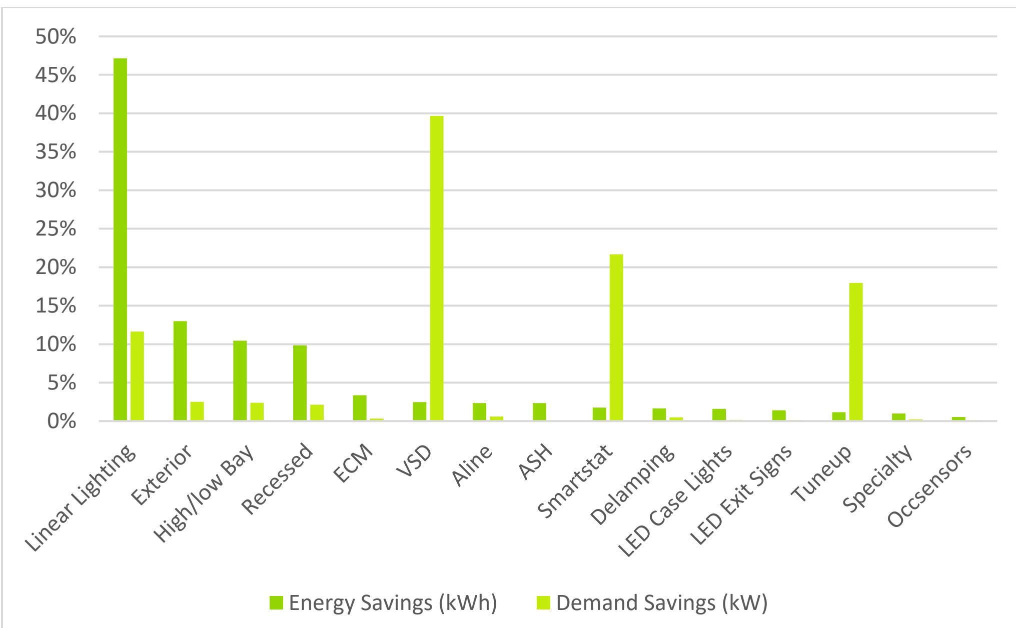
Source: SBES Tracking Database

Duke Energy uses assumptions and algorithms primarily from the New York Technical Resource Manual[1] (TRM) as the basis for energy and demand savings calculations[2] for lighting and refrigeration measures. This TRM is robust, well-established, and follows industry best practices for the measures found in the SBES program. The evaluation team believes the NY TRM is an appropriate basis for estimating savings in the DEC and DEP jurisdictions based on Guidehouse' s assessment of the underlying energy savings assumptions. Lime Energy worked with Duke Energy to develop the HVAC measures' deemed savings using regional data, Guidehouse reviewed the methodology for developing deemed savings estimates for these measures and think the deemed savings values are appropriate and agree with their use.

2.2.1 Program Summary by Measure

Efficient LED linear lighting retrofits were the highest contributor to program energy savings in 2019 -2020, followed by exterior lighting measures and a variety of LED lighting measures for DEC and DEP as seen in Figure 2-1 and Figure 2-2. However, HVAC measures such as VSD, Smart Thermostats and HVAC tune-ups contributed the most to demand savings for both jurisdictions. In addition, refrigeration measures (including EC motors, LED case lighting, and anti-sweat heaters) also contributed to savings. Overall, lighting measures contribute 86 percent of reported program energy savings, refrigeration measures contribute 9 percent and HVAC measures contribute the remaining 5 percent.

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

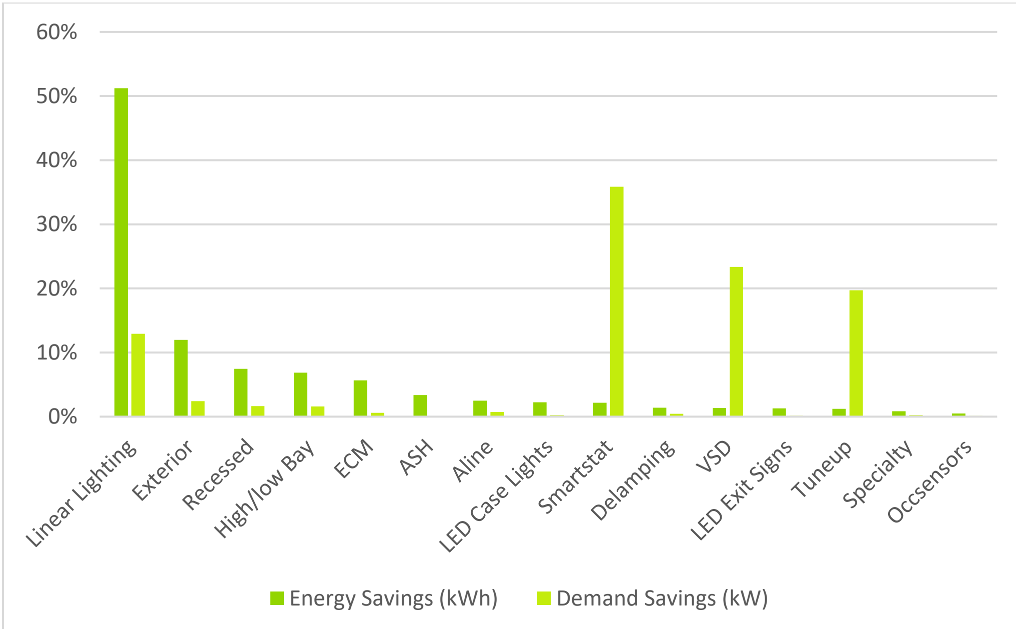


Source: SBES Tracking Database

[1] New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial, known as the Technical Resource Manual (TRM), Version 7, April 15, 2019

[2] The Pennsylvania Technical Reference Manual, 2016 is used for the anti-sweat heater control measure's algorithms and assumptions

Figure 2-2. DEP Reported Gross Energy and Demand Savings by Measure Category



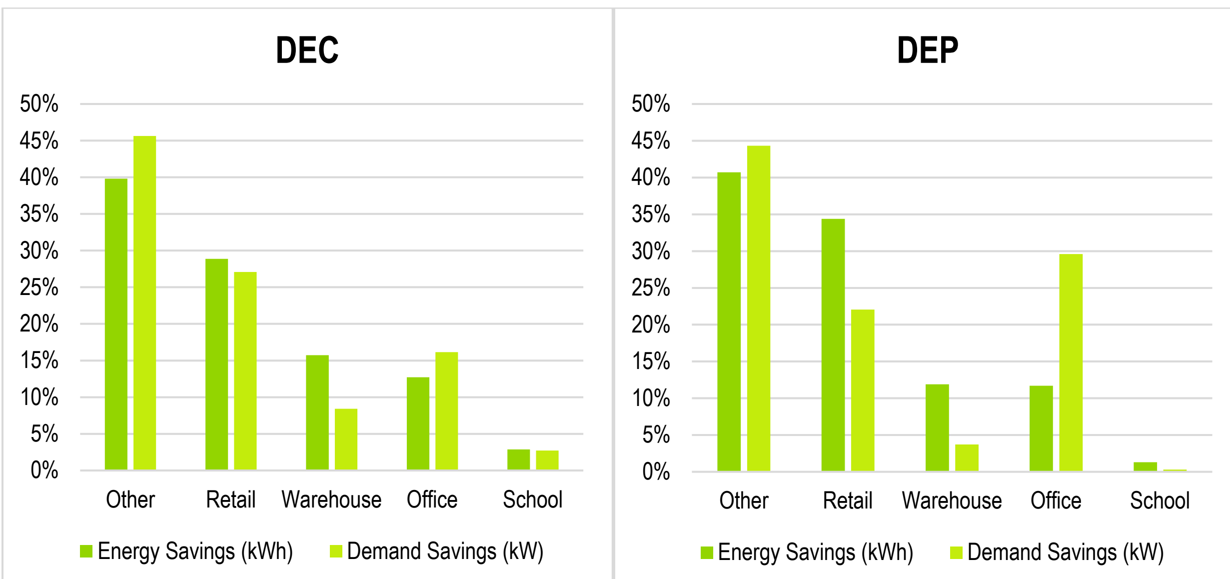
Source: SBES Tracking Database

2.2.2 Savings by Facility Type

Guidehouse reviewed the business type information in the tracking database to understand the participant demographics. The tracking data included SIC codes for each project, resulting in many unique detailed building types. As part of the engineering analysis for this evaluation, Guidehouse used the NEEP Mid-Atlantic TRM[3] to make impact adjustments to account for factors such as HVAC interactive effects and coincidence factors. To accomplish this, Guidehouse mapped the SIC codes from the tracking data to the facility types detailed in the TRM.

These facility types are shown below in Figure 2-3. Note that the largest category is “other”, which indicates either the SIC code was not populated or a suitable TRM facility type was not found. The distribution of facility types is representative of a large variety of small business customers, indicating that the program is successfully recruiting participants across several sectors. The “other”, retail, restaurant and warehouse facilities represent the largest contributors of energy and demand savings in both jurisdictions.

Figure 2-3. Reported Energy Savings by Facility Type



Source: SBES Tracking Database

[3]NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf

3. Impact Evaluation

3.1 Impact Results

Table 3-1 shows the program-level results for gross energy and demand savings for DEC and DEP. The subsequent tables, Table 3-2, Table 3-3, and Table 3-4 show the end use level results for gross energy and demand savings for DEC and DEP. Guidehouse estimates gross realization rates of 100%, 99% and 98% for DEC energy, summer coincident demand, and winter coincident demand, respectively. The gross realization rates for DEP are estimated as 101%, 99% and 98% for energy, summer coincident demand, and winter coincident demand, respectively. The realization rates in these tables have been determined according to the in-service rates calculated based on the findings of the virtual verification survey as well as an engineering/deemed savings review of the algorithms.

Table 3-1 Reported and Verified Program-Level Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	68,413,344	80,343	80,343
	Realization Rate	100.4%	98.6%	98.2%
	Verified Gross Savings	68,737,750	79,256	78,936
DEP	Reported Savings	46,571,185	51,433	51,433
	Realization Rate	100.7%	98.6%	97.7%
	Verified Gross Savings	46,888,802	50,696	50,267

Source: Guidehouse analysis, values subject to rounding

Table 3-2 Reported and Verified Lighting Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	59,789,384	16,221	16,221
	Realization Rate	100.5%	93.3%	91.3%
	Verified Gross Savings	60,113,791	15,134	14,814
DEP	Reported Savings	39,117,872	10,390	10,390
	Realization Rate	100.8%	92.9%	88.8%
	Verified Gross Savings	39,435,490	9,652	9,223

Source: Guidehouse analysis, values subject to rounding

Table 3-3 Reported and Verified HVAC Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	3,666,767	63,700	63,700
	Realization Rate	100.8%	92.9%	88.8%
	Verified Gross Savings	3,666,767	63,700	63,700
DEP	Reported Savings	2,197,861	40,590	40,590
	Realization Rate	100.0%	100.0%	100.0%
	Verified Gross Savings	2,197,861	40,590	40,590

Source: Guidehouse analysis, values subject to rounding

Table 3-4 Reported and Verified Refrigeration Impacts

Program	Parameter	Energy (kWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
DEC	Reported Savings	4,957,192	422	422
	Realization Rate	100.0%	100.0%	100.0%
	Verified Gross Savings	4,957,192	422	422
DEP	Reported Savings	5,255,451	453	453
	Realization Rate	100.0%	100.0%	100.0%
	Verified Gross Savings	5,255,451	453	453

Source: Guidehouse analysis, values subject to rounding

Table 3-5 below presents the energy, summer peak and winter peak impacts by the different measure categories in the DEC SBES program. Table 3-6 presents the same impacts by measure category for the DEP SBES program.

Table 3-5 Reported and Verified Measure-Level Impacts - DEC

Measure Category	Reported Savings (kWh)	Verified Energy Savings (kWh)	Energy Realization Rate	Reported Savings (kW)	Verified Demand Savings (Summer kW)	Summer Demand Realization Rate	Verified Demand Savings (Winter kW)	Winter Demand Realization Rate
A-Line Lamps	1,605,753	1,697,337	106%	482	580	120%	591	123%
Anti Sweat Heater	1,602,710	1,597,708	100%	38	38	100%	38	100%
De-lamping	1,137,371	1,105,993	97%	390	416	107%	306	79%
ECM	2,302,550	2,302,550	100%	263	263	100%	263	100%
Exterior Lights	8,886,092	8,440,067	95%	2,007	0	0%	1,896	94%
Bay Lights	7,146,435	6,898,134	97%	1,909	2,256	118%	2,256	118%
LED Tubes	32,263,196	32,956,441	102%	9,349	9,471	101%	7,312	78%
LED Case Lighting	1,084,809	1,084,809	100%	121	121	100%	121	100%
LED Exit Signs	955,181	991,480	104%	110	140	128%	140	128%
Occupancy Sensors	356,876	346,393	97%	89	72	80%	72	80%
Recessed Lighting	6,729,790	6,941,007	103%	1,706	1,986	116%	2,024	119%
Smart Thermostat	1,199,650	1,199,650	100%	17,415	17,415	100%	17,415	100%
Specialty Lights	675,811	709,064	105%	178	213	119%	217	122%
Tune-up	786,372	786,372	100%	14,425	14,425	100%	14,425	100%
VSD	1,680,745	1,680,745	100%	31,860	31,860	100%	31,860	100%
Grand Total	**68,413,344**	**68,737,750**	**100%**	**80,343**	**79,256**	**99%**	**78,936**	**98%**

Source: Guidehouse analysis, values subject to rounding

Table 3-6 Reported and Verified Measure-Level Impacts – DEP

Measure Category	Reported Savings (kWh)	Verified Energy Savings (kWh)	Energy Realization Rate	Reported Savings (kW)	Verified Demand Savings (Summer kW)	Summer Demand Realization Rate	Verified Demand Savings (Winter kW)	Winter Demand Realization Rate
A-Line Lamps	1,161,239	1,223,170	105%	372	446	120%	455	122%
Anti Sweat Heater	1,571,502	1,571,502	100%	35	35	100%	35	100%
De-lamping	644,442	577,129	90%	226	221	98%	163	72%
ECM	2,636,283	2,636,283	100%	302	302	100%	302	100%
Exterior Lights	5,579,037	5,156,972	92%	1,237	0	0%	1,139	92%
Bay Lights	3,188,803	3,088,653	97%	815	953	117%	953	117%
LED Tubes	23,850,441	24,499,920	103%	6,650	6,755	102%	5,216	78%
LED Case Lighting	1,047,666	1,047,666	100%	117	117	100%	117	100%
LED Exit Signs	603,599	634,030	105%	69	89	129%	89	129%
Occupancy Sensors	228,693	212,761	93%	57	47	82%	47	82%
Recessed Lighting	3,466,657	3,626,739	105%	845	997	118%	1,016	120%
Smart Thermostat	1,008,250	1,008,250	100%	18,439	18,439	100%	18,439	100%
Specialty Lights	394,961	416,116	105%	119	143	120%	146	122%
Tune-up	563,167	563,167	100%	10,137	10,137	100%	10,137	100%
VSD	626,444	626,444	100%	12,014	12,014	100%	12,014	100%
Grand Total	**46,571,185**	**46,888,802**	**101%**	**51,433**	**50,696**	**99%**	**50,267**	**98%**

Source: Guidehouse analysis, values subject to rounding

The following sections provide more details on the results, the methodology, and findings for the DEC and DEP impact evaluation.

3.2 Impact Evaluation Methodology

Guidehouse conducted an engineering-based analysis using standard savings algorithms to estimate the energy and demand impacts achieved by the program. The analysis was informed by virtual verification to validate measure quantities and characteristics as compared with information in the program tracking data. Additionally, Guidehouse reviewed relevant engineering parameters, such as HVAC interactive effects, and incorporated updates using the NEEP Mid-Atlantic TRM and 2016 Guidehouse logger analysis. The following subsections describe the methodology used for each element of this process, and the results are discussed in detail in Section 3.3.

3.2.1 Deemed Savings Review

Guidehouse conducted a deemed savings review to evaluate the energy and demand impacts reported in the tracking database for each measure type and category. Guidehouse evaluated all program measures and supporting data parameters. During the time period covered by this evaluation cycle, Lime Energy was the implementation contractor.

Guidehouse conducted a detailed review of the tracking data and impact estimates included within the documents provided by Duke Energy. Guidehouse replicated impact estimates using engineering calculations based on algorithms provided by Lime Energy and using measure parameters from the tracking data where available. Guidehouse also calculated preliminary ex post impacts for lighting measures that included basic modifications to include HVAC interactive effects and coincidence factors[4]. Based on these ex post impacts, Guidehouse calculated an "Engineering Review (ER)" verified realization rate which is the ratio of the savings calculated through the deemed savings review and the reported savings. See Section 3.3.1 for more information and findings from the deemed savings review.

3.2.2 Sample Design

The participation data provided by Duke Energy indicated that the vast majority of energy savings are from lighting measures, with a small contribution of energy savings from refrigeration and HVAC measures. Guidehouse analyzed the program tracking data to characterize the trends in equipment and project size. Similar to previous evaluation cycles, Guidehouse stratified the evaluation sample by project size for lighting and grouped together refrigeration and HVAC measures. This allowed for a proper assessment of a range of projects while maximizing the proportion of total program savings that is represented by the evaluation. It should be noted that for calculations and reporting, HVAC and refrigeration measures were separated out of their combined strata.

Guidehouse used a combined sampling approach but considered strata-level characteristics of each jurisdiction. The combined sample design for both jurisdictions can be seen in Table 3-7 below. The original launch of the virtual verification did not produce the adequate amount of responses to fit the sample design, so more projects were needed to be added to the sample.

In addition to working with the Lime Energy database to create the sample population, the file was analyzed to create reported quantity totals for the lighting, HVAC, and refrigeration

[4] HVAC interactive effects in the savings calculations for indoor lighting measures were sourced from the NEEP Mid-Atlantic TRM and were based on building type, with an assumption of AC and non-electric heating to be conservative

measures. This allowed the virtual verification to ask customers to confirm the quantity installed or provide a reason for a different verified quantity value.

Guidehouse targeted a 90/10 sampling confidence and relative precision for virtual verification at the program level. This expected sample size was approximately 107 projects for verification, seen in the tables below. This was based on a coefficient of variation of 0.5 for all strata, found in past field verification activities for this program. Guidehouse received a total of 90 completed impact surveys back from the sample, representing approximately 6,000 measures. The targeted sampling confidence and precision was 90 percent ± 10 percent, and the achieved was 90 percent ± 2.5 percent

Table 3-7 DEC Expected Sampling Summary

Stratum	Population Project Count	Verification Sample Size
Lighting Large	118	15
Lighting Medium	396	20
Lighting Small	1,969	21
HVAC and Refrigeration	1,065	51
Total	**3,548**	**107**

Source: Guidehouse analysis of DEC-DEP program tracking data

3.2.3 Virtual Verification

Guidehouse conducted verification for a sample of program participants to evaluate the consistency of measure characteristics with the program tracking database. Data collection was structured to gather the information necessary to inform the engineering algorithms used to estimate program impacts.

Guidehouse sent email invitations to a sample of participants. The virtual verification link was personalized so each participant only filled in the information relevant to their project. The virtual verification survey was designed to take about 15-20 minutes for a participant to complete while present at their project location. Participants received an incentive of $25-$50 to compensate them for the time required to complete the virtual verification.

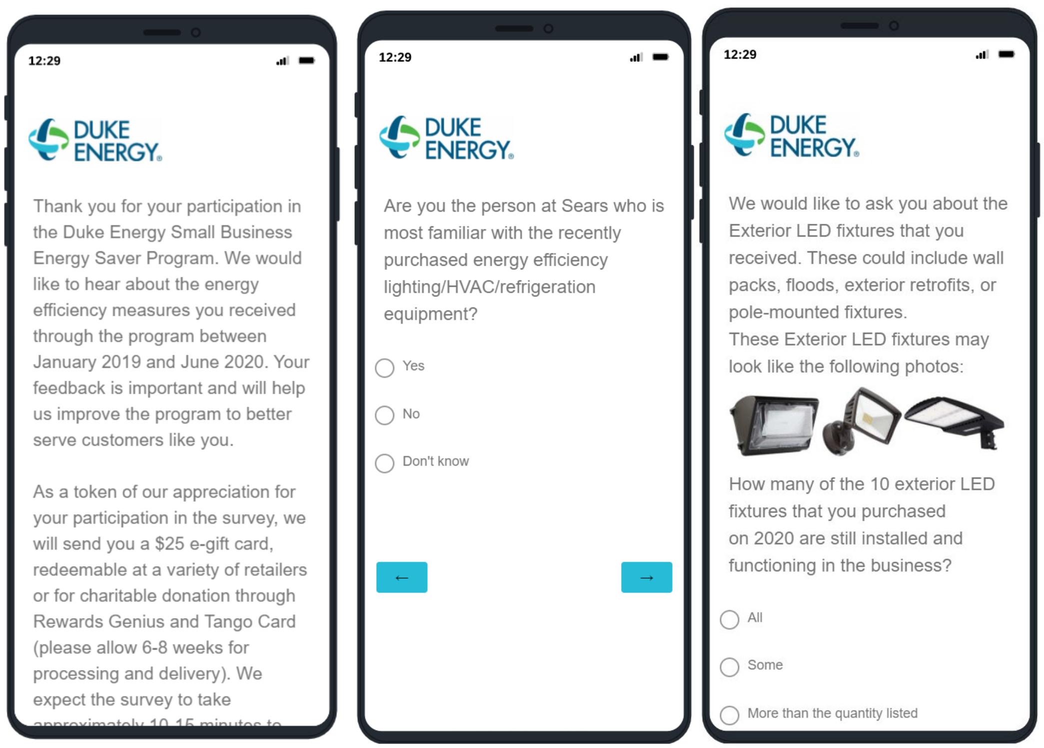
Guidehouse conducted a soft launch of the virtual assessment for a smaller sample of customers to test the process and determine response rates. Early feedback allowed for adjustments to maximize responses. Participants received reminders to complete the assessment. Guidehouse monitored the progress of completes relative to targets and designed a back-up sample to receive invitations when targets were not being met by the initial sample.

Guidehouse used the Qualtrics platform to create the virtual verification interface that participants used to collect key project information. The virtual verification requested photo documentation of certain project characteristics. Customers used a mobile device, such as a smartphone or tablet, to complete the verification process. The virtual verification included general questions about facility features and detailed questions about selected equipment.

Guidehouse asked questions about building HVAC characteristics, operating schedules, measure quantity, lamp/fixture wattage, and efficiency characteristics during the virtual verification. Due to the response rates for these various questions, Guidehouse only used verified measure quantities to update project savings. Guidehouse compared responses associated with heating and cooling system types and hours of operation to the database for consistency checks.

Figure 3-1 shows an example of the Qualtrics virtual verification platform. Participants used their mobile device to access the personalized link and open the interface in a web browser. In the equipment section, participants were prompted to upload pictures of the installed equipment using the camera on their mobile device. Guidehouse used a combination of participant-reported and documentation-based information to inform the verified energy and demand impact calculations.

Figure 3-1 Virtual Verification Platform Example



Source: Guidehouse Virtual Verification Qualtrics Survey

Survey invitations were sent to 2,202 participants between 2/08/2021 and 3/05/2021, with multiple reminders and escalating incentives. This includes all participants who did not receive invites for the process survey. Guidehouse also contacted 150 customers via phone which resulted in 7 additional customers taking the virtual verification survey. Ultimately, 302 participants began the survey, and 90 participants completed the questions in entirety. The 90 completed virtual impact surveys represented almost 6,000 individual measures.

Table 3-8 shows the virtual verification response summary by measure and includes the reported and verified measure quantities.

Table 3-8 Virtual Verification Response Summary by Measure

Measure	Number of Responses by Measure*	Reported Measure Quantity	Verified Measure Quantity
Specialty Lamps	6	56	56
LED Tubes	76	5,127	5,115
Tune-up	9	28	28
Bay Lights	3	91	26
Lighting Controls and Exit Signs	18	116	115
A-Line Lamps	20	167	156
Exterior Lights	14	75	75
Recessed Lights	10	236	233
VSD	3	12	12
De-lamping	1	8	8
Anti-Sweat Heaters	1	5	5
ECM	7	49	49
LED Case Lighting	4	9	9
Total	**172**	**5,979**	**5,887**

Source: Guidehouse Virtual Verification
**Respondents often had multiple measure categories in their projects*

3.3 Impact Evaluation Findings

This section examines findings from the deemed savings review and discusses the main drivers of the savings realization rates. Guidehouse calculates the realization rate as the verified savings divided by the reported savings by measure, which is driven by a combination of the in-service rate, the HVAC interactive effects, and the coincidence factors, described as follows:

1. In-Service Rate (ISR) is the ratio of the verified (i.e., installed) quantity to the reported quantity from the program tracking data.

