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1 Executive Summary

1.1 Program Summary

The Energy Efficiency Education in Schools Program is a Duke Energy Ohio (DEO) energy efficiency program 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 DEO NTC program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Research into Action, for the school and program year of August 2017 through May 2018.

1.2.1 Impact Evaluation

The evaluation team conducted the evaluation as detailed in this report to estimate energy and demand savings attributable to the 2017-2018 DEO NTC program. The evaluation was divided into two research areas - to determine gross and net savings (or impacts). Gross impacts are energy and demand savings estimated at a participant's home that are the direct result of the homeowner's installation of a measure included in the Duke Energy home kit. Net impacts reflect the degree to which the gross savings are a result of the program efforts and funds. Table 1-1 and Table 1-2 present the summarized findings of the impact evaluation.

Table 1-1: 2017-2018 Energy Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	499.0	37.1%	185.0	1.13	209.3
Demand (kW)	0.134	15.4%	0.021		0.023

Table 1-2: 2017-2018 Program Level Energy Savings

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	3,225,037	37.1%	1,195,598	1.13	1,343,181
Demand (kW)	867.7	15.4%	133.4		150.4

Figure 1-1 provides the verified energy saving share by measure, and Table 1-3 provides gross verified energy and demand savings by measure and net to gross ratio details.

Figure 1-1: 2017-2018 DEO NTC Gross Verified Energy Savings

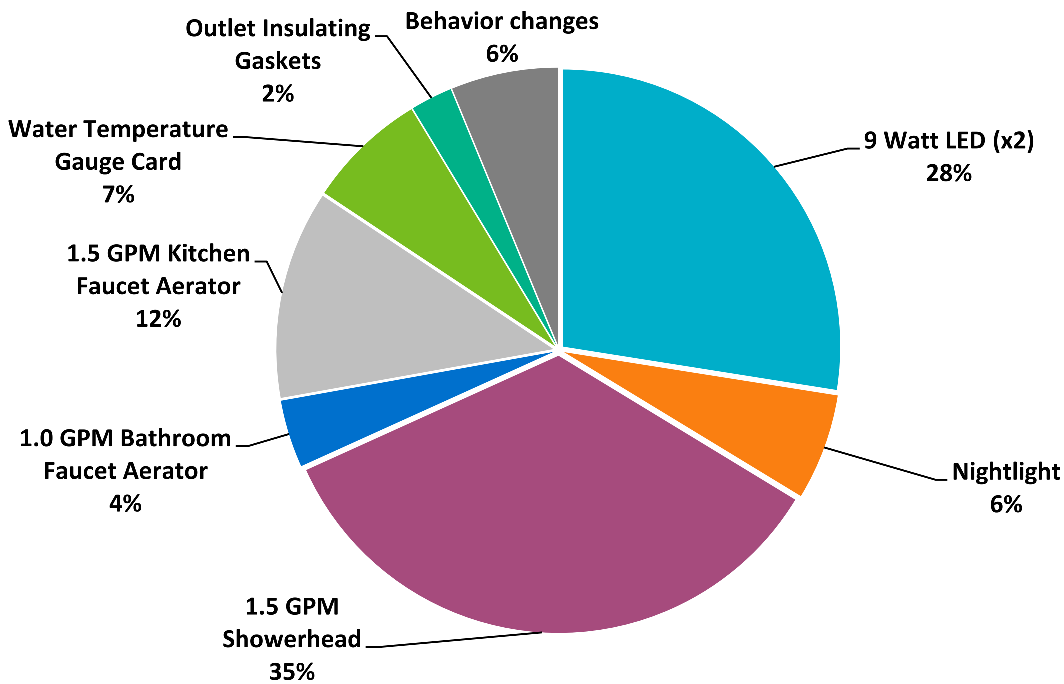


Table 1-3: DEO NTC Program Year 2017-2018 Verified Impacts by Measure

Measure	Gross Energy Savings per unit (kWh)	Gross Demand per unit (kW)	Free Ridership	Spillover	Net to Gross Ratio
9 Watt LED*	50.9	0.006	0.15	0.28	1.13
Nightlight	11.5	0.000			
1.5 GPM Showerhead	63.9	0.010			
1.0 GPM Bathroom Faucet Aerator	7.3	0.001			
1.5 GPM Kitchen Faucet Aerator	22.5	0.001			
Water Temperature Gauge Card	12.9	0.002			
Outlet Insulating Gaskets	4.5	0.001			
Behavioral Changes	11.5	0.001	-	-	-
Total Kit and Behavioral Impacts	**185.0**	**0.021**	**0.15**	**0.28**	**1.13**