2. HVAC Interactive Effects are multipliers that reflect effects on space heating and cooling loads caused by a reduction in heat output from efficient lighting. HVAC interactive effects only impact lighting measures. Note that the implementer did not apply HVAC interactive effects for any measures, so this adjustment is equal to the average HVAC interactive effect itself. There are separate adjustments for energy savings and demand savings.

3. Coincidence Factor (CF) represents the portion of installed lighting that is on during the peak utility hours. This affects only demand reductions, not energy savings.

Overall, in-service rates tend to result in minor decreases to the verified energy savings, while HVAC interactive effects result in an increase in savings for lighting measures. Generally, the application of coincidence factor results in decreased demand savings for lighting measures.

3.3.1 Deemed Savings Review

Guidehouse reviewed the program tracking data provided by Duke Energy to assess program activity and the availability of key data fields necessary to support the evaluation. The pre- and post-retrofit measure descriptions summarize the equipment details for each line item in the database, and Guidehouse was able to identify the fields that correspond to ex ante (i.e., reported) energy and demand impacts.

The lighting controls, anti-sweat heater controls, LED case lighting, and refrigeration ECM motor measures were initially lacking information in the Lime Energy tracking data. Lime Energy then provided additional documentation to assist in the review of the program tracking data. Guidehouse used this to confirm that the Lime Energy lighting and refrigeration measure savings in the tracking data align with the algorithms from the New York and Pennsylvania Technical Reference Manuals, as in prior evaluations of this program.

Lime Energy also provided their HVAC measure deemed savings table and provided some background on how those values were developed.

3.3.1.1 Anti-Sweat Heater Controls

Lime Energy calculated the anti-sweat heater controls measure savings using the algorithms from the Pennsylvania TRM.

Refrigerator/Cooler

$$\mathrm{D}kWh_{per\ unit} = \frac{kW_{coolerbase}}{DoorFt} \times (8{,}760 \times CHA_{off}) \times \left(1 + \frac{R_h}{COP_{cool}}\right)$$

$$\Delta kW_{peak\ per\ unit} = \frac{kW_{coolerbase}}{DoorFt} \times CHP_{off} \times \left(1 + \frac{R_h}{COP_{cool}}\right) \times DF$$

Freezer

$$\mathrm{D}kWh_{per\ unit} = \frac{kW_{freezerbase}}{DoorFt} \times (8{,}760 \times FHA_{off}) \times \left(1 + \frac{R_h}{COP_{freeze}}\right)$$

$$\Delta kW_{peak\ per\ unit} = \frac{kW_{freezerbase}}{DoorFt} \times FHP_{off} \times \left(\frac{R_h}{COP_{freeze}}\right) \times DF$$

where:

N	= Number of doors or case length in linear feet having ASH controls installed
R_h	= Residual heat fraction; estimated percentage of the heat produced by the heaters that remains in the freezer or cooler case and must be removed by the refrigeration unit
$Unit$	= Refrigeration unit

8,760	= Hours in a year
$kW_{cooler\ base}$	= Per door power consumption of cooler case ASHs without controls
CHP_{off}	= Percent of time cooler case ASH with controls will be off during the peak period
CHA_{off}	= Percent of time cooler case ASH with controls will be off annually
DF_{cool}	= Demand diversity factor of cooler, accounting for the fact that not all anti-sweat heaters in all buildings in the population are operating at the same time.
COP_{cool}	= Coefficient of performance of cooler
$kW_{freezerbase}$	= Per door power consumption of freezer case ASHs without controls
FHP_{off}	= Percent of time freezer case ASH with controls will be off during the peak period
FHA_{off}	= Percent of time freezer case ASH with controls will be off annually
DF_{freeze}	= Demand diversity factor of freezer, accounting for the fact that not all anti-sweat heaters in all buildings in the population are operating at the same time.
COP_{freeze}	= Coefficient of performance of freezer

3.3.1.2 Electronically Commutated Motors

Lime Energy calculated the electronically commutated motor for Walk-In/Reach-In units measure savings using the algorithms from the New York TRM.

Annual Electric Energy Savings

$$\Delta kWh = \Delta kWh_{EFan} + \Delta kWh_{RH}$$

$$\Delta kWh_{EFan} = units \times \left(\frac{A_{EFan} \times V_{EFan} \times \sqrt{Phase_{EFan}}}{1{,}000}\right) \times F_{PA} \times F_{EFan} \times hrs_{EFan}$$

$$\Delta kWh_{RH} = \Delta kWh_{EFan} \times Comp_{Eff} \times 0.284$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \Delta kW_{EFan} + \Delta kW_{RH}$$

$$\Delta kW_{EFan} = units \times \left(\frac{A_{EFan} \times V_{EFan} \times \sqrt{Phase_{EFan}}}{1{,}000}\right) \times F_{PA} \times F_{EFan} \times CF$$

$$\Delta kW_{RH} = \Delta kW_{EFan} \times Comp_{Eff} \times 0.284$$

where:

ΔkWh	= Annual electric energy savings
ΔkW	= Peak coincident demand electric savings
Δtherms	= Annual gas energy savings
ΔkWh_{EFan}	= Annual electric savings due to evaporator fan motor replacement
ΔkWh_{RH}	= Annual electric savings due to reduced heat from evaporator fan motor replacement
ΔkW_{EFan}	= Summer Peak Coincident Demand Savings due to evaporator fan motor replacement
ΔkW_{RH}	= Summer Peak Coincident Demand Savings due to reduced heat from evaporator fan motor replacement
units	= Number of measures installed under the program
A_{EFan}	= Nameplate amperage of existing evaporator fan motor
V_{EFan}	= Nameplate voltage of existing evaporator fan motor
$Phase_{EFan}$	= Phase of existing evaporator fan
1,000	= Conversion factor, one kW equals 1,000 W
F_{PA}	= Power factor
F_{EFan}	= Reduction of load by replacing evaporator fan motor
hrs_{EFan}	= Evaporator fan annual operating hours
$Comp_{Eff}$	= Efficiency of the cooler/freezer compressor (kW/Ton)
0.284	= Conversion factor from kW to Tons of refrigeration (Tons/kW)
CF	= Coincidence factor

3.3.1.3 Refrigerated LED Case Lighting

Lime Energy calculated the refrigerated LED case lighting measure savings using the algorithms from the New York TRM.

Annual Electric Energy Savings

$$\Delta kWh = \left(\frac{(W \times units)_{baseline} - (W \times units)_{ee}}{1{,}000}\right) \times hrs \times (1 + (Comp_{eff} \times 0.284))$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \left(\frac{(W \times units)_{baseline} - (W \times units)_{ee}}{1{,}000}\right) \times CF \times (1 + (Comp_{Eff} \times 0.284))$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
Δtherms	= Annual gas energy savings
units	= Number of measures installed under the program
W	= Rated wattage of lamp or fixture (Watts)
baseline	= Baseline condition or measure
ee	= Energy efficient condition or measure
1,000	= Conversion factor, one kW equals 1,000 Watts
hrs	= Lighting operating hours
CF	= Coincidence factor
$Comp_{Eff}$	= Efficiency of the cooler/freezer compressor (kW/Ton)
0.284	= Conversion factor from kW to Tons of refrigeration (Tons/kW)

3.3.1.4 HVAC Measures Deemed Savings

Lime Energy worked with Duke Energy to determine the deemed savings for the HVAC measures: fan motor VSDs, HVAC tune-ups, and smart thermostats. For VSDs, Lime Energy provided engineering algorithm(s) used to calculate the energy savings values to support the determination of deemed savings values. For smart thermostats and HVAC tune-ups, deemed savings values were provided to Lime Energy. Lime Energy's regional adjustment methodology for smart thermostats and HVAC tune-ups used 5 years of cooling degree day comparisons with a base temperature of 60 degrees Fahrenheit. There was no adjustment for the VSD measure since VSDs have very little weather dependence.

Since Lime Energy worked with Duke Energy to develop the HVAC measures' deemed savings using regional data, we think the deemed savings values are appropriate and agree with their use.

3.3.1.5 Lighting Controls

Lime Energy also shared the following algorithm used to calculate the lighting control measure energy savings:

$$kWh = \left[kW_{before} * Qty_{before} * \left(Hours * (1 - ReductionFactor)\right)\right] - \left[kW_{after} * Qty_{after} * \left(Hours * (1 - ReductionFactor)\right)\right]$$

The ReductionFactor variable Lime Energy used is equal to 0.3. Guidehouse was unable to replicate the lighting control savings since baseline wattage data was not provided.

3.3.1.6 Lighting Measures

As outlined in previous EM&V reports and in following the best practices for commercial lighting impact verification, Table 3-9 shows the algorithms used by Guidehouse to calculate the savings for the lighting measures. These algorithms are similar to those commonly found in technical reference manuals for commercial lighting measures and match the methodology outlined in the New York TRM. Lime Energy followed similar algorithms to calculate lighting measure savings but did not include HVAC interactive effects or coincidence factors (for demand savings only). A discussion on each impact parameter is included after the table.

Table 3-9 Engineering Algorithms for Lighting Measures

Measure	Energy Savings Algorithm	Coincident Peak Demand Savings Algorithm
Lighting Measures	$kWh = ISR * \frac{(W_b * Qty_b) - (W_{ee} * Qty_{ee})}{1000} * HOU * IF\_Energy$	$kW = ISR * \frac{(W_b * Qty_b) - (W_{ee} * Qty_{ee})}{1000} * CF * IF\_Demand$
ISR = in-service rate*		
Qty_b = baseline quantity of equipment		
Qty_ee = efficient quantity of equipment		
HOU = operating hours		
Watts_b = baseline watts		
Watts_ee = efficient watts		
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		

**Guidehouse did not apply an ISR to the preliminary ex post impacts. ISRs were applied based on findings from evaluation activities. Source: Guidehouse analysis*

Baseline and Efficient Wattage

Based on the measure descriptions in the tracking database, estimates for baseline and efficient wattage appeared to be reasonable and are likely accurate records of project equipment and specifications. The virtual verification survey supported the wattage information provided in the tracking database, as a small subset of respondents provided wattage information.

HVAC Interactive Effects for Energy and Demand

The HVAC interactive effects represent additional HVAC impacts due to changes in heating and cooling load for lighting measures located in conditioned spaces. The tracking databases did not apply HVAC interactive effects for any lighting measures, which resulted in adjustments to the energy and demand savings during Guidehouse’ s engineering review. The HVAC Interactive effects by building type as presented in Table 3-6 were applied from the NEEP Mid-Atlantic TRM to the verified savings as calculated from the engineering review.

Coincidence Factor (CF)

The tracking database included a single demand savings field for lighting measures, which does not incorporate a coincidence factor. Guidehouse interpreted the demand impacts in the tracking data as non-coincident impacts, and the evaluation incorporated summer and winter coincidence factors to calculate kW impacts for reporting purposes. Table 3-7 and Table 3-8 present the summer and winter peak coincident factors that were used in the calculation of the verified demand savings stemming from the engineering review.

3.3.2 HVAC Interactive Effects

HVAC interactive effects are the lighting-HVAC interaction factors that represent the reduced space cooling requirements due to the reduction of waste heat rejected by efficient lighting. Because of this, HVAC interactive effects are not applicable to exterior lighting measures. The evaluation team applied HVAC interactive effects to both the energy and demand savings calculations for the interior lighting measures. The HVAC interactive effects shown in Table 3-10 are sourced from Appendix E (Commercial & Industrial Lighting Waste Heat Factors) in the NEEP Mid-Atlantic TRM and are based on building type[5]. Note that the implementor did not apply HVAC interactive effects for any of the lighting measures claimed in the program year. The HVAC interactive effects adjustment is between 1.00 and 1.10 for energy and 1.00 and 1.44 for demand.

Table 3-10 HVAC Interactive Effects Multipliers from the NEEP Mid-Atlantic TRM

Building Type	WHFe	WHFd
Office	1.10	1.36
Retail	1.06	1.27
School	1.10	1.44
Warehouse	1.02	1.23
Other	1.08	1.35

Source: NEEP Mid-Atlantic TRM

HVAC interactive effects and coincidence factors are the main reason for discrepancy between the reported and verified savings in interior lighting measures. The addition of HVAC interactive effects to the energy savings calculations resulted in an increase of savings. The addition of the HVAC interactive effects to the demand savings resulted in an increase in demand savings.

3.3.3 Coincidence Factors

To develop summer and winter coincidence factors for the lighting measures, Guidehouse used findings from the lighting logger measurements conducted during the 2016 DEC-DEP evaluation. Coincidence factors account for the fact that not all lights are on for the duration of the peak demand period. Coincidence factors range from 0.0 and 1.0, based on measure type, and are detailed in Table 3-11 below. The implementer did not apply coincidence factors to the demand savings for lighting measures. LED exit signs that are on all day receive a summer and winter coincidence factor on 1.0, while exterior lights receive a summer coincidence factor of 0.0 and winter coincidence factor of 1.0.

Lighting controls have a separate set of coincidence factors based on building type, similar to the HVAC interactive effects. There coincidence values come from the NEEP Mid-Atlantic TRM Appendix E (Commercial & Industrial Lighting Waste Heat Factors) and can be found in Table 3-12.

[5] NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf . The HVAC interactive effects (or waste heat factors) used are for Maryland buildings with AC and non-electric heat.

Table 3-11 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis

Measure	Summer Coincidence Factor	Winter Coincidence Factor
LED Exit Sign	1	1
A Line Lamp	0.914	0.931
Recessed Light	0.914	0.931
Specialty Light	0.914	0.931
LED Tube	0.802	0.619
High/low Bay	1	1
Delamping	0.902	0.664
Exterior Light	0	1

Source: DEC-DEP 2016 logger data analysis.

Table 3-12 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM

Building Type	Coincidence Factor
Office	0.70
Retail	0.83
School	0.35
Warehouse	0.80
Other	0.62

Source: NEEP Mid-Atlantic TRM

3.3.4 Engineering Review (ER) Realization Rate

During the engineering review process, Guidehouse used the HVAC interactive effects as well as summer and winter peak coincident factors to adjust the deemed impacts.

On average the addition of HVAC interactive effects resulted in an increase of 5% in energy savings and 25% in demand savings. The addition of coincident peak demand factors resulted in an average decrease of 20% in summer peak demand savings and 25% in winter peak demand savings.

Table 3-13 and Table 3-14 show the realization rates stemming from the engineering review for energy, summer peak and winter peak demand savings for each stratum.

Table 3-13 DEC Engineering Review (ER) Realization Rate

Stratum	Energy Realization Rate	Summer Peak Demand Realization Rate	Winter Peak Demand Realization Rate
Lighting Large	105%	97%	98%
Lighting Medium	106%	96%	97%
Lighting Small	106%	101%	93%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**100%**	**99%**

Source: Guidehouse Engineering Review

Table 3-14 DEP Engineering Review (ER) Realization Rate

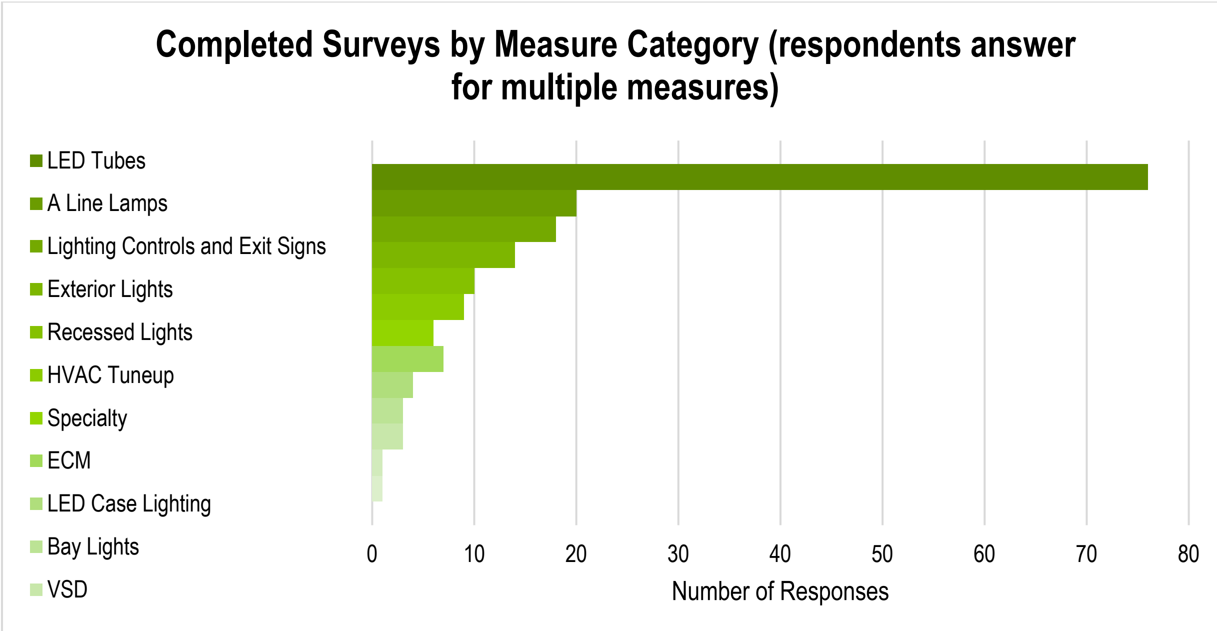
Stratum	Energy Realization Rate	Summer Peak Demand Realization Rate	Winter Peak Demand Realization Rate
Lighting Large	104%	88%	108%
Lighting Medium	106%	96%	99%
Lighting Small	107%	104%	87%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**99%**	**99%**

Source: Guidehouse Engineering Review

3.3.5 In-Service Rates (ISR)

Guidehouse analyzed the responses to the virtual verification survey to identify the verified quantities of equipment installed. Guidehouse calculated the ISR as a ratio between the findings from the virtual verification and the quantities reported in the program-tracking databases. As seen in Figure 3-2, Guidehouse received responses to questions representing the majority of program measure categories.

Figure 3-2 Survey Responses by Measure Category



Source: Guidehouse Virtual Verification

Table 3-15 shows the reported and verified quantities by stratum as collected from the virtual verification survey. Although the number of completed virtual assessments was slightly lower than Guidehouse' s target, this did not impact the precision goals of the evaluation. This is because in-service rates (ISR) at the site level were still extremely high within the sample group, with a 96% realization rate ISR from the survey alone. A table of ISR by stratum can be seen below in Table 3-16.

Table 3-15 Response Summary by Stratum

Stratum	Sample Size	Sample Reported Quantity	Sample Verified Quantity
Lighting Large	3	1,039	965
Lighting Medium	9	2,549	2,546
Lighting Small	53	2,288	2,273
HVAC	14	40	40
Refrigeration	11	63	63
Total	**90**	**5,979**	**5,887**

Source: Guidehouse Virtual Verification

Table 3-16 Verification Energy Realization Rate ISR

Stratum	ISR
Lighting Large	85%
Lighting Medium	100%
Lighting Small	100%
HVAC	100%
Refrigeration	100%
Total	**96%**

Source: Guidehouse Virtual Verification

As shown in Table 3-17 below, the ISR for each measure varied from 29% to 100%. The high/low bay lights measure had the lowest ISR of 29% while the rest of the measures had ISR between 93% and 100%. 11 out of the 13 measure categories had an ISR between 99% and 100%.

Table 3-17 Virtual Verification In-Service Rates Findings

Measure	ISR
Specialty Lamps	100%
LED Tubes	100%
Tune-up	100%
Bay Lights	29%
Lighting Controls and Exit Signs	99%
A-Line Lamps	93%
Exterior Lights	100%
Recessed Lights	99%
VSD	100%
De-lamping	100%
Anti-Sweat Heaters	100%
ECM	100%
LED Case Lighting	100%

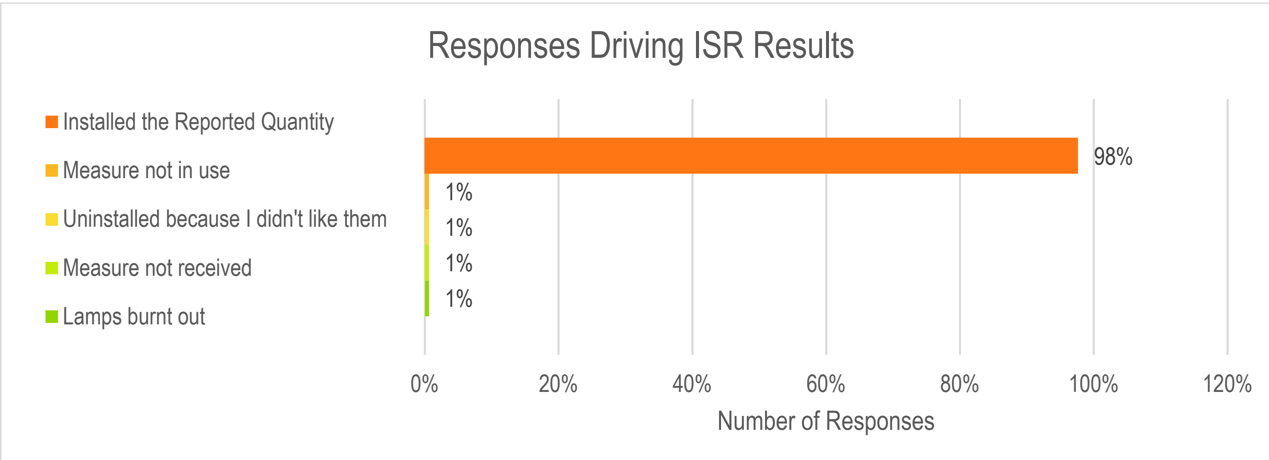
Source: Guidehouse Virtual Verification

**90 virtual verification surveys were completed, with respondents answering questions about multiple measures*

The majority of respondents (98%) reported that they installed the quantity of their measure that was reported in the program tracking data, as shown in Figure 3-3. Four percent of the respondents said that the quantities reported in the program tracking data for their measure were either no longer installed or were never installed. One percent of respondents said the measure is no longer in use, with no further explanation. One percent of respondents said they uninstalled the measure because they didn’t like it. One percent said they never received the measure and the last 1% said their lamps burnt out, so they are no longer installed.

Overall, the ISR values are high and indicate the program is accurately tracking installed measures. Additionally, even though the ISRs decreased for some measures, overall energy savings increased through the application of HVAC interactive effects that were added in during the engineering review. The lighting large strata was the only strata that saw an overall decrease in energy savings due to the ISR.

Figure 3-3 Responses Driving ISR Results



Source: Guidehouse Virtual Verification

3.1 Verified Realization Rates based on ISR and ER

This section presents the overall realization rates based on verified gross savings, separated out by jurisdiction. This process includes merging the realization rates calculated based on the engineering review and in-service rates from the virtual verification assessments.

Table 3-18 presents the overall realization rates for DEC, and Table 3-20 presents the DEP overall realization rates. Table 3-19 and Table 3-21 present the realization rates by end use for DEC and DEP respectively. As mentioned in earlier sections, the virtual verification assessments were used to determine in-service rates (ISRs) for each category. Guidehouse calculated separate impacts using an engineering review (ER) process that included applying algorithms from the New York and Pennsylvania TRMs and measure characteristics from the program tracking data. The total realization rates were obtained using both the verified quantity from the surveyed customers and the engineering review calculations. The ER energy realization rate was 105% for DEC and DEP and the ISRs was 96%.

These realization rates were impacted by the interactive effects in the engineering review calculations. For both programs, these interactive effects increased the verified savings above the reported savings, and the ISR from the virtual verification decreased the verified savings slightly to bring both realization rates to their final values of 100% and 101%. Figure 3-4 and Figure 3-5 show how each calculation method impacted the realization rate for each stratum, as well as the jurisdictions' overall realization rate.

Table 3-18 Energy Installation Rate by Strata – DEC

Stratum	ER	ISR	Total Energy Realization Rate
Lighting Large	105%	85%	89%
Lighting Medium	106%	100%	106%
Lighting Small	106%	100%	106%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**96%**	**100%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-19 Energy Installation Rate by End Use – DEC

End Use	ER	ISR	Total Energy Realization Rate
Lighting Large	106%	96%	101%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**96%**	**100%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-20. Energy Realization Rate by Strata – DEP

Stratum	ER	ISR	Total Energy Realization Rate
Lighting Large	104%	85%	89%
Lighting Medium	106%	100%	106%
Lighting Small	107%	100%	107%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**96%**	**101%**

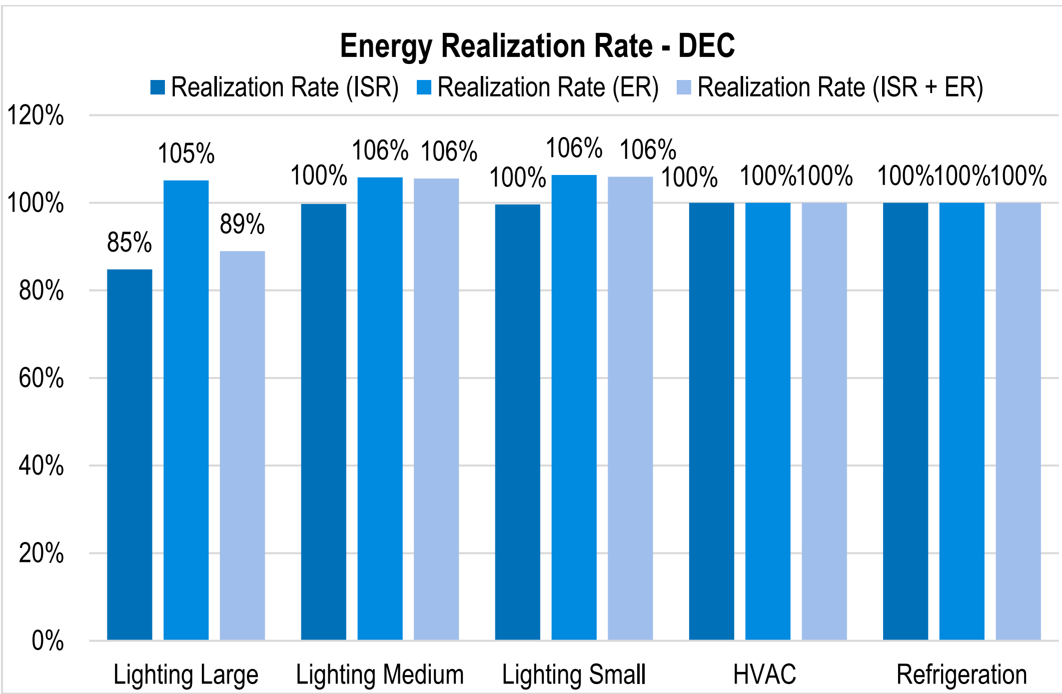
Source: Guidehouse analysis, values subject to rounding.

Table 3-21 Energy Installation Rate by End Use – DEP

End Use	ER	ISR	Total Energy Realization Rate
Lighting	106%	96%	101%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**105%**	**96%**	**101%**

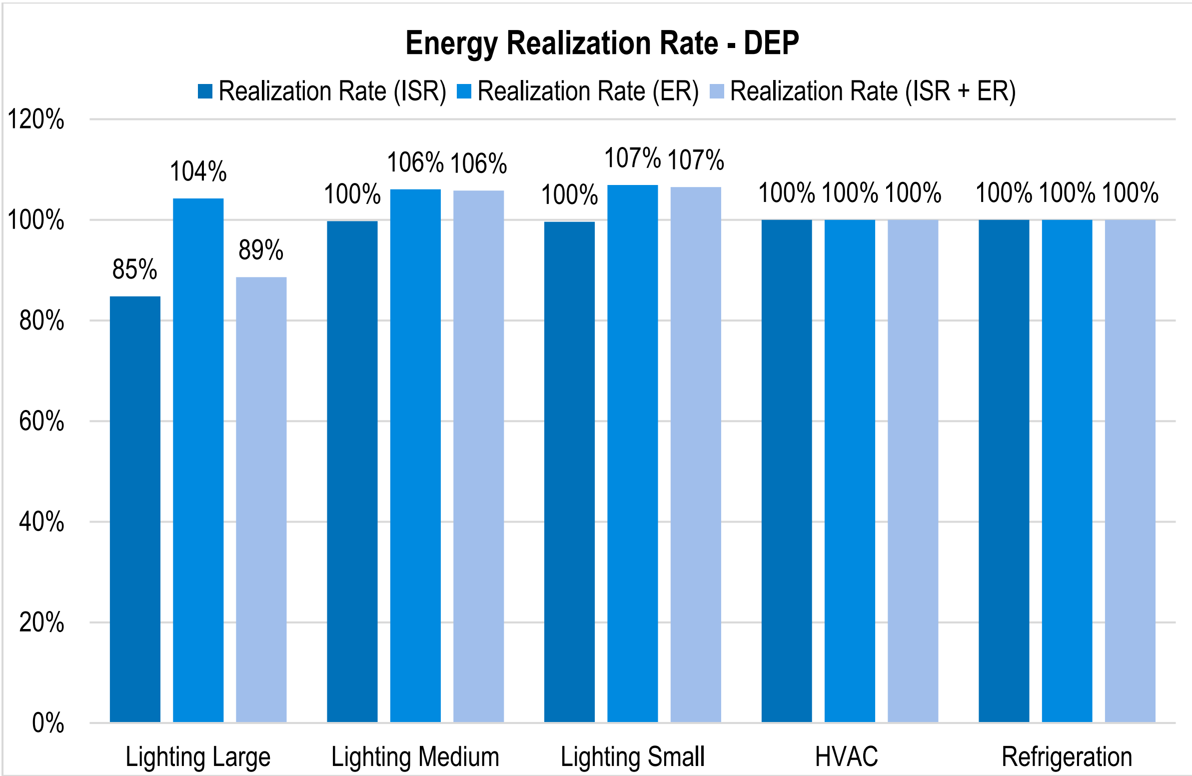
Source: Guidehouse analysis, values subject to rounding.

Figure 3-4 Comparison of Energy Savings Realization Rates by Strata - DEC



Source: Guidehouse analysis, values subject to rounding.

Figure 3-5 Comparison of Energy Savings Realization Rates by Strata – DEP



Source: Guidehouse analysis, values subject to rounding.

The summer and winter peak overall realization rates are shown in the tables below, broken out by jurisdiction. The in-service rates for DEC and DEP demand savings were relatively high at 99% for both summer and winter. The ER realization rates for summer and winter peak are impacted by the HVAC interactive effects and coincidence factors (summer and winter).The total realization rate combines these two verification savings methods. Table 3-22 to Table 3-29 below lay out the jurisdictions' realization rates by season, strata and end use.

For the DEC jurisdiction, the overall summer demand realization rate is 99%. This is because the interactive effects and summer coincidence factors increased or held the realization rate close to 100% while the verified quantities significantly reduced the Lighting Large realization rate, so the factors balanced each other out in the final realization rate. The jurisdiction's overall winter demand realization rate was slightly lower at 98% due to a stronger impact on the Lighting Small strata in addition to the summer realization rate's reasoning, resulting in an overall winter peak realization rate of 98%. Figure 3-6 and Figure 3-8 show how each calculation method impacted the summer and winter realization rate for each of DEC's stratum, respectively.

The DEP jurisdiction has an overall summer demand realization rate of 99% because the interactive effects, summer coincidence factors, and verified quantities once again balanced one another out. The 99% comes from those interactive effects and coincidence factors having a slightly higher influence on the realization rates than the verified quantities. The jurisdiction's overall winter demand realization rate was 98% because the winter demand coincidence factors decreased the Lighting strata's realization rates, producing a slightly lower overall winter peak realization rate. Figure 3-7 and Figure 3-9 show how the calculation methods impacted DEP's summer and winter realization rate for each stratum, respectively.

Table 3-22 Summer Peak Demand Realization Rates by Strata – DEC

Stratum	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting Large	97%	83%	80%
Lighting Medium	96%	100%	96%
Lighting Small	101%	100%	101%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**100%**	**99%**	**99%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-23 Summer Peak Demand Realization Rates by End Use – DEC

Stratum	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting	98%	96%	93%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**100%**	**99%**	**99%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-24 Summer Peak Demand Realization Rates by Strata - DEP

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	88%	83%	73%
Lighting Medium	96%	100%	96%
Lighting Small	104%	100%	104%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**99%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-25 Summer Peak Demand Realization Rates by End Use – DEP

End Use	ER	ISR	Total Summer Demand Realization Rate (ER +ISR)
Lighting	97%	96%	93%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**99%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-26 Winter Peak Demand Realization Rates by Strata – DEC

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	98%	83%	81%
Lighting Medium	97%	100%	97%
Lighting Small	93%	100%	93%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**98%**

Source: Guidehouse analysis, values subject to rounding.

Table 3-27 Winter Peak Demand Realization Rates by End Use – DEC

End Use	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting	96%	96%	91%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**98%**

Source: Guidehouse analysis, values subject to rounding

Table 3-28 Winter Peak Demand Realization Rates by Strata – DEP

Stratum	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting Large	94%	83%	79%
Lighting Medium	95%	100%	95%
Lighting Small	91%	100%	90%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**98%**

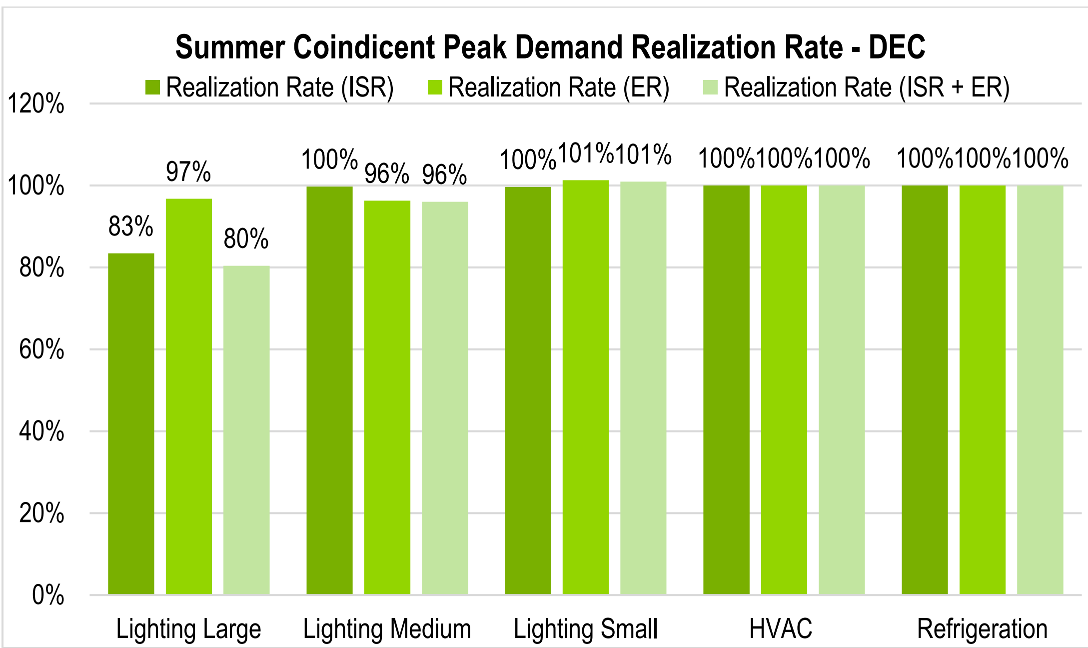
Source: Guidehouse analysis, values subject to rounding.

Table 3-29 Winter Peak Demand Realization Rates by End Use – DEP

End Use	ER	ISR	Total Winter Demand Realization Rate (ER +ISR)
Lighting	93%	96%	89%
HVAC	100%	100%	100%
Refrigeration	100%	100%	100%
Total	**99%**	**99%**	**98%**

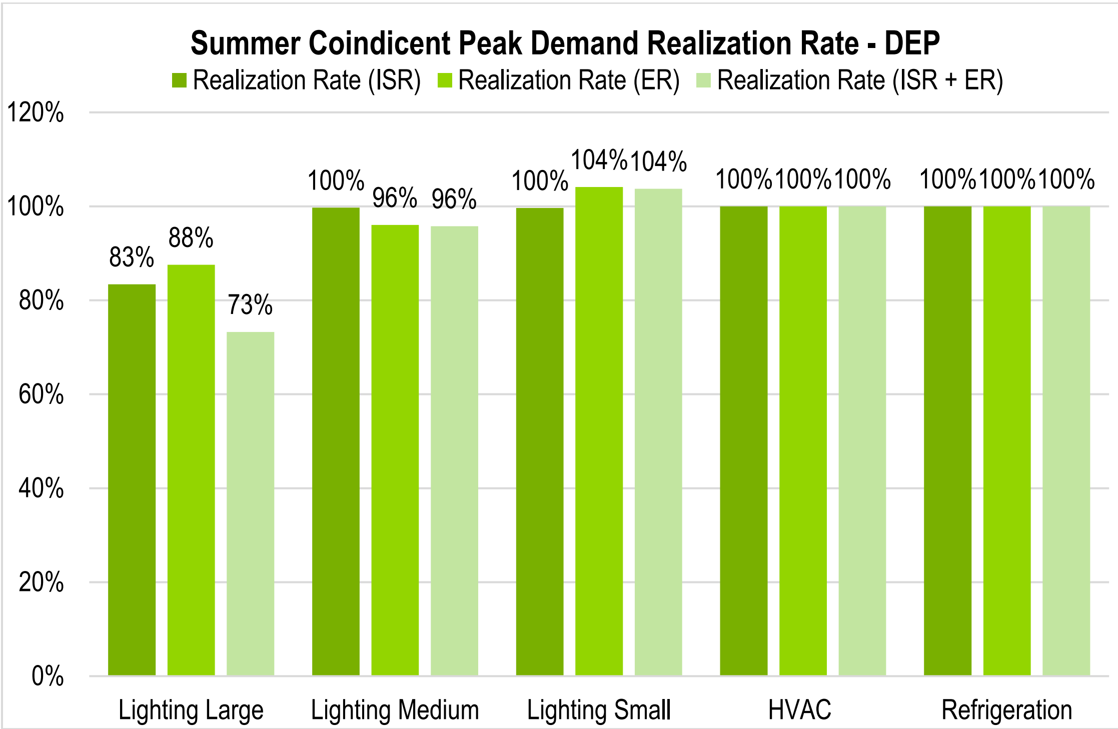
Source: Guidehouse analysis, values subject to rounding

Figure 3-6 Comparison of Summer Peak Demand Savings Realization Rates by Strata - DEC



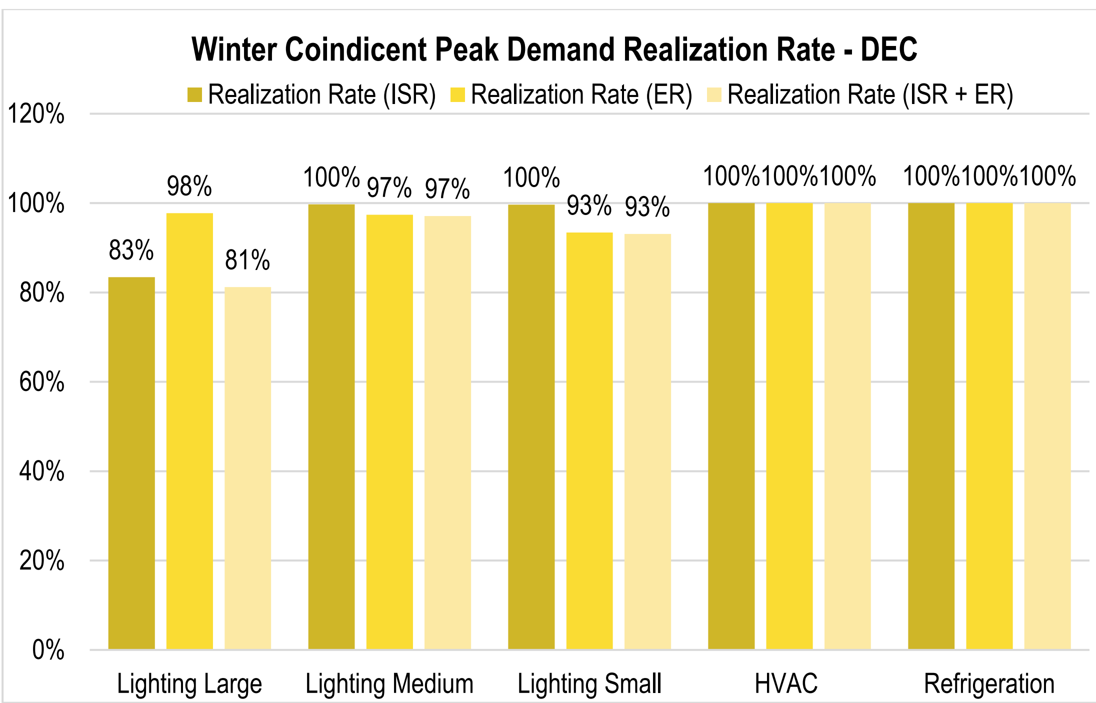
Source: Guidehouse analysis, values subject to rounding.

Figure 3-7 Comparison of Summer Peak Demand Savings Realization Rates by Strata – DEP



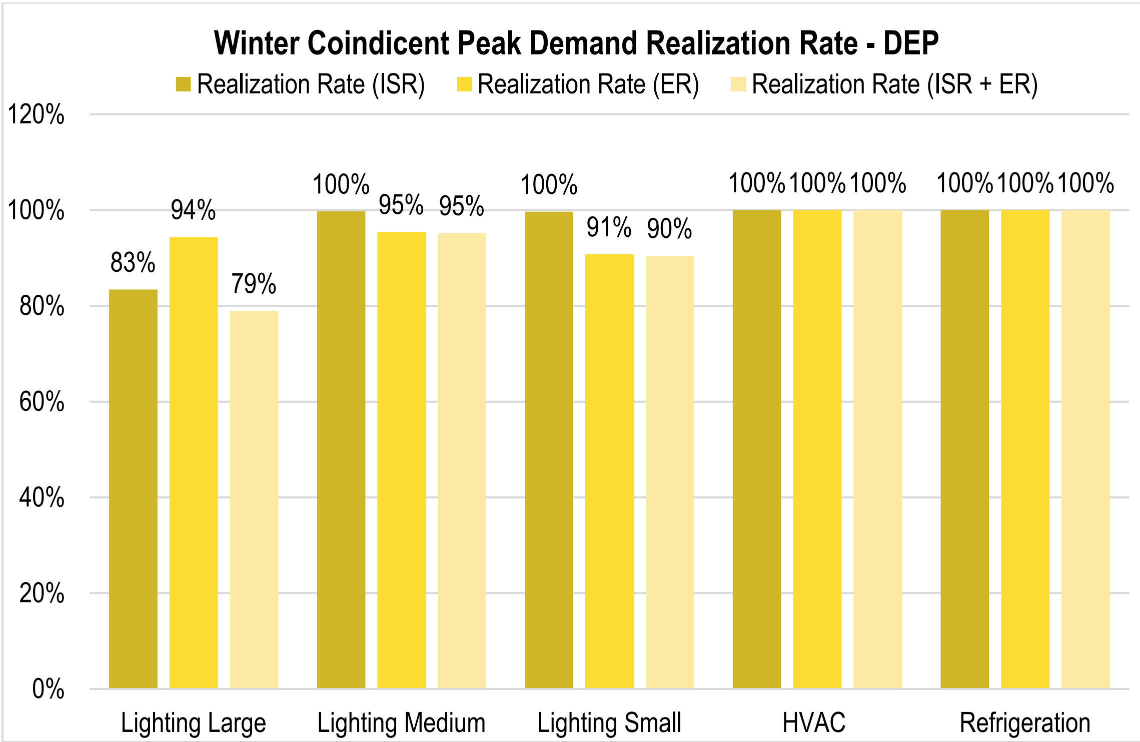
Source: Guidehouse analysis, values subject to rounding.

Figure 3-8 Comparison of Winter Peak Demand Savings Realization Rates by Strata - DEC



Source: Guidehouse analysis, values subject to rounding.

Figure 3-9 Comparison of Winter Peak Demand Savings Realization Rates by Strata – DEP



Source: Guidehouse analysis, values subject to rounding.

4. Process Evaluation

The purpose of the process evaluation is to understand, document and provide feedback on the program implementation components and customer experience.

4.1 Process Methodology

The evaluation team conducted in-depth interviews with SBES Program staff and implementation contractor (IC) staff as well as conducting customer participant surveys, as noted previously. The process findings summarized in this document are based on the results of:

- Participant surveys with 97 program participants.
- Program review, including interviews with the Duke Energy Program Manager and the IC staff; and a review of the program documentation.

Due to the COVID-19 pandemic, Guidehouse performed both the impact and process evaluation activities using online survey platforms, rather than prior evaluations where onsite field verification was used for the impact assessment. To accomplish the virtual assessments, Guidehouse randomly divided the population of participants into separate groups to receive invitations for process and impact-related surveys, such that participants would not be inundated with multiple requests. Email addresses were also not available for all participants. The response status of all process survey participants is outlined in Table 4-1.

Table 4-1. Response Status – Process Survey

Status	Number of Responses
Email Failed	325
Email Hard Bounce	11
Email Not Sent	35
Email Opened	1
Email Sent	536
Email Soft Bounce	15
Survey Finished	97
Survey Partially Finished	25
Survey Started	300
Total	**1,345**

Source: Guidehouse

4.2 Participant Survey

Guidehouse designed the surveys to ask specific questions about the program measure categories. The measure families as a part of this evaluation period are lighting, HVAC, and refrigeration. Participants received an email invitation to complete an online survey that was designed to collect detailed information about program experience and satisfaction. The survey was 15-20 minutes long and participants received an incentive of $10-$40 based on the timing of participation.

The survey effort successfully completed surveys with 97 customers to assess:
- Participation experience and satisfaction
- Participant channel and awareness
- Feedback about program components
- Program improvements
- Program benefits and challenges
- Satisfaction associated with implementation contractors
- Free-ridership, Inside and Outside Spillover

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

4.4 Participant Survey Findings

The following sections detail the process findings from all relevant sources of program information, including interviews with Duke Energy and IC staff and the results of the customer surveys, organized by topic. The feedback received indicates that the SBES Program serves Duke Energy's customers well and represents an important component of Duke Energy's portfolio of business energy efficiency programs. Key findings are as follows:

- 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":
    - 82 percent of respondents indicated 8-10 for satisfaction with overall program experience.
    - 90 percent of respondents indicated 8-10 for satisfaction with Lime Energy
- Sixty-six percent of respondents stated that equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time.
- Eighty-two percent of respondents mentioned that they are extremely likely to participate in this program or a similar Duke Energy program again.
- Sixty-three percent of respondents mentioned that that their attitude towards Duke Energy is more positive after participating in the program.
- Over Fifty percent of respondents stated that they had recommended the program to other businesses. On average, respondents recommended the program to an average of three other businesses.

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

1. Overall customer experience.
2. Implementation contractor.
3. Program challenges.
4. Program benefits.
5. Suggested improvements.

4.4.1 Customer Experience

Customers reported very high satisfaction with their overall program experience as shown in Figure 4-1. Only four percent of the participants rated their overall satisfaction as less than 5, and 82% rated their satisfaction as an 8, 9, or 10.