*Reflects savings for two 9 watt LEDs bulbs

1.2.2 Senate Bill 310 Compliance

In the state of Ohio, electric distribution utilities (EDUs), including DEO, are required to achieve a cumulative annual energy savings of more than 22% by 2027 per Ohio Senate Bill (SB) 310 . SB 310 also introduced new mechanisms that adjust how EDUs may estimate their energy savings achieved through demand side management programs. Specifically, SB 310 requires the Ohio Public Utilities Commission (PUC) to permit EDUs to account for energy-efficiency savings estimated on an “as-found” or a deemed basis. That is, an EDU may claim savings based on the baseline operating conditions found at the location where the energy-efficiency measure was installed, or the EDU may claim a deemed savings estimate. For example, if a DEO customer installed a LED light bulb, DEO can claim energy savings based on its own assumed deemed or calculated energy savings value associated with the lamp upgrade irrespectively of third party evaluation, measurement, and verification, which could show a higher or lower level of energy savings from observed conditions. The relevant language from SB 310 is provided in Appendix C.

Table 1-4 provides the gross savings per measure that DEO will claim per SB 310 for the Energy Efficiency Education School Kit for the 2017-2018 program year.

Table 1-4: SB 310 Compliance Gross Savings per Measure

Program	Claimed Gross Savings (kWh)	Claimed Gross Savings (kW - summer)	Claimed Gross Savings (kW - winter)	Source
Energy Efficiency Education School Kit	499.0	0.134	0.132	DEO program reported savings

1.2.3 Process Evaluation

The process evaluation assessed opportunities for improving the program's design and delivery in DEO service territory. 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 conducted phone (n=72) and web surveys (n=95) with student families that received a kit (n=167) and teachers who attended the performance (n=19). The team also conducted in-depth interviews with utility staff, NTC staff, and five teachers who completed the web survey.

Program Successes
The 2017-2018 DEO NTC program evaluation found successes in the following areas:

Teachers and parents awareness of DEO sponsorship of the kits. Almost all parents (90%) and most teachers (84%) knew that DEO sponsored the kits. Parents became aware of DEO sponsorship via the materials their children brought home (63%), information in the kit (31%), or via communications from the teacher or school (21%). Teachers became aware largely via communication from other teachers or from Duke Energy marketing materials associated with the kits and performance.

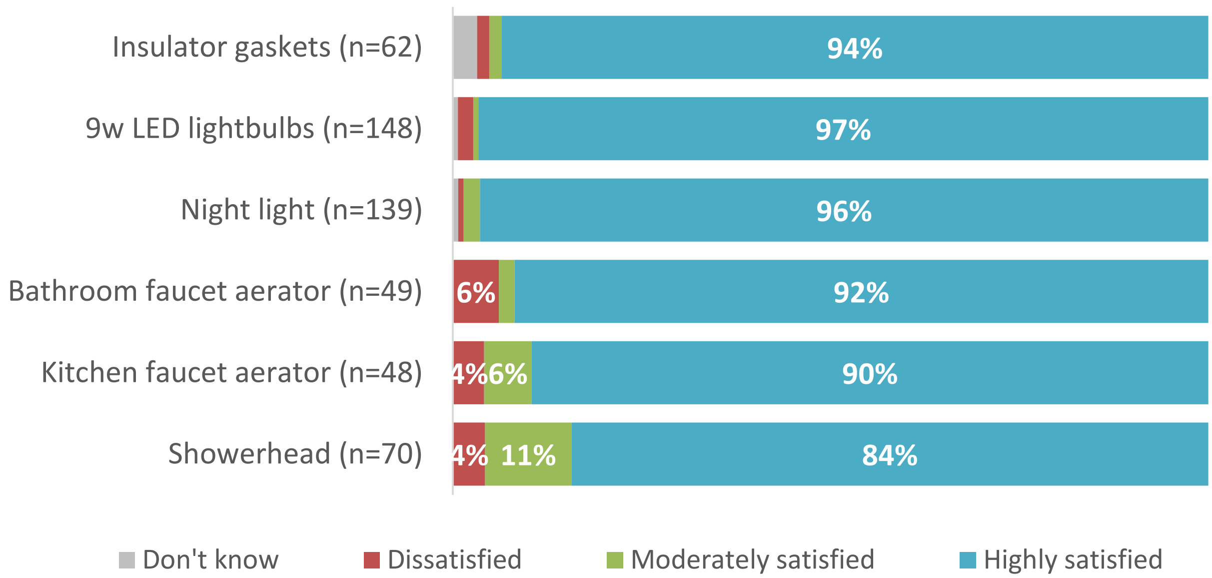
Parents largely learned about DEO kits from materials brought home by child. About three-quarters (74%) of parents learned about the kits from the materials their children brought home. Lesser reported ways included school newsletters (17%) and emails from their children's teacher or school (10%).