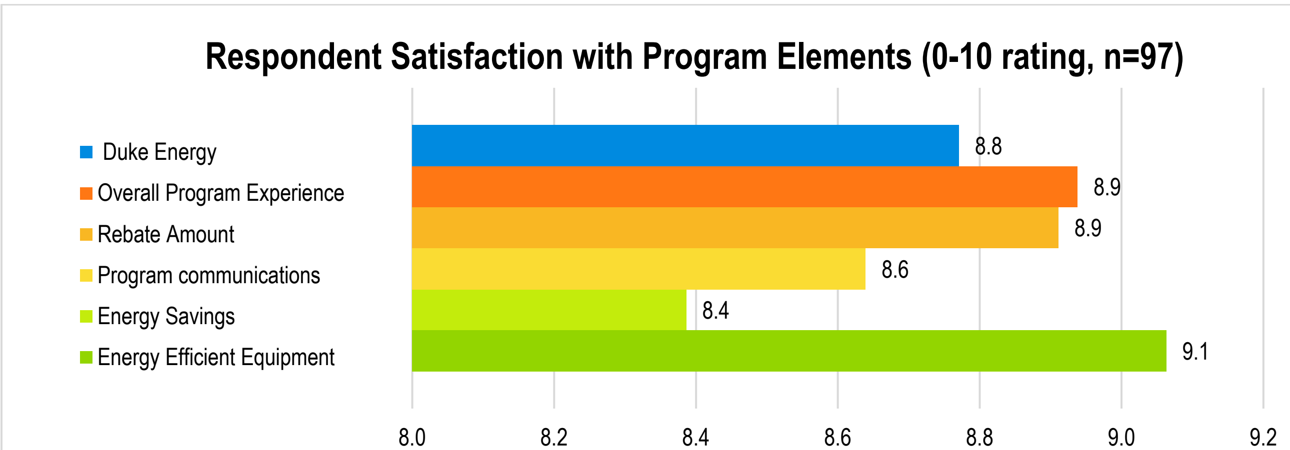
Guidehouse identified some correlations with overall program satisfaction that provide insight into drivers of high satisfaction:

- Customers with overall high program satisfaction were more satisfied on average with every program element, but the difference was particularly noticeable on two program elements:
    - **The energy savings resulting from the new equipment**: highly satisfied customers gave an average rating of 9.4 vs 4.9 among less satisfied customers. Five respondents mentioned that they have not seen any significant savings from the new equipment which is why they provided a lower rating.
    - **Program communications**: highly satisfied customers gave an average rating of 9.4 vs 5.7 among less satisfied customers. Three respondents mentioned that there could be clearer communication between their internal team and Duke Energy.

Around **63%** respondents mentioned that their attitude towards Duke Energy is more positive after participating in the program. These findings indicate both high program satisfaction and an opportunity to continue to market energy efficiency programs to previous participants to achieve deeper savings.

Participation in the SBES program generally served to improve customers' satisfaction with Duke Energy overall.

Figure 4-1. Program Satisfaction (n=97)



Source: Guidehouse analysis

4.4.2 Implementation Contractor

As mentioned in the previous section, customers are highly satisfied with the services provided by the implementation contractor, Lime Energy and that high satisfaction translates to high overall program satisfaction.

Nearly all (97%) said that the proposal was clear about the scope of work to be performed, and 99% of customers said that the proposal was clear about their share of project costs.

A large majority (89%) of customers said they knew who to contact if they had any questions or concerns about their project or any aspect of the program.

Respondents report high level of satisfaction with all different aspects of project implementation from the first assessment of energy efficiency at the project site to post installation clean-up as shown in Figure 4-2. 90% of respondents rated their satisfaction with different aspects of the project implementation at an 8 or higher, on a scale of 0 to 10.

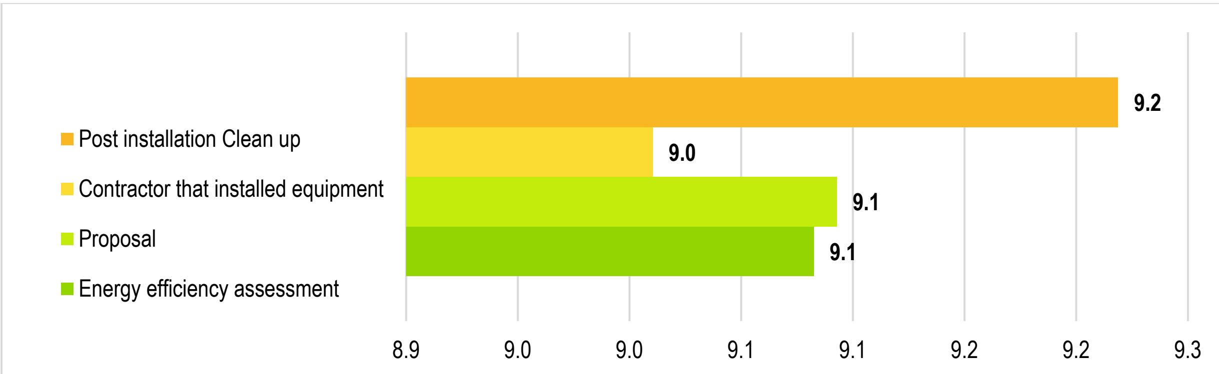
Some verbatim responses from the respondents supporting the high satisfaction:

"The program was excellent and allowed me to afford
the upgrade of lighting in my store. It has cut my monthly bill by every bit of the projection I was given. I am very thankful. Thank you!"

"They worked very well during COVID19 restrictions"

"It was fantastic. I recommended this service to a friend who is also a business owner and he did it as well and was equally thrilled."

Figure 4-2. Implementer and Contractor Satisfaction (n=97)



Source: Guidehouse analysis

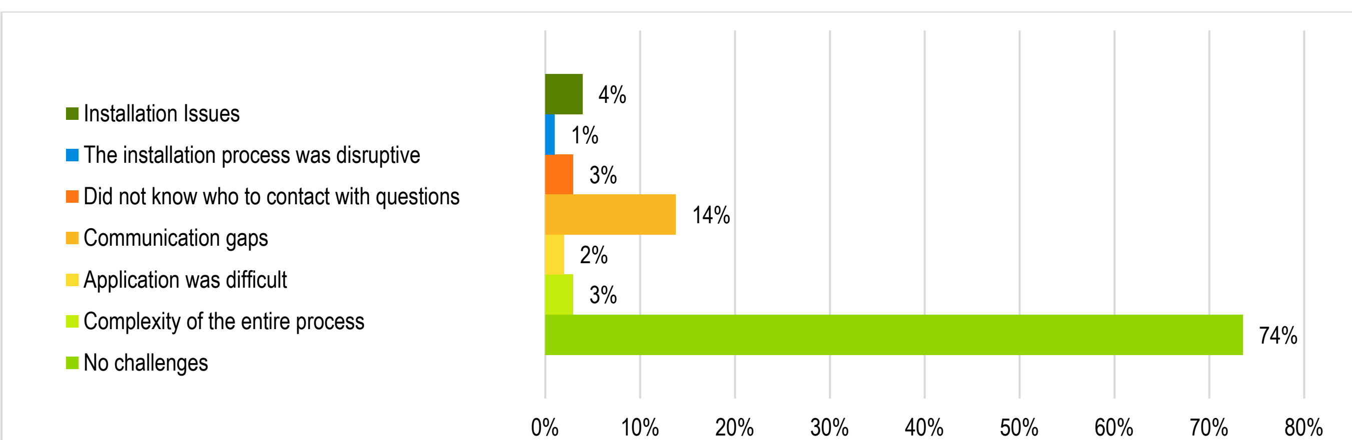
Customers are highly satisfied with the energy efficiency assessment conducted by Lime Energy as well as the proposal prepared by Lime Energy, with 90% rating their satisfaction as an 8 or higher for both program elements.

A similar percentage of customers, 89% rated their satisfaction with the inspection as an 8 or higher with the post installtion cleanup conducted by Lime Energy. Only one customer rated this aspect less than 5 out of 10.

4.4.3 Program Challenges

As seen in Figure 4-3, almost 74% of respondents did not experience any challenges with different program components. Fourteen respondents mentioned that there were communication gaps between Duke Energy, the implementation team and their internal team. Four respondents mentioned that installations of measures was not correct or incomplete. Five respondents mentioned that the application was difficult, and the process was too complex. Only one respondent mentioned that that the installation process was disruptive to their work.

Figure 4-3:Program Challenges/Drawbacks, (n=97)



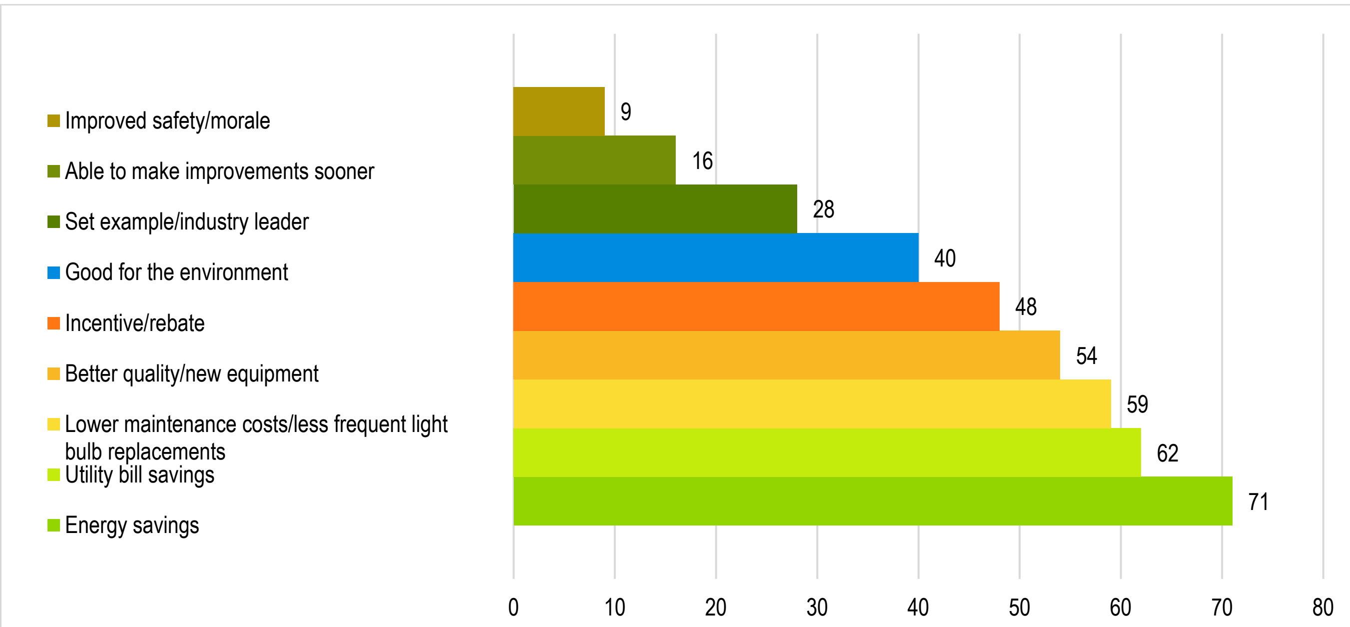
Source: Guidehouse analysis

4.4.4 Program Benefits

As shown in Figure 4-4, a majority of customers identified the energy savings and associated utility bill savings as the top benefit of participating in the SBES program. Better quality equipment and lower maintenance hassle were also significant benefits to many customers. Another important survey finding was that 66 percent of customers stated that the equipment offered through the program allowed them to upgrade all of the equipment they wanted at the time of the project, rather than piecing together the upgrades in multiple phases.

Majority of respondents (82%) mentioned that they are extremely likely to participate in this program or a similar Duke Energy program again.

Figure 4-4:Program Benefits, (n=97)

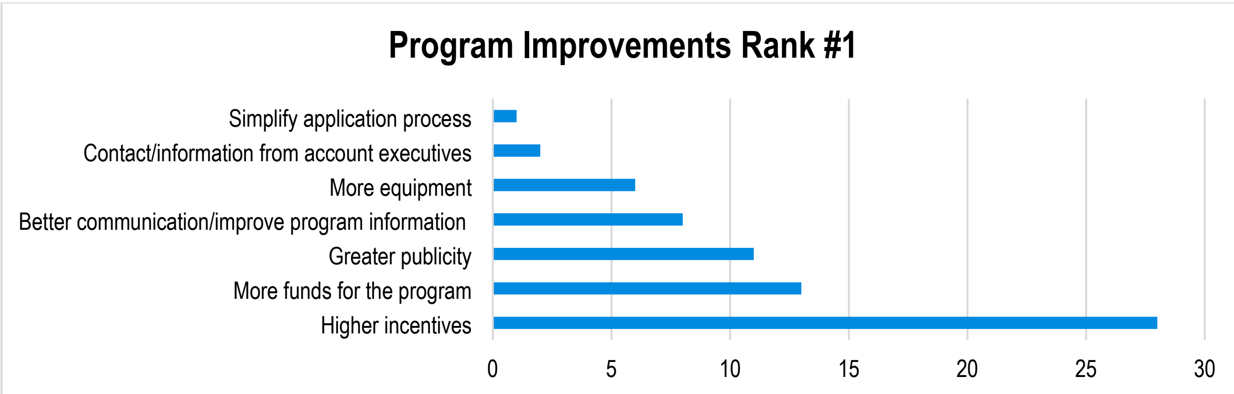


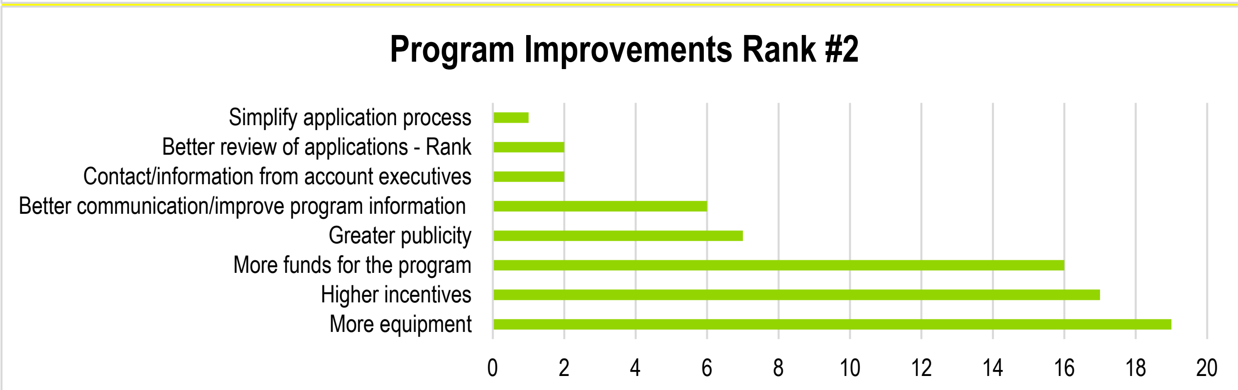
Source: Guidehouse analysis

4.4.5 Suggested Improvements

Overall program satisfaction is very high, but some customers had minor complaints or identified drawbacks of the program. Guidehouse asked respondents to rank the top 3 program improvements they would like to see in future programs. The two charts in Figure 4-5 show the different program improvements and how they were ranked by the respondents. As expected, higher incentive was ranked as the #1 program improvement requested by the majority of the respondents. More choice of equipment/measures and more funds for the program was the second and third highest ranked improvement requested by majority of the respondents.

Figure 4-5:Program Improvements





Source: Guidehouse analysis

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 and virtual verification 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 Guidehouse' s NTG analysis. In aggregate, the NTG results are very similar to findings from the prior evaluation.

Table 5-1. 2019-2020 Net-to-Gross Results

	Lighting	Refrigeration	HVAC	Lighting, HVAC & Refrigeration
Estimated Free Ridership	0.06	0.14	0.01	0.06
Estimated Spillover	0.08	0.08	0.06	0.07
Estimated NTG	**1.02**	**0.94**	**1.05**	**1.02**

Source: Guidehouse analysis, totals subject to rounding.

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

5.2.2 Estimating Spillover

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

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

[6] Scores were calculated by the following formulas:

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

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

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

- **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 received 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, weighted by the respondent's share of savings within the measure category
    - For spillover: by taking the sum of the individual spillover results (in kWh) for each measure category and dividing by the category's total program savings in the sample
- 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 program savings
    - For spillover: similarly, measure category results were subsequently weighted by each category's share of total program savings

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

Guidehouse conducted 96[7] 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. Participant Survey Completes by Project Type

Measure Category	Surveys
Lighting	64
Refrigeration	16
HVAC	16
Total	**96**

Source: Guidehouse analysis

5.3.2 Free-Ridership Results

Guidehouse 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. Guidehouse estimates free-ridership for the SBES Program at six percent of program-reported savings.

Guidehouse 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: Fifty out of 96 respondents indicated they had **prior plans to install energy efficient** equipment at their facilities before participating in the program. However, only 12 of the 50 respondents indicated their plans were **well-developed** (7 or higher on a scale of 0 to 10) in terms of identifying equipment for installation and 9 out of 28 respondents had budgeted for installing the equipment.

Program Importance: Respondents provided an average rating of 9 out of 10 for how important the financial incentive offered through the SBES program was in **influencing their decision** to upgrade their equipment.

Likelihood: Respondents were asked in the absence of the program, if they would have had at least some of the work done (in terms of both quantity of measures and the efficiency of measures installed). Five respondents indicated they would have installed about **32%** of the same energy efficiency equipment in the absence of the program.

Timing: Without the program, 29 respondents said that they would have installed the measures at the **same time or within 1-2 years, and the remainder would have delayed longer**.

[7]The survey was combined with process and NTG sections. One respondent did not complete the NTG section of the combined survey.

5.3.3 Spillover Results

The SBES Program influenced approximately five percent of participants to install additional energy efficiency measures on-site and influenced two percent of participants to install additional measures at other locations. Based on the survey findings, the evaluation team estimates the overall program spillover to be seven percent of program-reported savings. Participants reported a variety of spillover measures installed, including lighting (most common) and HVAC.

5.3.3.1 Inside Spillover

Table 5-3 shows the inside (within facility) spillover by measure type. The inside spillover for the program was estimated at **six** percent.

Program Importance: 32 out of 96 respondents indicated the program influenced them to install additional measures or change their behavior to be more energy efficient.

Qualified for Spillover: 19 out of the 32 respondents qualified for inside spillover based on information provided.

Spillover Savings Measures: Most respondents indicated retrofits to LED lights but a select few upgraded HVAC equipment like ductless mini split heat pumps and packaged HVAC units due to the program's influence. Their main rationale for not applying for an incentive was lack of awareness of incentives through the program or the measures not qualifying for an incentive through the program.

Table 5-3. Inside Spillover by Measure Type

Measure Family	Inside Spillover
Lighting	5.5%
Refrigeration	7.9%
HVAC	6.0%
Total	**5.7%**

Source: Guidehouse analysis, totals subject to rounding

5.3.3.2 Outside Spillover

Table 5-4 shows the outside (outside facility) spillover by measure type. The outside spillover for the program was estimated at two percent.

Program Importance: Only ten out of 97 respondents indicated the program influenced them to install additional measures or change their behavior to be more energy efficient, but the resulting impacts were relatively small.

Qualified for Spillover: Only five out of the ten respondents qualified for outside spillover based on information provided.

Spillover Savings Measures: All respondents contributing to spillover indicated retrofits to LEDs due to the program's influence. Their main rationale for not applying for an incentive was lack of awareness of incentives through the program or the measures not qualifying for an incentive through the program.

Table 5-4. Outside Spillover by Measure Type

Measure Family	Outside Spillover
Lighting	2.3%
Refrigeration	0.0%
HVAC	0.0%
Total	**2.0%**

Source: Guidehouse analysis, totals subject to rounding

5.3.3.3 Total Spillover

Total spillover is the sum of inside and outside spillover. Adding the result of 5.4% for inside spillover and 2.0% for outside spillover, Guidehouse found a total spillover of 7.4%.

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 two percent and the overall spillover value of nine percent, the NTG ratio is 1 – 0.06 + 0.07 = 1.02[8]. The estimated NTG ratio of 1.02 implies that for every 100 megawatt-hours (MWh) of realized savings recorded in SBES records, 102 MWh is attributable to the program. Table 5-5 shows the final NTG results.

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

	Free Ridership	Spillover	NTG Ratio
SBES Program Total	0.06	0.07	1.02

Source: Guidehouse analysis, totals subject to rounding.

Table 5-6 and Table 5-7 shows the verified net savings after applying the impact realization rate as well as the NTG ratio for energy and demand savings DEC and DEP respectively.

[8] The total is subject to rounding. The weighted average calculation of the overall NTG value is causing the rounding error.

Table 5-6. DEC SBES Reported, Verified Gross and Verified Net Savings

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	68,413	80,343	80,343
Realization Rate	100%	99%	98%
Verified Gross Savings	68,738	79,256	78,936
Net-to-Gross	102%	102%	102%
Verified Net savings	70,113	80,841	80,515

Source: Guidehouse analysis, totals subject to rounding.

Table 5-7. DEP SBES Reported, Verified Gross and Verified Net Savings

Parameter	Energy (MWh)	Summer Coincident Peak Demand (kW)	Winter Coincident Peak Demand (kW)
Reported Savings	46,571	51,433	51,433
Realization Rate	101%	99%	98%
Verified Gross Savings	46,889	50,696	50,267
Net-to-Gross	102%	102%	102%
Verified Net savings	47,827	51,710	51,272

Source: Guidehouse analysis, totals subject to rounding.

6. Conclusions and Recommendations

Guidehouse' s findings suggest that Duke Energy's SBES program is being delivered and tracked effectively in the DEC and DEP jurisdictions. Customer satisfaction is generally high, and the program measure installations appear to be tracked appropriately. Guidehouse presents the following list of recommendations to help improve program delivery and impacts:

1. **Consider introducing additional equipment choices in the program.** A subset of customers reported that the program was unable to provide all the energy efficiency equipment they wanted. Duke Energy should consider introducing more equipment choices in the program to include outdoor lighting and HVAC measures. This also presents an opportunity for channeling to other Duke Energy programs or education about measures that are not offered through the SBES program.
2. **Increase and improve program communications.** This is the most common challenge or drawback received from participants, indicating that customers were sometimes unclear about the various stages of the program process and did not receive proper communication and guidance from the implementer and/or Duke Energy. Additional education from both Lime Energy and Duke Energy account managers should help customers better understand the program participation process.
3. **Consider using TRM algorithms for HVAC measures.** Lime Energy and Duke Energy developed deemed savings estimates using regional data for HVAC measures. Although the methodology for developing these estimates was accurate, Guidehouse recommends Duke Energy consider using TRM algorithms too and substituting the variables in these algorithms using regional values to estimate savings. This may enhance the transparency of the impact estimates for these measures.
4. **The Program Net-to-Gross Ratio is high**. This indicates that the program is providing a key service to small business customers in helping them manage their energy use.

7. Summary Form

Small Business Energy Saver

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, HVAC, and refrigeration measures.

- **Lighting measures:** LED lamps and fixtures, LED exit signs, occupancy sensors.
- **Refrigeration measures:** LED case lighting, EC motor upgrades, anti-sweat heater controls,
- **HVAC Measures:** HVAC controls, thermostats, and tune-ups

Evaluation Methodology

The evaluation team used engineering analysis and virtual impact assessments as the primary basis for estimating program impacts. Additionally, online surveys were conducted with participants to assess customer satisfaction and determine a net-to-gross ratio.

Impact Evaluation Details

- **Virtual verification surveys were completed by 90 participants.** Guidehouse designed the virtual impact assessment survey tool to collect data about project and measure characteristics for comparison to tracking records and for engineering analysis.
- **In-Service rates (ISRs) varied by equipment type.** The evaluation team found ISRs ranging from 0.29 to 1.00 depending on the equipment type.
- **Participants achieved an average of 35 MWh and 29 MWh of energy savings per year for DEC and DEO respectively.** The program is accurately characterizing energy and demand impacts.

Date	July 07, 2021
Region(s)	Duke Energy Progress Duke Energy Carolinas
Evaluation Period	DEC 1/1/2019 – 6/30/2020 DEP 1/1/2019 – 6/30/2020
Annual net MWh Savings	DEC 70,113 MWh DEP 47,827 MWh
Per Participant net MWh Savings	DEC 34.83 MWh DEP 29.41 MWh
Coincident MW Impact	DEC 79.25MW DEP 50.69 MW
Net-to-Gross Ratio	1.02
Previous Evaluation(s)	2016, 2015, 2014, 2013

8. 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.

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 8-1, Table 8-2 and Table 8-3. Note that for this evaluation the EM&V team applied the coincidence factors for both summer and winter peak demand reductions by lamp type from the logger data analysis completed in 2016. For lighting controls, these values were taken from the NEEP Mid-Atlantic TRM, v10[9].

Table 8-1 HVAC Interactive Effects Multipliers from the NEEP Mid-Atlantic TRM

Building Type	WHFe	WHFd
Office	1.10	1.36
Retail	1.06	1.27
School	1.10	1.44
Warehouse	1.02	1.23
Other	1.08	1.35

Source: NEEP Mid-Atlantic TRM, V10

Table 8-2 Summer and Winter Coincidence Factors for Lighting Measures from DEC-DEP 2016 Logger Analysis

Measure	Summer Coincidence Factor	Winter Coincidence Factor
LED Exit Sign	1	1
A Line Lamp	0.914	0.931
Recessed Light	0.914	0.931
Specialty Light	0.914	0.931
LED Tube	0.802	0.619
High/low Bay	1	1
Delamping	0.902	0.664
Exterior Light	0	1

Source: DEC-DEP 2016 logger data analysis.

[9]NEEP TRM (April 2020, v10), https://neep.org/sites/default/files/media-files/trmv10.pdf

Table 8-3 Coincidence Factors for Lighting Controls from the NEEP Mid-Atlantic TRM

Building Type	Coincidence Factor
Office	0.70
Retail	0.83
School	0.35
Warehouse	0.80
Other	0.62

Source: NEEP Mid-Atlantic TRM, V10

Additionally, the Duke Energy DSMore table is embedded below for reference.

DSMore table - DEC
DEP SBES - 11 22 21.x

Appendix A. Process and NTG Survey Guide

DEC/DEP Small Business Energy Saver (SBES) Program
Commercial & Industrial (C&I)

Introduction and Confirmation

Guidehouse is evaluating Duke Energy's Small Business Energy Saver program, and our records show your business participated in this program during this past one or two years. This survey will help Duke Energy better understand the experience and impacts this program had on your business . Your responses are completely confidential.

Landing Page

Thank you for your willingness to complete this survey! Before you get started, just a few notes:

- This survey will ask about your experience with Duke Energy's Small Business Energy Saver program and the different type of energy efficiency equipment installed in your business.
- We are offering a $10 e-gift card for completing the survey. This gift card will be emailed to you within two weeks of completing the survey.

S1. Thanks in advance for your time. Our records indicate your business received **[INSERT SAMPLE_MEASURE_FAMILY]** from the Small Business Energy Saver program on [INSERT INSTALLDATE) , at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**. Is this correct?

Yes	1 **[SKIP TO S3]**
No	2 **[CONTINUE]**
Don't know	3 **[CONTINUE]**

S1a. Is there anyone available who might know about your company's participation in the program and the energy efficiency **[INSERT SAMPLE_MEASURE_FAMILY]** done at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**?

Yes	1 **[CONTINUE]**
No	2 **[THANK AND TERMINATE]**

S2. Can you provide an email address for that person?

Yes, Please enter email address	1 **[GO BACK TO S1]**
No	2 **[THANK AND TERMINATE]**
Don't know	3 **[THANK AND TERMINATE]**

[FOR TERMINATIONS]: These are all the questions we have for you. Thank you for your time.

S3. Our records show that you had the following energy efficiency improvements installed AT THIS SITE:
[INSERT SAMPLE_MEASURE(S)]. Is this correct?

Yes 1 **[GO TO S4]**

No 2 **[GO TO S3a]**

Don't know 3 **[THANK AND TERMINATE]**

S3a. Was any other energy efficiency equipment installed at this site?

Yes 1 **[GO TO S3b]**

No 2 **[THANK AND TERMINATE]**

Don't know 3 **[THANK AND TERMINATE]**

[FOR TERMINATIONS. These are all the questions we have for you. Thank you for your time.

S3b. Please tell me what energy efficiency equipment was installed at your facility through the DUKE ENERGY program

____**[OPEN END]**

For the purposes of this survey, the questions will focus on just the **[INSERT MEASURE_FAMILY] which you had installed and not the other measures, and we will just refer to them as "energy efficient equipment."**

S4. How did you learn about the Small Business Energy Saver program? (LIST OPTIONS; ACCEPT MULTIPLE RESPONSES.)

Contacted by my DUKE ENERGY account representative
or other DUKE ENERGY staff 1

I contacted my DUKE ENERGY account representative to find out about possible programs 2

Contacted by a LIME ENERGY representative.............................. 3

Contacted by a trade ally, vendor, or contractor 4

Energy efficiency conference or workshop 5

Advertising by vendor or contactor... 6

Word of mouth through a business colleague 7

Word of mouth through a family, friend, or neighbor....................... 8

Through a trade organization or professional organization/association 9
Mailer or other print materials sent by the program 10
At a trade show 11
Participation in other DUKE ENERGY programs 12
Internet research/DUKE ENERGY website 13
Social media/online ad 14
Duke Energy call center 15
Email/e-newsletter from Duke Energy 16
Print material/flyer dropped off at my business 17
Other (Please specify) 18
Don't know 19

S5. Prior to participating in the Small Business Energy Saver program, what concerns did you have about participation, if any?

Cost of project 1
Access to financing/loan for project 2
Disruption to business during installation 3
Quality/performance of new equipment 4
Other (Please specify) 5
Don't know 6

Contractor and Proposal Module

The next few questions will be about your experiences with the program implementer, Lime Energy, and the equipment installer.

CP1. On a scale of 0 to 10, with 0 being “Not at all satisfied” and 10 being “Extremely satisfied”, how satisfied would you say you are with …? [MATRIX STYLE QUESTION]

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don’t know
CP1a. The energy efficiency assessment conducted by Lime Energy at your business site												
CP1b. The proposal prepared for you by Lime Energy												

CP2. Was the proposal clear about the scope of work to be performed?

Yes 1 **[SKIP TO CP3]**

No 2

Don’t know ....3 **[SKIP TO CP3]**

CP2a. Why not?

____**[OPEN END]**

CP3. Was the proposal clear about your share of the project’s final cost?

Yes 1

No 2

Don't know 3

CP4. If you had any questions or concerns about any aspect of your project or the DUKE ENERGY program, did you know who to contact?

Yes 1

No 2

Don't know 3

CP5. On a scale of 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied would you say you are with …? [MATRIX STYLE QUESTION]

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don't know
CP5a. The contractor that installed the equipment												
CP5b. The post-installation cleanup												

CP6. Do you have any comments to share, good or bad, about the installation contractor or the post-installation cleanup?

____**[OPEN END]**

Net to Gross Module

Next are questions relating to your decision to purchase energy efficient equipment for this site.

Free Ridership/Prior Plans

P1. Prior to participating in the program, had you considered installing energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Yes 1

No .... 2 **[SKIP TO RC1]**

Don't know 3

P1a. Please describe any plans that you had to install the efficient **[INSERT SAMPLE_MEASURE_FAMILY]** prior to participating in the program.

____**[OPEN END]**

P2a. Again, please think about before your involvement with the program. 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.

Had not yet planned for equipment and installation										Identified and selected specific equipment and the contractor to install it	Don’t know
0	1	2	3	4	5	6	7	8	9	10	98

P2b. Still thinking about your plans prior to program participation, 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?

Had not yet budgeted or considered payment										Already had sufficient funds budgeted and approved for purchase
0	1	2	3	4	5	6	7	8	9	10

Role of Contractor

RC1. Did Lime Energy help you with your choice of the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment installed?

Yes 1

No.. 2 **[SKIP TO IC1]**

Don’t know .... 3**[SKIP TO IC1]**

RC1a. On a scale of 0 to 10, where 0 is “Not at all important” and 10 is “Extremely important,” how important was the recommendation from Lime Energy in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don’t know
0	1	2	3	4	5	6	7	8	9	10	98

Importance: Categories

IC1. Please tell me in your own words how the program influenced your decision to install the energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

____**[OPEN END]**

Now I want to ask you a few questions about the importance of two different elements of the program to your decision to install the new equipment. Both questions ask you to rate the importance using a 0 to 10 scale where 0 means "Not at all important" and 10 means "Extremely important".

IC2. How important was the program's financial incentive or project discount in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

IC3. How important were the program's advertising and information resources (including the energy efficiency assessment itself) in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY]**?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

Likelihood

[IF SAMPLE_MEASURE_FAMILY = "Lighting" THEN ASK L1, ELSE SKIP TO L2.]

L1. Given everything you've just said about the program, what is the likelihood that you **would have installed the same energy-efficient lighting** (in the same quantity and the same level of efficiency) without the program and its financial and technical assistance.

Definitely would NOT have installed the same energy efficient lighting 1

MAY HAVE installed the same energy efficient lighting, even without the program 2

Definitely WOULD have installed the same energy efficient lighting anyway 3

Don't know 4

[IF L1 = 2, 3, or 4, CONTINUE. OTHERWISE, SKIP TO IO1.]

L1a. As best you can, please estimate the percent of the Lighting you think you would have installed at the same high level of efficiency had the program not been available. (USE “998” FOR DON’T KNOW.)

___ % **[RECORD 0-100 OR 998 FOR DON’T KNOW]**

[IF SAMPLE_MEASURE_FAMILY = “Refrigeration” THEN ASK L2, OTHERWISE, SKIP TO IO1.]

L2. Given everything you’ve just said about the program, on a scale of 0 to 10 where 0 is definitely would not have installed and 10 is definitely would have installed, what is the likelihood that you would have installed the same energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment had the program not been available?

__________ **[RECORD 0-10 OR 98 FOR DON’T KNOW]**

[IF SAMPLE_MEASURE_FAMILY = “HVAC and Refrigeration” THEN ASK L3, OTHERWISE, SKIP TO IO1.]

L3. Given everything you’ve just said about the program, on a scale of 0 to 10 where 0 is definitely would not have installed and 10 is definitely would have installed, what is the likelihood that you would have installed the same energy-efficient **[INSERT SAMPLE_MEASURE_FAMILY]** equipment had the program not been available?

__________ **[RECORD 0-10 OR 98 FOR DON’T KNOW]**

Importance: Overall

IO1. Given everything you’ve just told me about the program, please tell me how important the program was in your decision to install the energy efficient **[INSERT SAMPLE_MEASURE_FAMILY] equipment**? Please use a 0 to 10 scale where 0 is “Not at all important” and 10 is “Extremely important”.

Not at all important										Extremely important	Don’t know
0	1	2	3	4	5	6	7	8	9	10	98

Timing

T1. Without the program, when would you have installed the efficient **[INSERT SAMPLE_MEASURE_FAMILY]**? Would it have been…(READ LIST)?

At the same time as you did 1

Within 1 year of the time you did 2

Between 1 and 2 years 3

Sometime after 2 years 4

Would have never installed without the program 5

Spillover (Inside Spillover)

Now we have a few questions concerning any **non-incentivized equipment** you may have also installed at this location.

IS1. Did your experience with the program in any way influence you to incorporate additional energy efficiency equipment where you did not receive a program incentive at this site?

Yes 1 **[CONTINUE]**

No 2 **[SKIP TO OS1]**

Don't know 3 **[SKIP TO OS1]**

IS2. Please briefly describe how the program has influenced your decisions to incorporate additional energy efficiency equipment that were not part of a program incentive.

____**[OPEN END]**

IS3. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important", how important was your participation in the program in your decision to install additional energy efficiency equipment?

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF IS3 >5, CONTINUE, ELSE SKIP TO OS1]

IS4. What type of energy-efficient equipment did you install without program incentives, and what were the approximate quantities and project costs? Estimates are fine.

	Energy-Efficient Equipment Types	Equipment Characteristics	
	(Please describe the equipment as specifically as possible.) (1)	Quantity (1)	Project Cost ($) (2)

Equipment Type 1 (1)			
Equipment Type 2 (if applicable) (2)			
Equipment Type 3 (if applicable) (3)			
Equipment Type 4 (if applicable) (4)			

IS5. Now, please think only about the additional energy efficiency equipment not installed through the program (which received no incentives). Would you estimate the energy savings from these additional non-incentivized equipment to be less than, similar to, or more than the energy savings from the SBES program equipment?

Less than the SBES project 1

Similar to the savings from the SBES project 2

More than the SBES project 3

Don't know 4

IS6. Why didn't you apply for a program incentive for the additional energy efficiency equipment?

____**[OPEN END]**

Outside Spillover

This next set of questions asks about any **non-incentivized energy efficiency equipment** you may have installed at **other** locations within the Duke Energy service territory.

OS1. Did your experience with the program in any way influence you to incorporate energy efficiency equipment at other facilities that did not receive program rebates yet are also served by DUKE ENERGY? Do not include projects that participated in any DUKE ENERGY program.

Yes 1

No 2

Don't know 3

[IF OS1 = 1, CONTINUE, OTHERWISE, SKIP TO BB1.]

OS1a. About how many other facilities were influenced that did not participate in the program? (USE 98 FOR DON'T KNOW.)

___

INSERT NUMBER OF FACILITIES **[RECORD 1-100]**

OS2. Please briefly describe how the program has influenced your decisions to incorporate additional high-efficiency equipment at other facilities that did not participate in the program.

______________________________________ **[OPEN END]**

OS3. On a scale of 0 to 10, where 0 is "Not at all important" and 10 is "Extremely important," how important was your participation in the program in your decision to install additional energy efficiency equipment at other facilities

Not at all important										Extremely important	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF OS3 > 5, CONTINUE. OTHERWISE, SKIP TO BB1]

OS4. What type of energy-efficient equipment did you install without program incentives, and what were the approximate quantities and project costs? Estimates are fine.

	Energy-Efficient Equipment Types	Equipment Characteristics

	(Please describe the equipment as specifically as possible.) (1)	Quantity (1)	Project Cost ($) (2)
Equipment Type 1 (1)			
Equipment Type 2 (if applicable) (2)			
Equipment Type 3 (if applicable) (3)			
Equipment Type 4 (if applicable) (4)			

OS5. On average, would you estimate the energy savings from these other non-program facilities to be less than, similar to or more than the energy savings from the energy efficiency equipment installed through the program?

Less than the SBES project 1

Similar to savings from the SBES project 2

More than the SBES project 3

Don't know ..4

OS6. Why didn't you apply for a program incentive for the additional energy efficiency equipment?

____**[OPEN END]**

Benefits and Barriers

Before wrapping up, we have a few more questions related to participation and satisfaction.

BB1. Did you experience any problems, delays or difficulties with the program, and if so what were they? (OPEN ENDED – CODED IN ANALYSIS)

The process took too long 1

Too many delays between steps in the process 2

The process was too complex 3

The application materials were difficult to understand 4

Lack of coordination and communication among program staff 5

Did not know who to contact with questions 6

The program staff was not responsive/unable to get needed information or status updates 7

The program staff was not knowledgeable 8

The incentives were less than I expected 9

I do not like the equipment installed 10

I was not given a choice on the specific equipment installed 11

The installation process was disruptive 12

Things were damaged during the installation 13

The post-installation clean-up took too long 14

The equipment failed/required repairs/did not work well 15

The equipment installed was sized incorrectly 16

Energy savings were not as significant as expected 17

I don’t know where to buy replacement bulbs 18

Other (Please specify) 19

Don’t know 20

No problems experienced **[EXCLUSIVE]** 22

[Ask if BB1<> 21]

BB1a. How easy or difficult was it to resolve the problem(s) that you experienced? Please rate on a scale of 0 to 10 in which 0 means very difficult and 10 means very easy.

Very difficult (0)	1	2	3	4	5	6	7	8	9	Very easy (10)	Don't know	Problems were not resolved

BB2. If you could change anything about the entire program process, from the audit to signoff to payment, what would you change?

____**[OPEN END]**

BB3. On a scale of 0 to 10, with 0 being "Not at all satisfied" and 10 being "Extremely satisfied", how satisfied would you say you are with …? **[MATRIX STYLE QUESTION; RANDOMIZE a-e]**

Items	Not at all satisfied (0)	1	2	3	4	5	6	7	8	9	Completely satisfied (10)	Don't know
BB3a. The energy efficiency equipment installed through the program												
BB3b. The energy savings resulting from the new equipment												
BB3c. **[If lighting]** The quality of the light produced by the new light fixtures/bulbs												
BB3d. Program communications												
BB3e. The amount of the rebate												
BB3f. The overall program experience												
BB3g. Duke Energy												

[IF ANY RESPONSE TO BB3a-g < 5, CONTINUE. OTHERWISE, SKIP TO BB4]

BB3h. Why did you rate [BB3a-BB3g] as you did?

____**[OPEN END]**

BB4. How did participation in the Small Business Energy Saver program affect your attitude toward Duke Energy? Relative to before the program, is your attitude toward Duke Energy?

....Much more positive 1

Somewhat more positive 2

About the same 3

Somewhat more negative, or 4

Much more negative 5

Other (Please specify) 6

Don't know 7

BB5. On a scale of 0 to 10, with 0 being "Not at all likely and 10 being "Extremely likely", given the chance, how likely would you be to participate in this or a similar program again?

Not at all likely										Extremely likely	Don't know
0	1	2	3	4	5	6	7	8	9	10	98

[IF BB4 < 7, ASK BB5a. OTHERWISE, SKIP TO BB6]

BB5a. What—if anything—would persuade you to definitely participate in the program again? ____ **[OPEN END]**

BB7. Have you recommended the program to other businesses?
Yes; how many? [ENTER NUMBER] 1

No 2

Don't know 3

BB8. What do you see as the main benefits to participating in the Small Business Energy Saver program? (OPEN ENDED – CODED IN ANALYSIS)
Energy savings 1

Utility bill savings 2

Lower maintenance costs/less frequent light bulb replacements 3

Better quality/new equipment 4

Incentive/rebate 5

Good for the environment 6

Improved safety/morale 7

Set example/industry leader 8

Able to make improvements sooner 9

Other (Please specify) 10

Don't know 11

Feedback and Recommendations

FR1. Do you have any suggestions on how the Small Business Energy Saver program could be improved? (RANK IN ORDER BY IMPORTANCE FOR YOUR ORGANIZATION) (OPEN ENDED – CODED IN ANALYSIS.)

Higher incentives 1

More equipment 2

Greater publicity 3

Better communication/improve program information 4

Contact/information from account executives 5

Longer time period to complete project 6

Better review of applications 7

Simplify application process 8

Electronic applications 9

More funds for the program 10

Other (Please specify) 11

No recommendations **[EXCLUSIVE]** 12

Don't know 13

FR2. Did the equipment offered through the program allow you to upgrade all of the energy efficiency equipment you wanted at the time?

Yes 1 **[SKIP TO FG1]**

No 2

Don't know 3 **[SKIP TO FG1]**

[IF FR2 < 7, ASK FR2a. OTHERWISE, SKIP TO BB6]

FR2a. What other energy efficiency equipment did you want to upgrade?

____**[OPEN END]**

Firmographics

Finally, I'd like to ask you a few general questions about your company, specifically the facility at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**.

FG1. Does your organization own or lease the space located at **[INSERT SAMPLE_CUSTOMER_ADDR1, "in" SAMPLE_CUSTOMER_CITY]**?
Own 1

Lease 2

Own part and lease part 3

Don't know 4

FG2. Who in your company makes decisions about how energy is managed at this facility?
I DO (describe role) **[OPEN END]**...... 14

Proprietor/Owner 1

President/CEO 2

Facilities Manager 3

Building/Store Manager 4

Energy Manager 5

Facilities Management/Maintenance Position 6

Chief Financial Officer 7

Other Financial/Administrative Position 8

Sales Staff 9

Lessor 10

Other (Please specify) 11

Don't know 12

FG3. What is the principal activity or type of business that is conducted at this location? This may not be the main activity of your organization, but should be the main activity that occurs at this location. For example, is it an office, a warehouse, a store?
Office 1

Retail (non-food) 2

School 3

Grocery Store 4

Convenience Store 5

Restaurant 6

Health Care/Hospital 7

Hotel or Motel 8

Warehouse 9

Personal Service	10
Community Service/Church/Temple/Municipality	11
Industrial Electronic & Machinery	12
Other Industrial	13
Agricultural	14
Condo Association/Apartment Management	15
Other (Please specify)	16
Don't know	17

FG 4. Please enter your preferred email address so that we can send you your $10 e-gift card through TangoCard Rewards Genius. You can select from a variety of retailers or donate your incentive to charity. Please allow 4-6 weeks to receive the incentive email.

- ○ Email address: (1) ____

- ○ No thanks - I do not wish to receive the e-gift card incentive (2)

Closing

Those are all of the questions we have for you. Your responses are very important to Duke Energy and will help as we design future energy efficiency programs. Thank you for participating in this survey!

2020 EM&V Interim Report for the EnergyWise Business Program

February 5, 2021

Prepared for:

Duke Energy Carolinas and Duke Energy Progress

Submitted by:
Guidehouse Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302
303.728.2500

Table of Contents

Evaluation Summary ii

Evaluation Methods iii

Energy Efficiency Impact Evaluation Approach iii

Findings and Conclusions iii

1. Introduction 5

1.1 Objectives of the Evaluation 6

1.2 Reported Program Participation 6

2. Evaluation Methods 8

2.1 Energy Efficiency Impact Methodology 8

2.1.1 Data Sources 8

2.1.2 Analysis Period, Participant Sample, and Data Cleaning 9

2.1.3 Assessment of a Matched Comparison Group 11

2.1.4 Estimating Ex-Post Impacts 12

3. Impact Findings 13

3.1 Energy Efficiency Impacts 13

3.2 Differences in Savings between DEC and DEP 16

3.3 Net-to-Gross 18

3.3.1 Energy Efficiency Impacts 18

4. Findings, Conclusions, and Recommendations 20

5. Summary Form 21

6. Program Impacts for Duke Energy Analytics A-1

Appendix A. Detailed Energy Efficiency Impact Methodology A-2

A.1 Assessment of Matched Comparison Group A-2

A.2 Regression Model Specification A-7

A.3 Participant Setpoint Analysis A-8

Evaluation Summary

Guidehouse conducted an impact evaluation to estimate energy impacts contributed by participants that received the thermostat between January 2018 and February 2019, using monthly energy consumption data. This report contains only the results of the energy impact analysis. Upon completion of the Summer 2021 DR season, Guidehouse will estimate demand response impacts on event days, using participant and non-participant advanced metering infrastructure (AMI) interval data.

Table 1 summarizes the estimated annual energy impacts for participants who installed a thermostat. Guidehouse found that on average, DEC participants saved 1,026 kWh per thermostat and DEP participants saved 423 kWh per thermostat.

Table 1: Per Device and Program Total Energy Impacts

Energy Provider	Devices	Impact per Device (kWh / Device)	Program Impact (MWh)	Margin of Error (90% CI)
DEC	5,304	1,026	5,440	±1,488
DEP	2,653	423	1,122	±724

Source: Guidehouse analysis. Values subject to rounding.

The EnergyWise® Business ("EnergyWise Business") program in the Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) territories, provides small and medium business customers that consume an average of at least 1,000 kWh per month and have one or more central air conditioning or heat pump units at their facility, with an opportunity to earn bill credits by allowing DEP and DEC to periodically cycle their HVAC equipment during conservation periods (i.e. curtailment or demand response – DR – events).

In the summer, participating devices may be controlled by DEP and DEC from May through September for up to four hours per event. Events typically occur between 1pm and 7pm on non-holiday weekdays. During the curtailment events, the HVAC compressors are typically cycled in 30-minute intervals for the duration of the event. Participants may opt out of up to two events per season. Additional opt-outs may result in the forfeiture of the annual bill credit. Participants who have electric heat pumps with electric resistance auxiliary heat strips can also participate in the winter DR season for an additional $25 bill credit. For the winter 2020/2021 season, events are expected to occur in the morning from 6:30am to 8:30am, around the peak demand hour of 7-8am.

Participants may elect to have curtailment dispatched via thermostat or switch. Participants equipped with the thermostat (the majority) can access the EnergyWise Business portal using a smartphone, tablet, or computer. The portal allows users to monitor and modify their facility HVAC runtimes, change the temperature setpoints, and program customized cooling and heating schedules. The purpose of the portal is to facilitate the adoption of energy efficiency behaviors by participants, specifically the practice of adjusting HVAC setpoints to reduce space heating and cooling energy consumption. The portal includes tips to help participants optimize energy use, including tutorials and preset features for energy efficiency, away times, and vacations.

Evaluation Methods

Guidehouse's impact evaluation approach for this report focuses on energy impacts. Demand impacts will be established after the summer 2021 DR season.

Energy Efficiency Impact Evaluation Approach

Guidehouse assessed the suitability of using a matched comparison group (MCG) to estimate savings, but concluded that such an approach was unsuitable for this evaluation due to evidence of divergent energy consumption behavior after the time period used to select the MCG. As a result, Guidehouse proceeded by using a within-subjects regression approach, using participants only.