Teachers were highly satisfied with performance, reporting that the performance was not missing important components, was age appropriate for most students, and engaged the students. Nearly all (17 of 19) stated they were "highly satisfied", most (17) noted the performance was not missing important concepts, and 18 of 19 noted the performance was age appropriate. All interviewed teachers reported the performance was engaging, humorous, and effective.

Distribution of kit request forms goes well. Teachers reported no problems receiving kit request forms and all noted they distributed the forms to their students, typically immediately after the performance.

Student families are highly satisfied with kit items. Respondents were highly satisfied with all measures, especially the lighting items. (Figure 1-2)

Figure 1-2: Kit Recipient Satisfaction with Installed Measures



Many kit recipients value the educational information in the kit. Two-thirds of respondents read the energy saving educational information in the kit and most of those reported it was "highly helpful."

The program influenced some families to adopt energy saving behaviors. Half of parents reported taking an energy saving action and over half (57%) of respondents reported their child has adopted new energy saving behaviors since receiving their kit. Parents most commonly said that they had changed their thermostat settings and that their child now turns off lights when not using a room (45%)..

Program Challenges

The 2017-2018 DEO NTC program evaluation met some challenges in the following areas:

Instructional material use is limited. Teachers reported distributing kit request forms to their students yet noted limited use of the instructional materials associated with the kit request forms. Twelve of the 19 respondents (five elementary and seven middle school teachers) reported receiving the educational materials and those that received them either did not use the materials or used them in a limited way. Of those that used the materials, teachers deemed them "moderately useful" at best.

There is variation in the emphasis individual teachers put on the value of kits. All teachers encouraged their students to request kits, but they varied in the tenacity of their approach. Almost all reported vocally encouraging students to request a kit, but far fewer reported taking additional actions like sending reminders to parents or awarding prizes to kids that get parents to request a kit.

Getting more families to install all measures in the kits. Parent respondents noted they installed at least one measure in the kit, but few install all measures. Most respondents installed the LED lights and the nightlights, however far fewer installed the water saving measures and the insulator gaskets.

1.3 Evaluation Conclusions and Recommendations

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

Conclusion 1: NTC performances satisfy teachers by engaging students. It is less clear that the performances are linked to classroom learning, awareness at home, or change in behavior. Teachers reported high satisfaction with the performance and recalled that the performance engaged students. However, curriculum materials were not always distributed or remembered by teachers whose use of the materials was limited. Those that did use the materials determined they were, at best, “moderately useful.”

Parents were often not aware the performance occurred and about half of parents reported changes in their or their children’s energy use behavior since receiving the kits, but those changes in behavior were limited.

Recommendation: Find ways to increase use of materials, such as:

- making sure teachers are aware, NTC aligns their materials with state science standards, and
- concentrating scheduled performances around the time schools are covering similar topics, such as around Earth Day

Conclusion 2: There is an opportunity to greater emphasize the kits and get more families to request and install kits. About one-third of teachers follow-up with students to see if parents requested kits, but there is great variation in how much emphasis teachers place on promoting the kits. Additionally, two-thirds of parents did not know kits were associated with a performance and instructional materials.

Recommendation: Provide schools with information or pre-written messaging they can use to communicate the value of the kits to parents.