Guidehouse estimated annual per participant savings by applying a regression analysis to participant consumption data observed in the period from March 1, 2019 through February 29, 2020 (the "Post-Install Period"). Only participants that enrolled in the period from January 1, 2018 through February 28, 2019 (the "Install Period" or the evaluation sample period) were included in the estimation data. Program impacts were calculated by multiplying estimated annual per participant impacts by the number of participants that enrolled during the Install Period. The impacts per thermostat were calculated by dividing the per participant results by the average number of thermostats at each participant site.

Findings and Conclusions

The principal EM&V findings and conclusions regarding the estimated energy impacts are as follows:

- **Participants are estimated to have reduced an average of 1,026 kWh per device in DEC and 423 kWh per device in DEP for the post-installation period.** The post-installation period was March 2019 through February 2020, and applies to the evaluation sample of participants who enrolled between January 2018 through February 2019. More savings were realized in summer months compared with winter, which reflects the fact that only some participants use electric heating (approximately 20%). Guidehouse has developed hypotheses for the difference in savings between DEC and DEP participants, which may be used to guide future evaluation and program implementation.

- **Guidehouse concluded that selecting a suitable non-participant comparison group was not possible with the data available for estimating energy impacts.** Guidehouse observed evidence of differing evolution of consumption patterns between participants and selected matches from the pre- to post-installation periods, which suggests that the consumption behavior of selected matches may not evolve in similar ways as participants as would be assumed when using a comparison group. This result suggests that an MCG comprised of non-participants is unsuitable for estimating energy efficiency impacts for small and medium-sized businesses in this program.

Based on the impact findings above, Guidehouse recommends that Duke Energy consider the following recommendations:

- **Consider customer targeting or outreach activities to increase energy savings.** Targeting more customers with electric heat could increase winter energy savings. Guidehouse understands that future program data will have more accurate tracking of HVAC equipment types, which would facilitate such targeting efforts. Duke Energy may wish to consider increasing outreach encouraging participants to adopt more energy efficient setpoints. Although program technicians assist participants with initial thermostat setup, it is unclear how the settings persist over time. Following up with participants to encourage them to optimize these settings may increase the amount of energy savings achieved in the program.

- **Consider using future process evaluations to better understand differences in savings estimated in DEP and DEC service territories.** Consistent with the findings of the prior evaluation conducted by another evaluator, Guidehouse estimated that average savings per participant were lower for DEP participants than for DEC participants. Participants interviews or surveys may be used to better understand the factors that cause DEP participants to exhibit lower savings. For example, surveying DEC and DEP participants may show differences in willingness to use temperature setbacks or capability of reducing HVAC consumption based on business operation considerations.

1. Introduction

The EnergyWise® Business (“EnergyWise Business”) program in the Duke Energy Progress (DEP) and Duke Energy Carolinas (DEC) territories, provides small and medium business customers that consume an average of at least 1,000 kWh per month and have one or more central air conditioning or heat pump units at their facility, with an opportunity to earn bill credits by allowing DEP and DEC to periodically cycle their HVAC equipment during conservation periods (i.e. curtailment or demand response events).

Upon enrollment, eligible participants select to receive either a “smart” Wi-Fi communicating thermostat[1] capable of remote set-point adjustment, or a switch device to allow DEP and DEC to cycle the participant’s HVAC during DR events. The switch device may be either Wi-Fi connected or cellular. Participants may select one of three options for participating:

- 30% Cycling - Participants receive an annual bill credit of $50 per device controlled for the summer season.
- 50% Cycling - Participants receive an annual bill credit of $85 per device controlled for the summer season.
- 75% Cycling - Participants receive an annual bill credit of $135 per device controlled for the summer season.

In the summer, participating devices may be controlled by DEP and DEC from May through September, for up to four hours per event. Events typically occur between 1pm and 7pm on non-holiday weekdays. During the curtailment events, the HVAC compressors are cycled in 30-minute intervals for the duration of the event. Participants may opt out of up to two events per season Additional opt-outs may result in the forfeiture of the annual bill credit. Participants with electric heat pumps or electric resistance heating can also participate in the winter DR season for an additional $25 bill credit. For the winter 2020/2021 season, events are expected to occur in the morning from 6:30am to 8:30am, around the peak demand hour of 7-8am.

Participants with the thermostat can access the EnergyWise Business portal using a smartphone, tablet, or computer. The portal allows users to monitor and modify their facility HVAC runtimes, change the temperature setpoints, and program customized cooling and heating schedules. The purpose of the portal is to facilitate the adoption of energy efficiency behaviors by participants, specifically the practice of adjusting HVAC setpoints to reduce space heating and cooling energy consumption. The portal includes tips to help participants optimize energy use, including tutorials and preset features for energy efficiency, away times, and vacations.

[1] Note that this is not an “adaptive” thermostat.

1.1 Objectives of the Evaluation

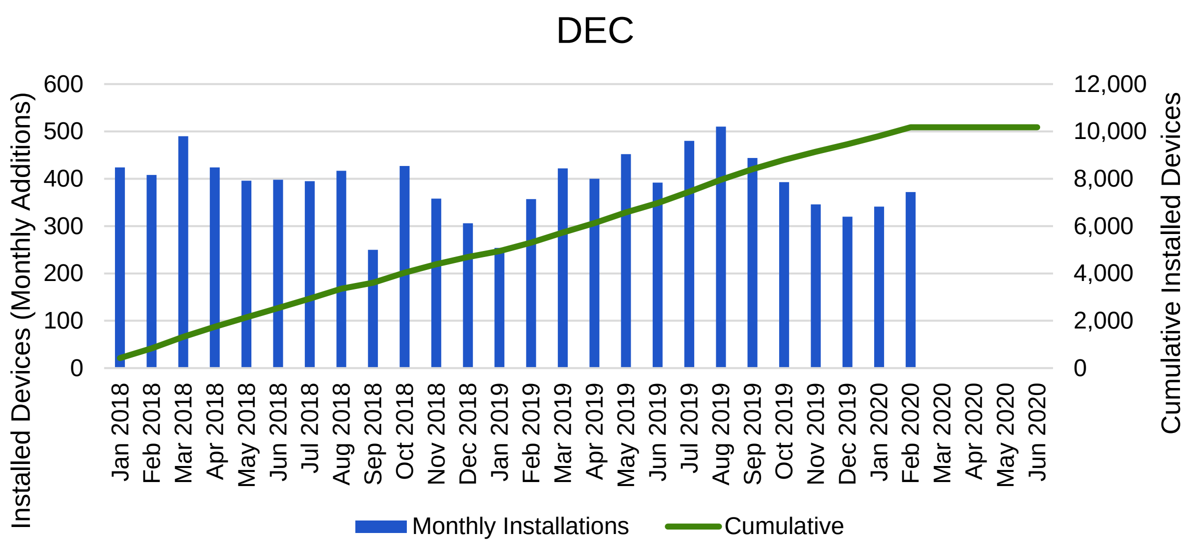
The key objectives for the impact analysis conducted as part of this evaluation, as identified in Guidehouse's evaluation plan, include:

- **Energy Efficiency Impacts:** estimate the annual energy efficiency impacts for participants who have a thermostat and enrolled in the program between January 2018 and February 2019.

1.2 Reported Program Participation

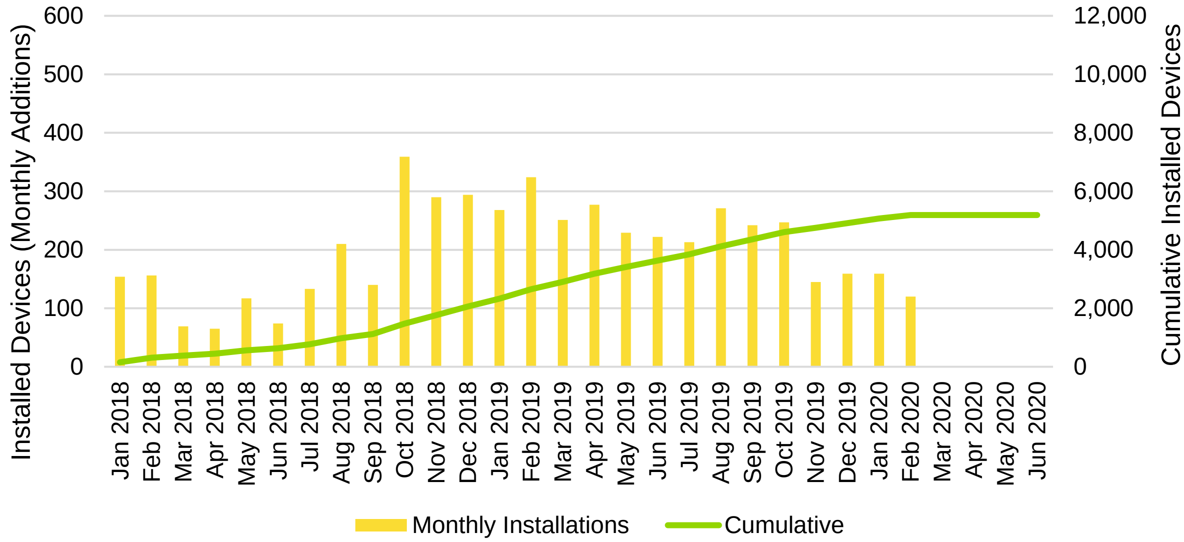
Figure 1-1 and Figure 1-2 illustrate installations between January 2018 and February 2020 for DEC and DEP, to show trends in participation over time outside of the evaluation sample period. In this time period, Duke Energy installed 10,176 and 5,188 devices in DEC and DEP territories respectively. From this population, the energy impacts in the report include a sample of participants who enrolled between January 2018 and February 2019, to allow sufficient post-installation consumption data to accrue for analysis.

Figure 1-1: Installations between January 2018 and February 2020 – DEC



Source: Guidehouse analysis

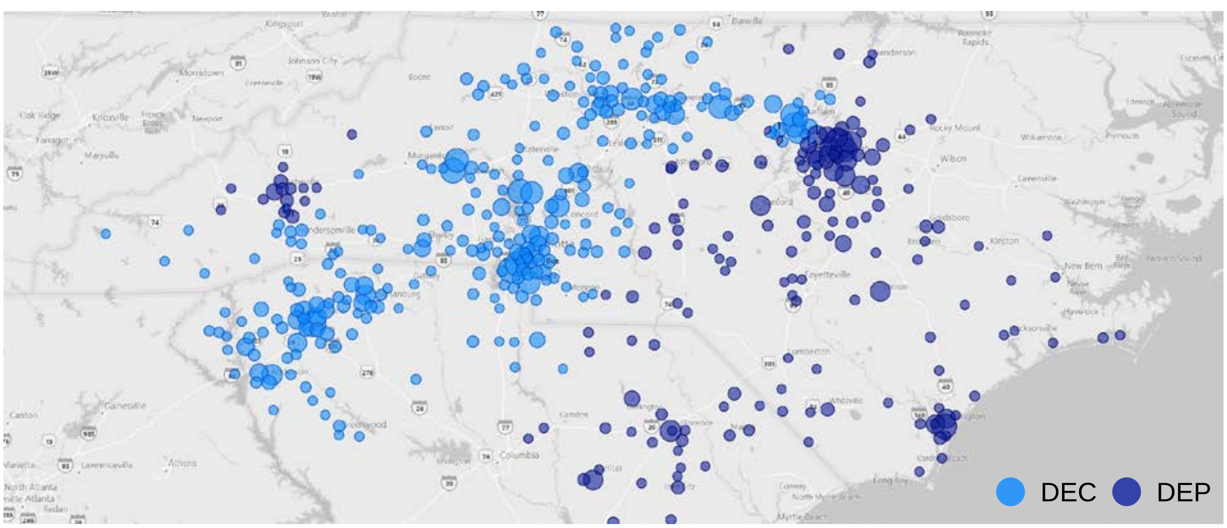
Figure 1-2: Installations between January 2018 and February 2020 – DEP



Source: Guidehouse analysis

Figure 1-3 shows the geographic distribution of participants. Most installations occurred around cities including Charlotte and Raleigh, although participation was achieved throughout the service territories.

Figure 1-3. Geographic Distribution of Participants



Source: Guidehouse Analysis
Size of Circle is Proportional to the Number of Installations

2. Evaluation Methods

This chapter of the evaluation report provides a description of the approaches used to conduct the evaluation. Additional technical details related to the impact approaches may be found in Appendix A.

2.1 Energy Efficiency Impact Methodology

Guidehouse estimated thermostat energy savings impacts using a within-subjects regression analysis applied to participant monthly consumption data, weather data, and data flags identifying the period after which each participant's thermostat was installed. This analysis also controlled for participation in other Duke Energy programs during the same time period, effectively netting out the impacts from other energy efficiency programs such as the Small Business Energy Saver.

A "within-subjects" regression approach is one which includes only participants and implicitly uses observed participant consumption prior to program enrollment to develop an estimate of participant baseline consumption in the program period and the estimated impact of the program on participant consumption in the post-installation period. A detailed description of the regression model specification is included in Appendix A.2.

Guidehouse also performed an experimental analysis comparing participant consumption patterns with those of a large pool of non-participants in pre-program period to select an MCG (non-participants with consumption patterns very similar to those of participants). As discussed below in Section 2.1.3, and in greater detail in Appendix A, Guidehouse's exploratory analysis identified that such an approach appears to be inappropriate for an evaluation of energy efficiency impacts for the small to medium businesses in this program.

2.1.1 Data Sources

For the energy efficiency evaluation, Guidehouse used the following data provided by Duke Energy:

- Monthly consumption data, for DEC and DEP participants and non-participants:
    - DEC: Calendarized monthly billing data for the period of January 2016 through February 2020 for 5,850 participants and 97,571 eligible non-participants[2]
    - DEP: Calendarized monthly billing data for the period of March 2017 through February 2020 for 2,898 participants and 66,899 non-participants. DEP billing consumption data was not available prior to March 2017.
- Customer cross-sectional data, including -

[2] Non-participant data were used only in exploratory analysis. All impacts reported in this evaluation are estimated based only on participant consumption data.

- o Standard Industry Classification (SIC) Code
- o HVAC equipment type (participants only)
- o HVAC system capacity in tons of refrigeration (participants only)
- o Program device type – switch or thermostat (participants only)
- o Participant enrollment and drop-out dates

- List of participants that participated in other DEP or DEC EE programs, including measures and installation dates.

Guidehouse collected hourly dry-bulb temperature data for the period of January 2016 through February 2020 from twelve weather stations across the Carolinas and developed a weighted average hourly time series for the analysis based on the number of participants closest to each station. This single time series was then used in subsequent modeling to estimate energy efficiency impacts. The stations and corresponding weights are listed in Table 2-1.

Table 2-1. Weather Stations and Weighting Used for Analysis

Weather Station	Weight
Raleigh-Durham Airport	27.4%
Charlotte/Douglas Airport	22.3%
Piedmont Triad Airport	9.1%
Hickory Regional Airport	8.6%
Greenville Downtown Airport	8.3%
Florence Regional Airport	7.0%
Greenville-Spartanburg Airport	4.8%
Asheville Regional Airport	4.1%
Occonee County Airport	3.4%
Anderson Regional Airport	3.1%
Wilmington International Airport	1.7%
Craven County Airport	0.2%

Source; Guidehouse Analysis

2.1.2 Analysis Period, Participant Sample, and Data Cleaning

Guidehouse has divided the participant consumption data into three different periods for analysis:

- **Pre-Install Period (January – December 2017):** the year prior to thermostats being installed for all participants in the estimation sample. No participant included in the analysis had enrolled in the program during this period.
- **Install Period (January 2018 – February 2019):** the year during which participants in the estimation sample installed thermostats. All participants included in the analysis enrolled in the program during this period.
- **Post-Install Period (March 2019 – February 2020):** the year during which all participants in the estimation sample have a thermostat installed. All participants included in the analysis had enrolled in the program prior to this period.

Guidehouse performed data cleaning on the provided monthly consumption data, including checking for:

- Very large consumption (>2,500 kWh per day in a month)
- Negative consumption
- At least 8 months of data in the pre- and post-install periods. This requirement was chosen to balance data completeness while maximizing the number of participants that could be included in analysis, and is consistent with other Guidehouse evaluations.

Table 2-2 summarizes the number of participant accounts that were able to be included in the analysis after the data cleaning process.

Table 2-2. Summary of Accounts Included in Data Cleaning Process

Description	Accounts (DEC)	Accounts (DEP)
All accounts that installed thermostats between January 2018 and February 2019	3,080	1,519
Accounts with any billing data	3,033	1,498
Accounts in the sample after cleaning (i.e. had at least 8 months of billing data in both the pre- and post-periods)*	1,929	1,019
Remaining accounts after removing customers that changed consumption from pre- to post-period by more than 100%**	1,893	1,008

Source: Guidehouse Analysis
** Essentially all (>99%) accounts dropped in data cleaning were due to a lack of sufficient data in either the pre- or post-period.*
*** Guidehouse investigated trimming the sample of customers that exhibited very large changes in energy usage to mitigate potential bias, as discussed in Appendix A.1.*

2.1.3 Assessment of a Matched Comparison Group

Guidehouse assessed the suitability of estimating impacts using a lagged dependent variable (LDV) approach[3] supported by an MCG developed from eligible non-participants. In this process, each participant is assigned a “match.” This is the non-participant whose pre-installation period consumption most closely resembles the given participant. In general, this approach is also commonly referred to as quasi-experimental design and is generally the preferred evaluation method in absence of true experimental design (e.g. a randomized control trial, or RCT).

The purpose of selecting an MCG is to find a group of customers for whom energy usage patterns would be expected to follow a parallel trend over time to that of the participants in absence of the program treatment. The treatment in this case is the installation of a thermostat.

The key assumption of selecting an MCG is that the relative difference between participant and MCG consumption is consistent over time in absence of the treatment, conditional on the independent variables included in the regression equation. In the residential sector, this assumption is generally regarded as unproblematic due to the homogenous nature of residential consumption patterns. However, the heterogeneity of small businesses means that the key assumption that underlies this approach may be too restrictive and not reflect the realities of small business. In other words, two businesses that exhibit similar usage patterns in the period in which they are matched may not evolve in similar ways over time. This may be due to differences in business types or to administrative details related to the data themselves. For example, if the electricity account holder is a landlord, the business may change entirely between the pre-program and the program period without any indication.

To assess the suitability of an MCG approach for this evaluation, Guidehouse selected matches for both DEC and DEP participants. Each participant was assigned the non-participant from the same SIC division[4] that had the most similar monthly consumption pattern during the pre-installation period. Guidehouse’s exploratory analysis found that participant and comparison group consumption patterns outside of the pre-program matching period diverged materially from each other in a manner inconsistent with what might typically be expected of the program treatment.

Specifically, when using an MCG, savings estimates changed substantially in response to the incremental removal of participants and matches from the estimation set. Conversely, estimated savings using participants only (a within-subjects approach) were robust to the same sub-setting – the regression parameter values were insensitive to the sample used. This result suggests the presence of some non-program effect impacting the relative difference between participant and match consumption over time. Absent any observable data to control for this effect, it will result in omitted variable bias in the model, and inaccurate estimates of savings.

Therefore, Guidehouse concluded that an MCG was not appropriate for this analysis using the data available. Guidehouse proceeded with the analysis using a within-subject approach which considers participants only and compares consumption before and after installation of the

[3] The LDV approach is a special case of the difference-in-differences approach.

[4] Standard industry classification division denotes the broad industry category the small business belongs to. See https://www.naics.com/sic-codes-counts-division/.

thermostat. For a more detailed description of the methods used for selecting and assessing the suitability of a matched control group, see Appendix A.1

2.1.4 Estimating Ex-Post Impacts

Guidehouse employed a within-subject regression analysis to estimate impacts. This approach uses a model that implicitly compares the energy consumption of participants before and after installation of the program thermostat. This type of model is also known as a “pre-post” model. The model estimated for this analysis controls for the effects of weather (cooling and heating degree days), month of year, and participation in other DEP or DEC EE programs (such as Small Business Energy Saver). The treatment effect was modeled to be weather-dependent, on both cooling and heating degree days – savings, that is, are assumed to be a function of temperature.

In this model, any changes in consumption over time that are not explicitly controlled for by the independent variables are attributed to the treatment. As described in Section 2.1.3, Guidehouse employs within-subject models only in the absence of true experimental design (e.g., an RCT) and when matched controls are either not available or inappropriate.

The regression model provides ex-post (i.e., historical) impact estimates for the post-installation period described in Section 2.1.2, March 2019 through February 2020. These are obtained by applying the estimated treatment parameters to the observed weather in this period. For additional details regarding the regression model used for this analysis, see Appendix A.2.

3. Impact Findings

This chapter provides a detailed summary of the impact findings, and is divided into three sections:

- **Energy Efficiency Impacts.** This section summarizes the estimated energy efficiency impacts.
- **Differences in Savings between DEC and DEP.** This section discusses the differences in estimated savings for the two service territories.
- **Net-to-Gross.** This section describes the assumptions informing the net-to-gross ratio applied in this evaluation.

3.1 Energy Efficiency Impacts

Table 3-1 shows the ex-post energy efficiency impacts for the period from March 2019 through February 2020 for those participants who enrolled between January 2018 and February 2019. The program achieved an estimated 5,440 MWh and 1,122 MWh of savings for DEC and DEP participants respectively over the post-install period.

Table 3-1. Ex-Post EE Impacts – Program Total Mar 2019 through Feb 2020

Energy Provider	Devices	Program Impact (MWh)	Margin of Error (90% CI)	Relative Precision (+/-)
DEC	5,304	5,440	±1,488	±27%
DEP	2,653	1,122	±724	±65%

Source: Guidehouse analysis of DEC and DEP data, values subject to rounding.

Figure 3-1 and Table 3-2 show per participant EE savings in each season of the post-install period. Overall, the program delivered 1,743 kWh (DEC) and 724 kWh (DEP) of energy savings per participant over the entire post-install period. This amounts to about 3.9% of facility consumption in DEC and 1.8% in DEP. Statistically significant savings were estimated in both summer and winter seasons, but more savings accrued in the summer – 1,094 kWh (DEC) and 455 kWh (DEP) per participant. The higher savings during the summer months is consistent with Guidehouse's analysis of program tracking data that indicates that approximately 20% of participants have heat pumps installed.

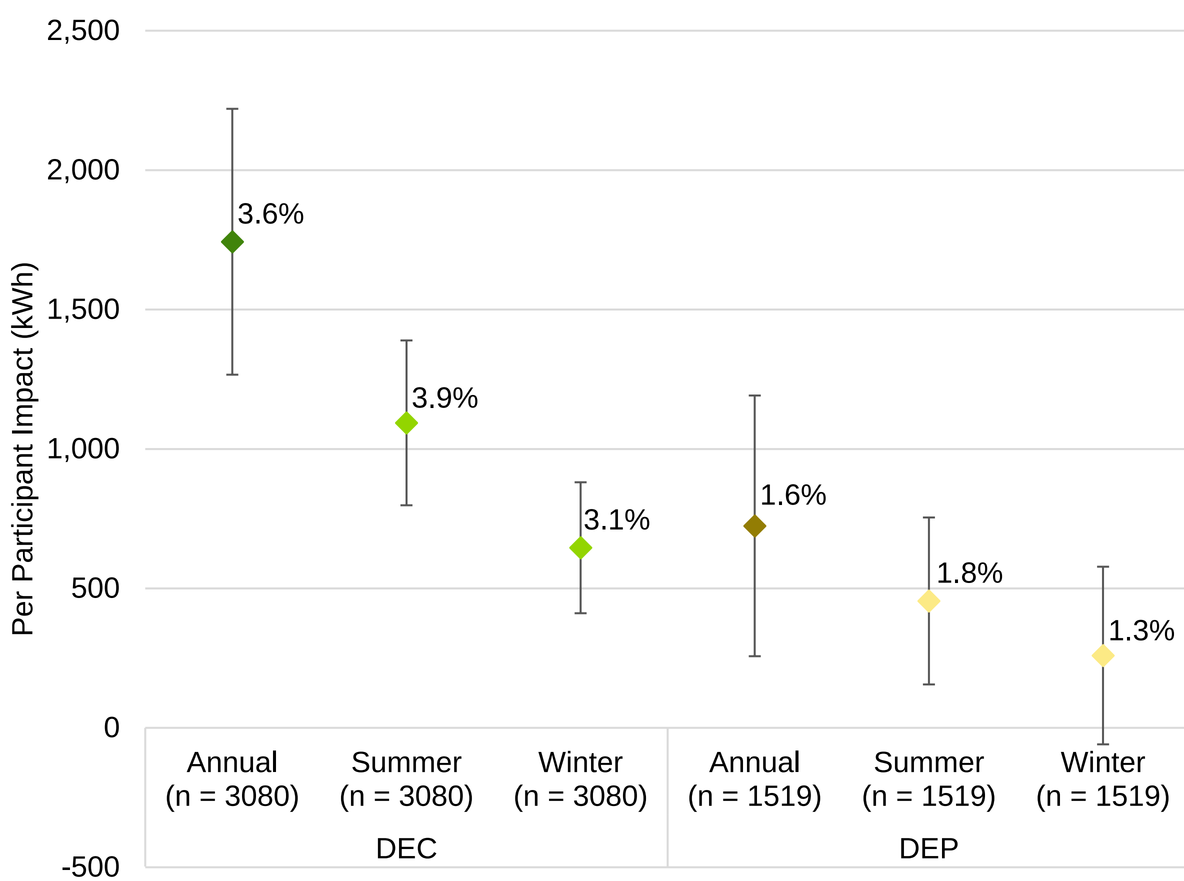
Table 3-2. Ex-Post EE Impacts – per Participant by Season

Energy Provider	Season	Impact (kWh / Participant)	Margin of Error (90% CI)	Savings (% Facility)
DEC	Summer	1,094	±296	3.9%
	Winter	646	±235	3.1%
	Annual	**1,743**	**±477**	**3.6%**
DEP	Summer	455	±299	1.8%
	Winter	259	±319	1.3%
	Annual	**724**	**±468**	**1.6%**

* Summer (May – Oct) and Winter (Nov – Apr) may not add up exactly to Annual impacts due to rounding and the fact that they are estimated separately from annual impacts.

Source: Guidehouse analysis of DEC and DEP data, values subject to rounding.

Figure 3-1. Ex-Post EE Impacts – Per Participant by Season



**percentages indicate savings as a percent of total facility consumption, and bars indicate margin of error.*
Source: Guidehouse analysis of DEC and DEP data.

Similarly, Table 3-3 and Figure 3-2 show per device energy savings in each season of the post-install period. Overall, the program delivered 1,026 kWh (DEC) and 423 kWh (DEP) of energy savings per device over the entire post-install period. Savings were observed for both summer and winter seasons, but more savings accrued in the summer – 644 kWh (DEC) and 266 kWh (DEP) per device.

Table 3-3. Ex-Post EE Impacts – per Device by Season

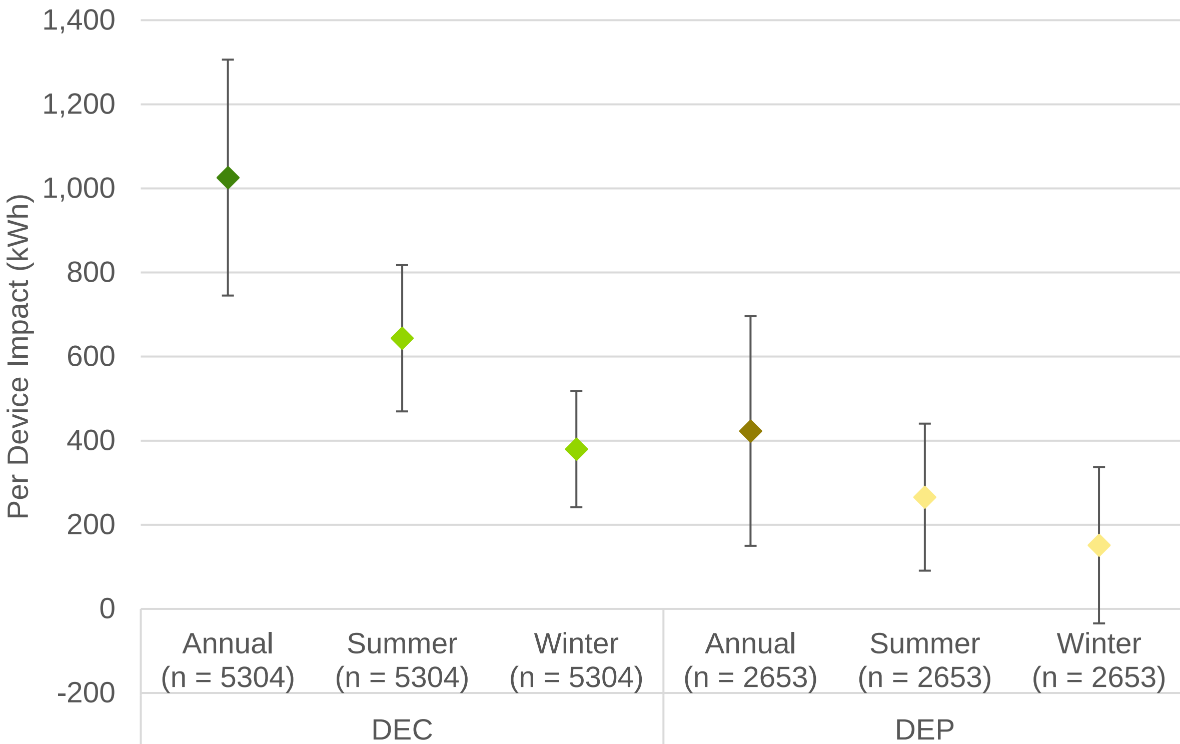
Energy Provider	Season	Impact (kWh / Device**)	Margin of Error (90% CI)
DEC	Summer	644	±174
	Winter	380	±138
	Annual	1,026	±281
DEP	Summer	266	±175
	Winter	152	±186
	Annual	423	±273

* Summer (May – Oct) and Winter (Nov – Apr) may not add up exactly to Annual impacts due to rounding and the fact that they are estimated separately from annual impacts.

*** Per device impacts are based on an average of 1.71 devices per participant (DEC) and 1.75 devices per participant (DEP).*

Source: Guidehouse analysis of DEC and DEP data, values subject to rounding.

Figure 3-2. Ex-Post EE Impacts – Per Device by Season



**Bars indicate margin of error.*
Source: Guidehouse analysis of DEC and DEP data.

3.2 Differences in Savings between DEC and DEP

Guidehouse estimated materially higher savings for DEC participants (1,026 kWh / device) than DEP participants (423 kWh / device). This difference (603 kWh / device) is consistent with the findings of the prior evaluation completed by another evaluator, which found DEC impacts to be 503 kWh higher per device in DEC than DEP. Guidehouse has developed and explored several hypotheses that may explain the difference in achieved savings:

- **Different Participant Setpoint Behavior**: Duke Energy provided Guidehouse with thermostat setpoint schedule data for participants,[5] which provided some insight into how participants in DEC and DEP use the setback features of their thermostats. Setbacks are defined as the temperature setpoint programmed by a participant when a building is likely to be unoccupied, and more aggressive setbacks generally lead to energy savings. Guidehouse found that a greater percentage of DEC participants use setbacks for both heating and cooling seasons as compared to DEP participants. About 60% of DEC participants used heating setbacks as compared to about 40% of DEP participants, and about 40% of DEC participants used cooling setbacks as compared to

[5] Available setpoint schedule data was primarily for participants who installed a device after February 2019 and spanned the period of March 2019 through January 2020. Nevertheless, the data provided some insight into differing behavior among DEP and DEC participants.

about 30% for DEP. These differences between unoccupied and occupied setpoints suggest that DEC participants are more likely to exhibit energy efficient behavior than DEP participants, supporting Guidehouse's finding of greater kWh savings for DEC. This analysis is discussed in further detail in Appendix A.3. Further investigation of participant behavior before and after installation of the smart thermostat may provide additional insight into this phenomenon.

- **Use of Air Conditioning (AC) in Response to Temperature**: Higher AC usage for DEC participants for a given increase in temperature suggests a higher potential for savings. Guidehouse's regression modeling indicates for each incremental cooling degree day experienced, DEC participants increase their electricity demand by more than DEP participants. This modeling result indicates that when DEC and DEP participants are exposed to the same temperature, DEC participants on average use more electricity, suggesting that DEC participants tend to use their AC units more than DEP participants. The total cooling load over the summer season may still be higher for DEP customers, as it is generally warmer in DEP territory.

- **Differences in AC Size**: Larger AC units also suggests a higher potential for energy savings. Guidehouse found that the average size of AC units for DEC thermostats (4.3 tons, average over all thermostats) was slightly higher than DEP thermostats (4 tons, average over all thermostats). Depending on the efficiency of installed equipment, this difference may indicate differences in energy consumption between DEC and DEP participants.

- **Different Participant Business Types**: Differences in business types or operations between the territories may lead to variation in the flexibility to achieve energy savings. Based on SIC code, Guidehouse found that DEC participants include a larger share of Manufacturing and Retail participants, while DEP participants include a larger share of Finance and Services participants. In the manufacturing sector, DEC participants exhibited higher consumption (339 kWh / day) than DEP participants (152 kWh / day). While this difference does not completely account for the differences in savings achieved, it does illustrate that businesses have different consumption patterns and therefore may have a different capability of reducing HVAC usage via the thermostat.

These hypotheses can be used to direct future efforts in evaluation and program design. Potential activities to investigate these hypotheses include:

- **AC Size and Usage**: Further investigate available thermostat telemetry data and any additional available HVAC equipment characteristics (i.e. capacity, SEER/EER) that can be collected for DEC and DEP participants and directly compare the runtime and energy consumption of connected equipment on hot weather days. Alternatively, AMI data for summer 2021 (to be collected for the DR evaluation) may be used to compare whole facility energy consumption directly on hot weather days. In the future, existing thermostat type and temperature setpoints could be collected at the time of installation of the new device, to enable future investigation.

- **Participant Business Types and Behavior:** Future evaluations could include, for example, participant surveys to assess business capacity for saving energy (e.g., ability to curtail AC use during business hours) and willingness and ability to save energy via the thermostat (e.g., preferences for setpoints before and after installing the device). Participant surveys can also be used to understand how customers in each territory are engaging with the online portal.

3.3 Net-to-Gross

Evaluations of demand-side management programs typically estimate both net and gross savings, and often present a net-to-gross (NTG) ratio based on the evaluated percentage of energy reductions that may be ascribed either to free ridership (which decreases the NTG ratio) or to program spillover (which increases the NTG ratio).

Free ridership is typically defined as the percentage of savings that would have occurred absent the presence of the program. Spillover is typically defined as incremental savings actions undertaken by a program's participants not directly incented by the program.

All savings presented in this report should be considered net.

3.3.1 Energy Efficiency Impacts

The energy efficiency impacts of this program are net of any free ridership. This is because most of the key program elements that drive savings are not available in the consumer market. Furthermore, the program is designed primarily as a demand response program and it is unlikely that energy impacts driven by free ridership occur because participants enroll in demand response.

A participant is considered a free rider when it can be demonstrated that even absent the program the participant would have purchased the efficient equipment and adopted the efficient behavior promoted by that program.

In the case of this program, the energy efficiency equipment being deployed requires educated action on the part of the participant to achieve energy savings. This action requires information feedback provided by program-specific tools. Simply purchasing a Wi-Fi enabled thermostat would not yield any savings. Savings are delivered by the participants taking appropriate and impactful actions that the education, information feedback via the portal, and program-specific thermostat pre-sets empower them to do. It is the combined effect of these elements, packaged in a single offering, that results in the savings estimated in this evaluation.

Key program elements that customers could not acquire in the open market, elements that are essential for achieving the energy efficiency savings include:

- **Multi-Source Information.** Although some Wi-Fi-enabled thermostats for commercial enterprises allow the user to observe thermostat run-times (real-time and historical) the EnergyWise Business online portal allows users to observe things like thermostat run-times and set-points alongside consumption values. This more clearly identifies potential bill savings to participants than commercially available products.

  The portal doesn't just display HVAC usage and run-time characteristics, but combines both sets of information to deliver customized participant business-specific benchmarking, identifying for the participant (at portal login) periods of high usage and opportunities for bill savings.

- **Education and Tech Support.** When participants enroll, the thermostat is installed *and set up* by industry professionals in consultation with the key business decision-maker. This means that initial thermostat settings for all businesses will be calibrated to deliver savings without impinging on the core business. Additionally, the installer ensures that the participant can access all portal and thermostat functionality while they are on site. The program therefore delivers both a nearly universal adoption of initial energy saving settings and ensures that the business owner understands and can access and use the tools provided.

  In addition to the significant assistance provided at enrollment and installation, Duke Energy maintains a call center for participant technical support, specially trained for supporting this program, the thermostat and portal.

- **Maintenance and Energy-Saving Prompts.** In addition to the standard battery of energy efficiency tips and maintenance prompts, a key feature of the Duke Energy portal not otherwise available in the consumer market is its automated analysis of equipment condition – for example monitoring the relationship between run-time and temperature – and alerting the user when monitored metrics suggest maintenance could deliver cost-effective bill savings. This targeted advice effectively provides users with a customized maintenance schedule and reminders and is a program-specific feature, rather than a thermostat capability that could be obtained through the consumer market.

These elements are all major factors that drive savings and are all specific to the programmatic context of the technology deployed. Given that these elements are available only through participation in the program, Guidehouse believes the energy savings found in this evaluation are net savings.

4. Findings, Conclusions, and Recommendations

The principal EM&V findings and conclusions regarding the estimated energy impacts are as follows:

- **Participants are estimated to have reduced an average of 1,026 kWh per device in DEC and 423 kWh per device in DEP for the period of March 2019 through February 2020.** More savings were realized in summer months compared with winter, which reflects the fact that only some participants use electric heating. Guidehouse has developed hypotheses for the difference in savings between DEC and DEP participants, which may be used to guide future evaluation and program implementation.

- **Guidehouse concluded that selecting a suitable non-participant comparison group was not possible with the data available for estimating energy impacts.** Guidehouse observed evidence of differing evolution of consumption patterns between participants and selected matches from the pre- to post-installation periods, which suggests that the consumption behavior of selected matches may not evolve in similar ways as participants as would be assumed when using a comparison group. This result suggests that an MCG comprised of non-participants is unsuitable for estimating energy efficiency impacts for small and medium-sized businesses in this program.

Based on the impact findings above, Guidehouse recommends that Duke Energy consider the following recommendations:

- **Consider customer targeting or outreach activities to increase energy savings.** Targeting more customers with electric heat could increase winter energy savings. Guidehouse understands that future program data will have more accurate tracking of HVAC equipment types, which would facilitate such targeting efforts. Duke Energy may wish to consider increasing outreach encouraging participants to adopt more energy efficient setpoints. Although program technicians assist participants with initial thermostat setup, it is unclear how the settings persist over time. Following up with participants to encourage them to optimize these settings may increase the amount of energy savings achieved in the program.

- **Consider using future process evaluations to better understand differences in savings estimated in DEP and DEC service territories.** Consistent with the findings of the prior evaluation conducted by another evaluator, Guidehouse estimated that average savings per participant were lower for DEP participants than for DEC participants. Participant interviews or surveys may be used to better understand the factors that cause DEP participants to exhibit lower savings. For example, surveying DEC and DEP participants may show differences in willingness to use temperature setbacks or capability of reducing HVAC consumption based on business operation considerations.

5. Summary Form

EnergyWise Business
2019-2020
Completed EMV Fact Sheet

Description of Program

EnergyWise Business is a commercial HVAC load control program that targets small and medium businesses. At the time of enrollment participants are provided either with a thermostat or a load switch, with most customers having a thermostat. Participants must have a password-protected wireless network in order to qualify for a thermostat.

Participants may elect to be controlled using one of three cycling strategies: 30%, 50%, or 75%. Incentive for participation increases commensurate with the increased aggressiveness of the cycling strategy selected.

Impact Evaluation Methods

Guidehouse estimated energy impacts via a regression analysis of monthly consumption data for the estimation period of March 2019 through February 2020, for participants who installed a thermostat between January 2018 and February 2019.

Impact Evaluation Details

- **The program generated 5,440 MWh (DEC) and 1,122 MWh (DEP) of savings from March 2019 through February 2020.**

- **Participants are estimated to have reduced an average of 1,026 kWh / device (DEC) and 423 kWh / device (DEP) for the period of March 2019 through February 2020.** More savings were realized in summer months compared with winter, which reflects the fact that only some participants use electric heating. Guidehouse has developed hypotheses for the difference in savings between DEC and DEP participants, which may be used to guide future evaluation and program implementation.

Date:	2021-01-22
Region:	DEC and DEP
Evaluation Period	EE: 2019 – 2020
DR Event Program Impact (MW)	
EE Program Impact (MWh)	
Program total for participants with thermostats (Mar 2019 – Feb 2020	DEC: 5,440 MWh DEP: 1,122 MWh
Net-to-Gross Ratio	1

6. Program Impacts for Duke Energy Analytics

DSMore table -
DEC-DEP SBDR Therm

Appendix A. Detailed Energy Efficiency Impact Methodology

This appendix includes a more detailed description of Guidehouse's methodology for estimating energy efficiency impacts and ruling out the suitability of an MCG, resulting in a within-subject regression analysis.

A.1 Assessment of Matched Comparison Group

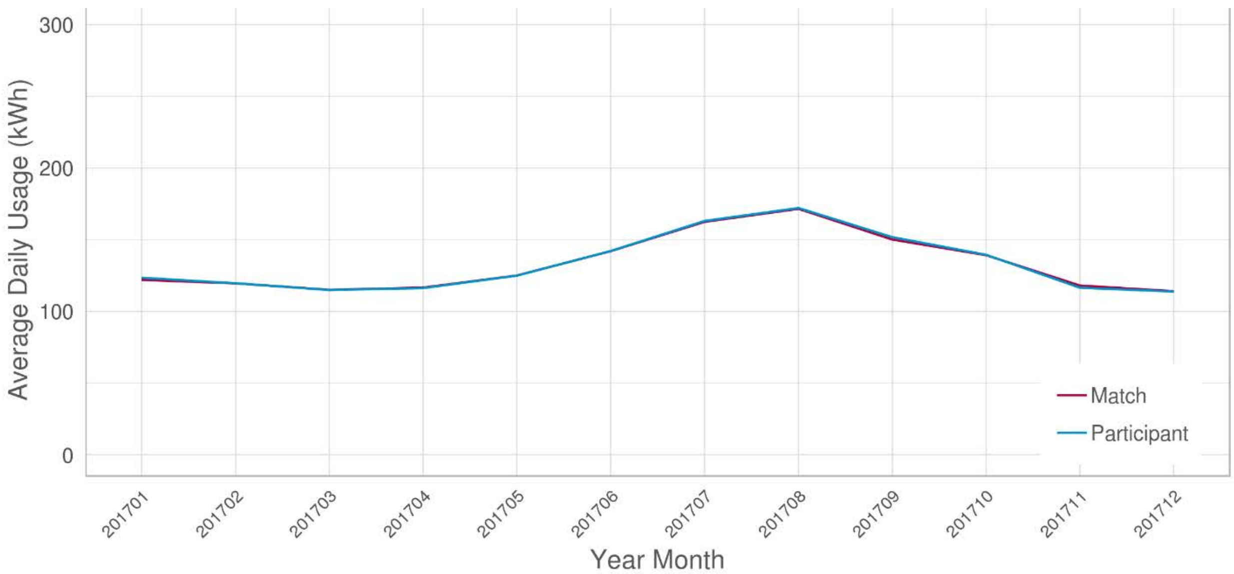
In absence of true experimental design (e.g., a randomized control trial), using an MCG is generally the preferred evaluation method for estimating energy savings for a program like EnergyWise Business. An MCG generally allows evaluators to control for unobserved trends in energy use that are unrelated to the installation of the program thermostat but consistent in effect across both participants and non-participants such as changes in energy use associated with macroeconomic factors. This approach is also commonly referred to as quasi-experimental and reduces the likelihood of specification bias.[6] Within-subject models that do not use a comparison group tend to be much more sensitive to model specification than models with a comparison group, which rely more heavily on contemporaneous observations of non-participant consumption to estimate participant baseline consumption.

Guidehouse developed an MCG where each participant was assigned a "match", which is the non-participant within the same SIC division (first two digits of the SIC Code) that has the most similar consumption patterns in the matching period (e.g., January to December 2017).[7] Figure A-1 and Figure A-2 compare average daily usage by month during the matching period between participants and matches for DEC and DEP, respectively. In general, the selected matches for both DEC and DEP, on average, exhibited similar behavior in the matching period, before any participants have installed the thermostat. DEP participants and matches showed large differences in the matching period. The underlying assumption of using an MCG is that the relative difference between participant and MCG consumption is consistent over time in absence of the treatment, conditional on the independent variables included in the regression equation, such that subsequent differences after installation of the thermostat can be attributed to energy savings.

[6] An LDV approach using an MCG, conditional on the assumption that the two groups' consumption will (absent the treatment) trend in a similar fashion, will tend to be less sensitive to what variables are included (or left out) of the model specification.

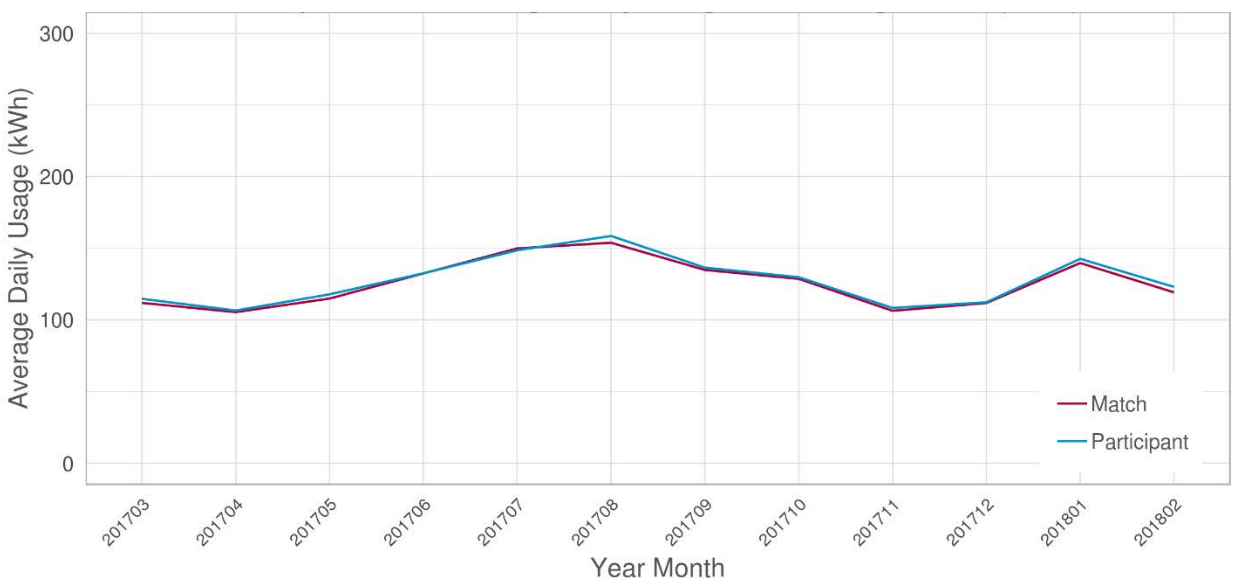
[7] For a small number of DEP customers who installed in January or February of 2018, data was only available for March 2017 onwards. Therefore, for DEP customers who installed in January 2018, the matching period was defined as March through December 2017. For DEP customers who installed in February 2018, the matching period was defined as March 2017 through January 2018. For all other DEP customers, the matching period was defined as March 2017 through February 2018.

Figure A-1. Comparison of Average Daily Usage – Matching Period (DEC)



Source: Guidehouse analysis of DEC and DEP data

Figure A-2. Comparison of Average Daily Usage – Matching Period (DEP)



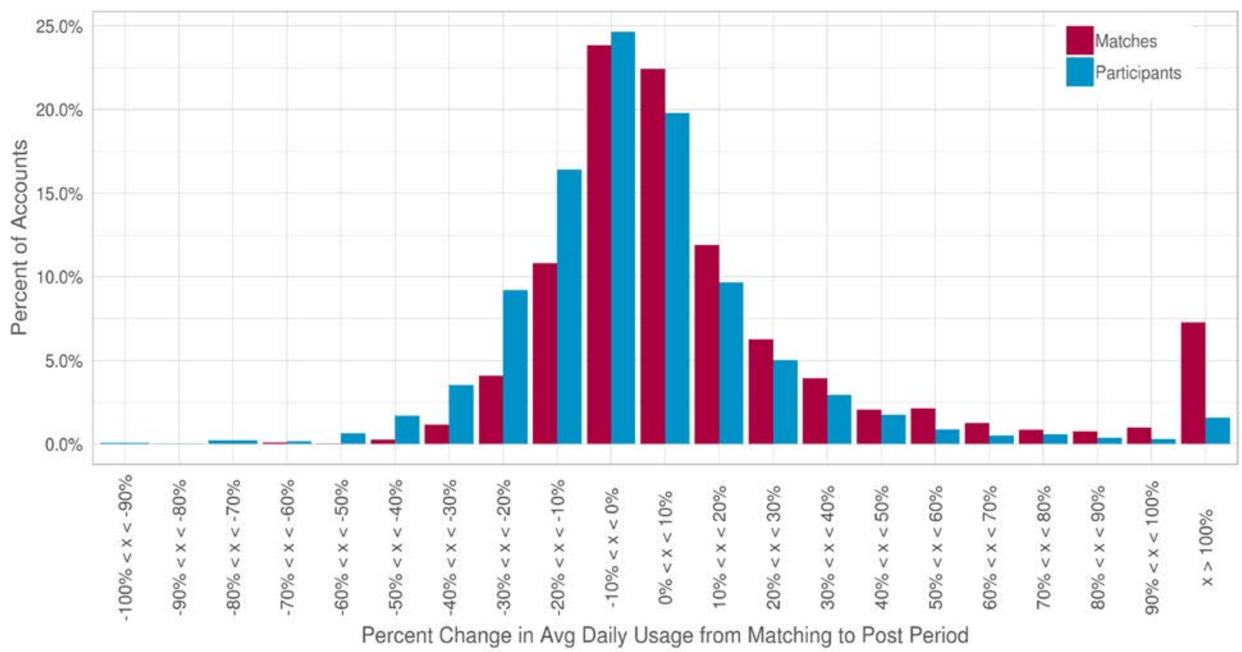
Source: Guidehouse analysis of DEC and DEP data

However, Guidehouse observed some large differences in the post-installation period, particularly for DEC participants and corresponding matches where changes in winter consumption would be unexpected as a result of installing a thermostat. As a result, Guidehouse further investigated match quality. Guidehouse observed that many participants changed their consumption significantly between the pre- and post-installation period (2017 to 2019). This phenomenon may be expected for small businesses, where changes in operations or tenancy may occur. However, these swings in usage may bias impacts if they either:

- Are not experienced similarly by participants and matches, e.g., if matches exhibit large swings in usage that participants do not;
- Are asymmetric, e.g., if swings are more likely to be increases than decreases, then large swing upwards will not 'cancel out' with large swings downward.

Figure A-3 shows the distribution of such changes for both participants and matches. In the middle of the distribution, (i.e. changes in consumption of ±10%), some differences are expected since the participants have installed a thermostat. However, higher levels of change such as increasing consumption by +100% are unexpected and not plausibly related to the installation of a thermostat. The selected matches showed a much higher proportion of customers that increased consumption by more than 100%, which suggests that the selected matches may have evolved differently over time, despite exhibiting similar consumption in the pre-installation (i.e., matching) period.

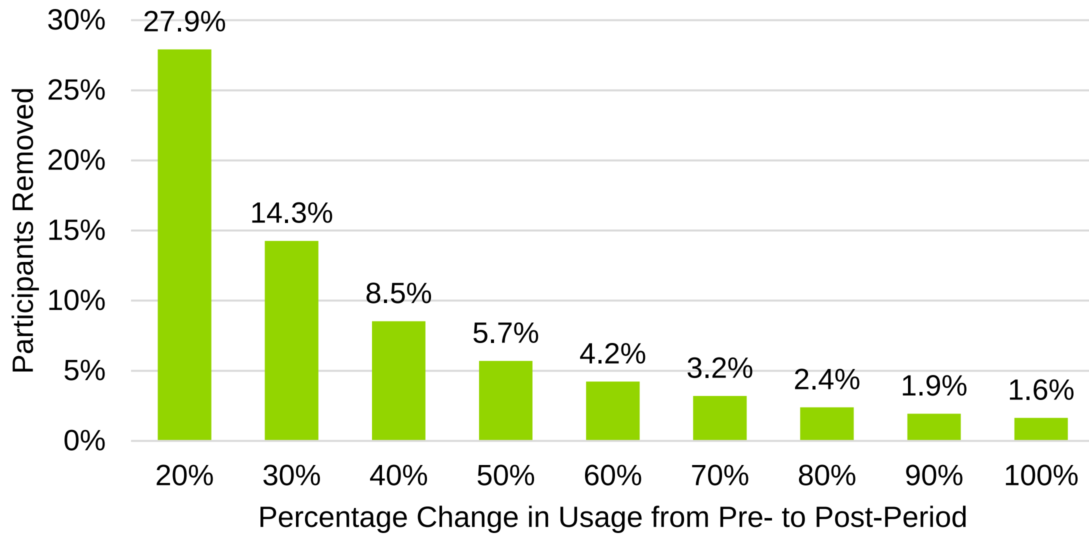
Figure A-3. Distribution of Change in Average Usage, Participants vs Matches



Source: Guidehouse analysis of DEC and DEP data

To test the sensitivity of savings estimates, Guidehouse investigated "trimming" the participant sample to remove customers that exhibited changes in average consumption larger than a certain percentage. Figure A-4 shows the percent of participants (for DEC and DEP combined) that would be removed at different thresholds, from ±20% to no trimming of the sample. For example, if the condition is set that customers whose consumption either doubles or falls to zero (±100% change) should be removed, 1.6% of customers must be "trimmed" from the estimation set.

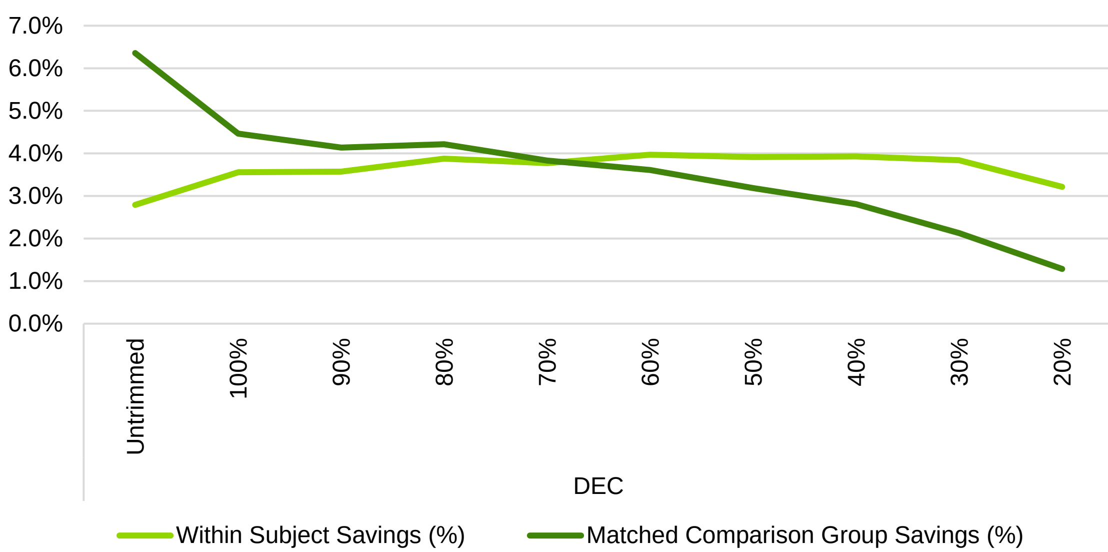
Figure A-4. Comparison of Average Daily Usage – Post Period



Source: Guidehouse analysis of DEC and DEP data

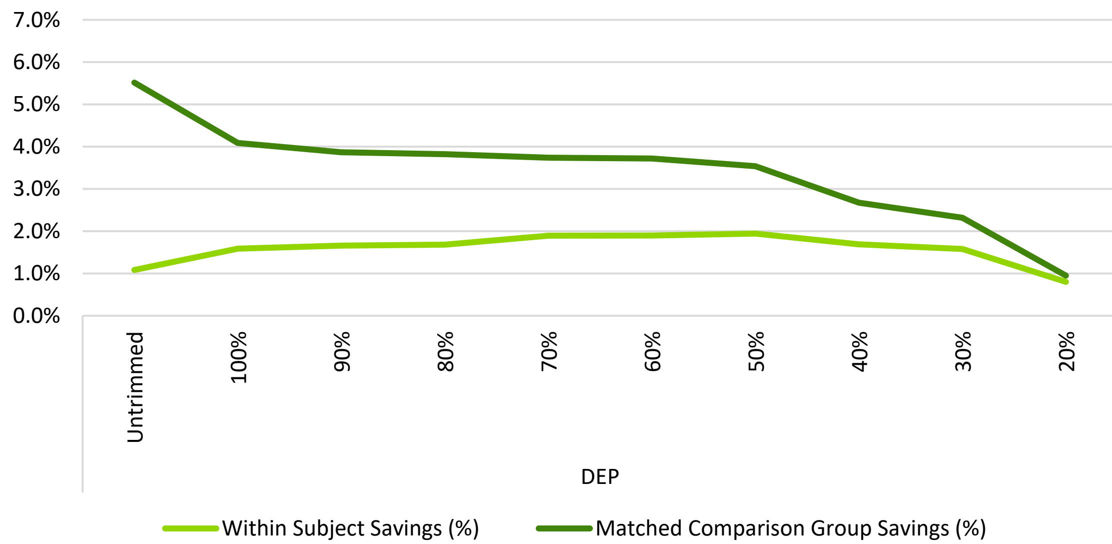
Guidehouse then explored the sensitivity of estimated savings at each level of trim, with the selected MCG and using the within-subjects approach. Guidehouse found that the savings estimates generated using an MCG varied substantially between different trim levels. In contrast, savings estimates estimated without an MCG were much less sensitive, as shown in Figure A-5 and Figure A-6. For both DEC and DEP, aside from the untrimmed and ±20% thresholds, savings estimates are relatively consistent as shown by the flatter profile of the within-subjects' lines.

Figure A-5. Comparison of Percent Savings Estimates at Different Trim Thresholds - DEC



Source: Guidehouse analysis of DEC and DEP data.

Figure A-6. Comparison of Percent Savings Estimates at Different Trim Thresholds - DEP



Source: Guidehouse analysis of DEC and DEP data.

The sensitivity of estimated savings to trim when using the selected MCG suggests that trimming the sample affects the group of participants differently than the selected matches, and therefore suggests that the selected matches may have evolved differently in terms of energy consumption behavior than participants for reasons unrelated to the EnergyWise for Business program.

Based on this investigation, Guidehouse concluded that an LDV approach with MCG is inappropriate for evaluating the impacts of energy efficiency for small businesses in the DEP and DEC territories.[8] Additionally, Guidehouse imposed a restriction on participants for the sample to have a change in average consumption of less than 100% between the pre- and post-installation periods. Guidehouse selected this threshold for the following reasons:

- this threshold removes approximately 2% of participants that could be considered outliers who increased their consumption by more than double their 2017 amount;
- the resulting sample of participants exhibits changes in usage that are more symmetric (i.e. between -100% and 100% of 2017 consumption); and
- estimated savings results were not sensitive to further trim levels.

Guidehouse proceeded with the analysis using a within-subject approach which considers participants only and compares consumption before and after installation of the thermostat.

[8] This finding should be understood to be specific to this program and set of jurisdictions, and caution should be used in generalizing this result to other jurisdictions, or even to other programs within this same jurisdiction.

A.2 Regression Model Specification

DEC and DEP participants were modeled separately. Equation A-1 shows the within-subjects model regression equation used for both models. These models estimate participant average daily usage in a given bill period as a function of month of year, cooling and heating degree days, and participation in Duke Energy's other energy efficiency programs. Only participant data is included in the models for the period from January 2016 through February 2020 (for DEC) and March 2017 through February 2020 (for DEP).

Equation A-1. Within-Subjects Regression Model

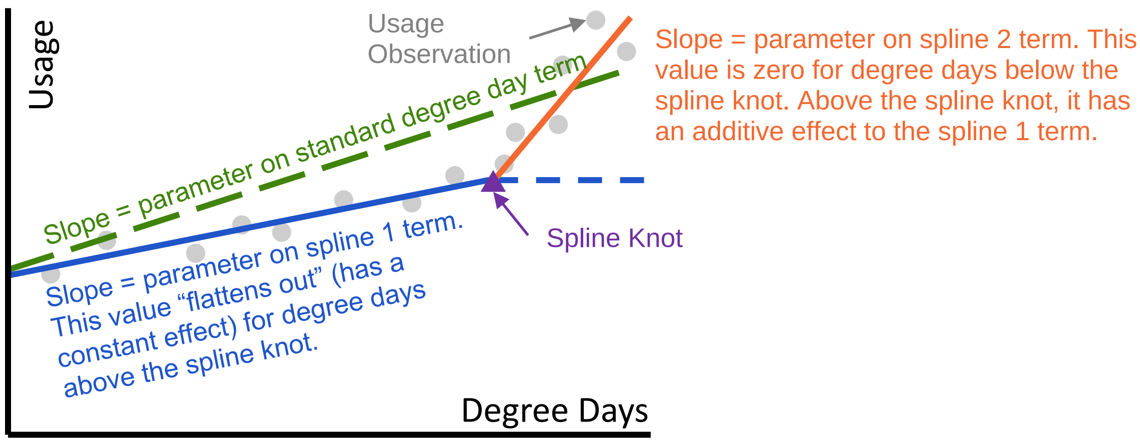
$$ADU_{it} = \alpha_i + \sum_J \beta_{1j} Month_{jt} + \beta_2 CDD_{it} + \beta_3 spline_1 HDD_{it} + \beta_4 spline_2 HDD_{it} + \beta_5 CrossPart_{it}$$
$$+\beta_6 Treatment_i \cdot CDD_{it} + \beta_7 Treatment_i \cdot spline_1 HDD_{it} + \beta_8 Treatment_i \cdot spline_2 HDD_{it} + \varepsilon_{it}$$

Where,

i	=	The subscript identifying the customer.
t	=	The subscript identifying the month of sample.
α_i	=	The customer-specific fixed effect.
ADU_{it}	=	Average daily consumption of kWh by customer *i* in month of sample *t*.
$Month_{jt}$	=	A set of binary variables taking a value of 1 when *j* = *t* and 0 otherwise; *j* indexes months 1-12.
CDD_{it}	=	average cooling degree days (base 65°F) in month of sample *t*.
$spline_1 HDD_{it}$, $spline_2 HDD_{it}$	=	a set of variables acting as a temperature spline for the average heating degree days (base 65°F) in month t experienced by customer I, with a spline knot of 19. As illustrated in Figure A-7, the spline models temperature dependent consumption with a different relationship at lower temperatures below the spline knot. The higher temperature component of the spline accounts for increased electricity usage at very cold temperatures, where auxiliary heating may be used for heat pumps.
$CrossPart_{it}$	=	A dummy variable equal to 1 if customer *i* participated in a related small business energy efficiency program (e.g. Small Business Energy Saver, etc.) during, or in any of the months prior to, month of sample *t*; and 0 otherwise.
$Treatment_{it}$	=	A dummy variable equal to 1 if customer *i* installed their smart thermostat during, or in any of the months prior to the month of sample *t*; 0 otherwise.
ε_{it}	=	The error for customer *i* during month of sample *t*. Standard errors are estimated from model residuals and are cluster-robust to account for any heteroskedasticity or serial correlation at the business level.

β = Parameter estimates. These values are the estimated relationship between demand and the variable for which the beta represents. β_7, β_8 are used to estimate average daily energy savings due to the program.

Figure A-7. Illustration of a Temperature Spline



A.3 Participant Setpoint Analysis

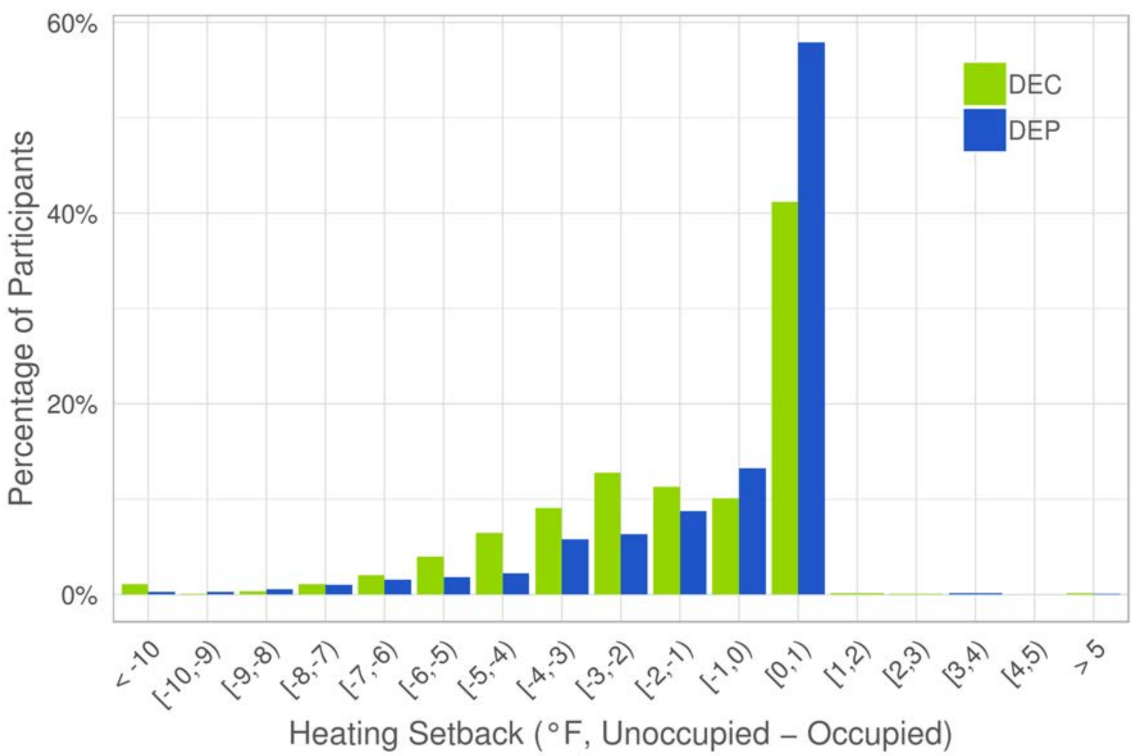
Guidehouse performed analysis of available thermostat setpoint telemetry data for participants in the program, to provide insight into the differences in estimated energy savings between DEP and DEC participants. Duke Energy provided a set of thermostat telemetry data for participants in both DEC and DEP territories. The data contained a log of participant thermostat setpoint schedules spanning the time period of March 2019 through January 2020, where entries appear every time a schedule is created. Customers can create a setpoint schedule in different ways: by day of week, by weekday and weekend, or by occupied and unoccupied. 95% of participants chose to set an unoccupied vs occupied schedule. Only 15% chose to set a daily schedule (10% of customers chose to use both types of schedules at different times). No DEP participants used a daily setpoint schedule, i.e. they only used an occupied vs unoccupied schedule.

The data contained schedules for participants who installed a device between January 2019 through February 2020; however, there was little overlap with the evaluation sample of those who installed between January 2018 and February 2020, as 98% of devices in the available data were installed after February 2019. Nevertheless, the data still provides insight into DEP and DEC participants, so Guidehouse analyzed the data to discover any trends that may explain differences in observed energy savings.

Since no DEP participants used a daily schedule, Guidehouse focused on comparing unoccupied and occupied setpoints to understand the extent to which customers in each territory use temperature setbacks, or a more energy efficient setpoint, when their business is unoccupied. In the summer, a setback corresponds to a higher setpoint, while in the winter a setback corresponds to a lower setpoint. A larger setback indicates more energy efficient behavior.

Figure A-8 compares the distribution of observed heating setbacks between DEC and DEP participants. Almost 60% of DEP participants with telemetry data do not appear to use any heating setback, compared with about 40% of DEC participants (indicated by the tall bars on the right of the distribution). Furthermore, setbacks for DEC participants are generally more aggressive than DEP, as indicated by the higher green bars for various setback levels. This suggests that DEC participants are exhibiting more efficient behavior on average than DEP participants during the heating season.

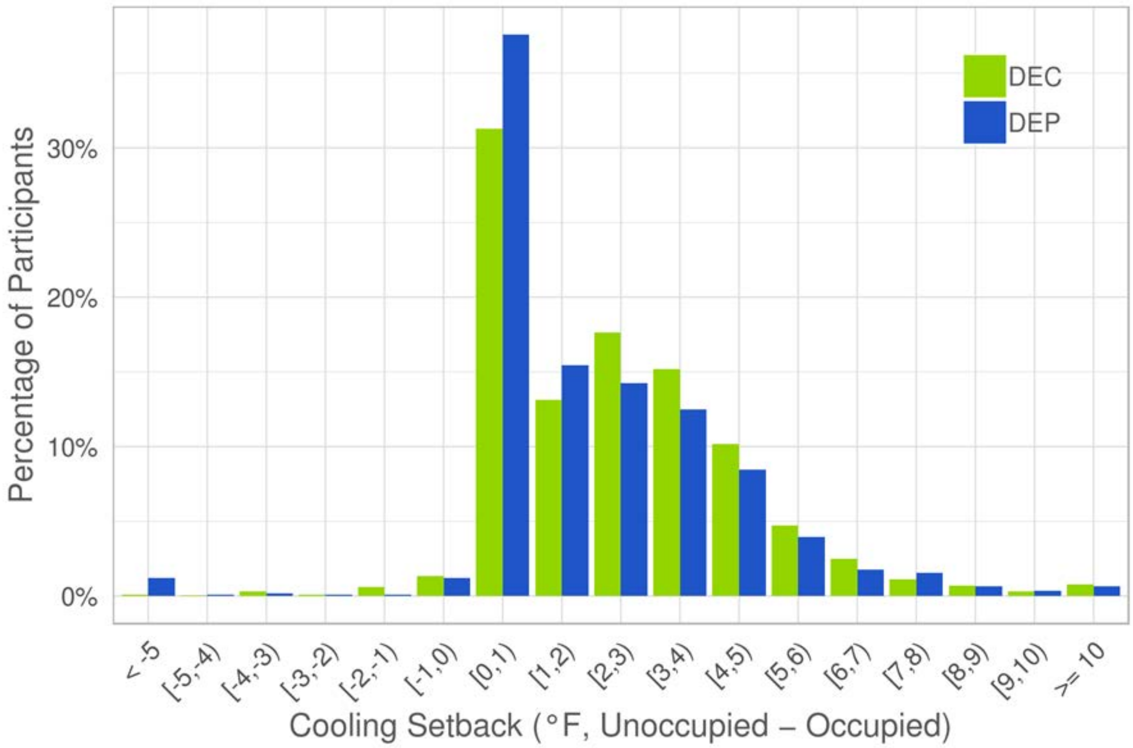
Figure A-8. Distribution of Observed Heating Setbacks



Source: Guidehouse Analysis

Similarly, Figure A-9 compares the distribution of observed cooling setbacks between DEC and DEP participants. Almost 40% of DEP participants with telemetry data do not appear to use any cooling setback, compared with about 30% of DEC participants. Furthermore, setbacks for DEC participants are generally more aggressive than DEP, as indicated by the higher green bars for various setback levels. This suggests that DEC participants are exhibiting more efficient behavior on average than DEP participants for the cooling season.

Figure A-9. Distribution of Observed Cooling Setbacks



Source: Guidehouse Analysis

Across both heating and cooling, occupied and unoccupied setpoints suggest that DEC participants exhibit more energy efficient behavior on average than DEP participants. Almost 60% of DEP participants do not use any heating setback, and almost 40% do not use a cooling setback. Comparatively for DEC participants, ~40% do not use a heating setback and ~30% do not use a cooling setback.

The differences in setback behavior may explain some of the differences in the estimated kWh savings between DEP and DEC. Note that this analysis was based on a more recent sample of participants than those used for estimating kWh savings. Nevertheless, the data provided some insight into differing behavior among DEP and DEC participants. Guidehouse also did not have data on behavior prior to installation of the thermostat; however, since a large portion of participants appear to not use any setback, we may assume that these customers did not use one before installing the new thermostat either.