Conclusion 3: The program influences families to save energy. Families save energy they would not have saved without receiving the kits and nearly all respondents installed at least one kit measure. Very few would have installed the kit measures without the prompt from their child and about one-fifth of parent respondents indicated a spillover action. Over half of parent respondents said they or their children adopted new energy saving behaviors since receiving the kit.

> **Recommendation:** Continue engaging student family households with the Education program.

Conclusion 4: The Education program could be a good "gateway" program to generate even more energy savings. Kit recipients could be good targets for other Duke Energy efficiency program promotions, as they:

- demonstrated willingness to save energy in their home
- expressed interest in installing additional kit items or other energy saving measures (many of which Duke Energy currently incents)
- are highly likely to read any information included with the kit
- are predominantly single family homeowners

Recommendations: Leverage kits to promote other Duke Energy efficiency programs, such as targeting these households for direct mail campaigns or including information on Smart $aver or the Online Savings Store in the kit.

2 Introduction and Program Description

2.1 Program Description

2.1.1 Overview

The Energy Efficiency Education in Schools Program is an energy efficiency program sponsored by Duke Energy Ohio (DEO). The program provides free in-school performances by the National Theatre for Children (NTC) that teach elementary and middle school students about energy and conservation concepts in a humorous and engaging format. This report will hereafter refer to the program as the NTC program.

In addition to the NTC performance, 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 (kit) from DEO; 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 fill out the kit form.

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 evaluation scope (the kit includes additional educational items described in section 0 below).

Table 2-1: 2017-2018 Kit Measures

Measures	Details
9 Watt LED	2 bulbs
Nightlight	1 LED plug-in nightlight
1.5 GPM Showerhead	1 low-flow showerhead
1.0 GPM Bathroom Faucet Aerator	1 low-flow faucet aerator
1.5 GPM Kitchen Faucet Aerator	1 low-flow kitchen aerator
Water Temperature Gauge Card	1 temperature card indicating water heat temperature
Outlet Insulating Gaskets	8 outlet and 4 light switch gaskets

2.2 Program Implementation

2.2.1 School Recruitment

Duke Energy sends NTC a list of approved schools in DEO territory, which NTC uses to contact schools to schedule NTC performances. NTC ships curriculum materials to participating schools approximately two weeks prior to the performance date.

2.2.2 NTC Performance

NTC has two age-appropriate shows for DEO's NTC program: Kilowatt Kitchen for elementary age students (Kindergarten through sixth grade) and The E-Team for middle school age students (6th through 8th 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 (renewable and nonrenewable sources)
- How energy is used
- How energy is wasted
- Energy efficiency and conservation

Performers also discuss how DEO offers students and their families free energy efficiency starter kits, and how the items in the kit can save energy in their homes.

2.2.3 DEO Kit Form Promotion and Distribution

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. To encourage participation, those requesting kits are automatically entered in drawings to win cash prizes for their household ($1,000) or their school ($10,000). DEO uses two vendors to fulfill kit requests. The participant's eligibility is confirmed by the firm R1 who sends the fulfillment request to AM Conservation who ships the kit to eligible homes that signed up for the program. The Process Flow Map in Appendix C outlines this process.

2.2.4 DEO Kit Eligibility

Student families can only receive a kit once every 36 months. Additionally, parents/guardians must fill out the survey included on the kit request form in order to receive a kit. The kit contents will differ if a family is a DEO customer versus a non-Duke Energy customer (Table 2-2).

Table 2-2: Measures Received by Customer Type

Measures	DEO Customer	Non-Duke Energy Customer
1.5 GPM Showerhead	✓	
1.5 GPM Kitchen Faucet Aerator	✓	
1.0 GPM Bathroom Faucet Aerator	✓	
Water flow meter bag	✓	
Water Temperature Gauge Card	✓	✓
13 Watt CFL	✓	
18 Watt CFL	✓	
LED Nightlight	✓	✓
Outlet Insulating Gaskets	✓	✓
Energy savers booklet	✓	✓
Product information and instruction sheet	✓	
Glow ring toy	✓	✓

2.2.5 Participation

For the defined evaluation period of August 2017 through May 2018, the program recorded a total of 6,463 kit recipients. During survey recruitment, no participants notified the evaluation team that their kits never arrived.

2.3 Key Research Objectives

Over-arching project goals will follow the definition of impact evaluation established in the "Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency," November 2007:

> *"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 DEO NTC program:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings[1] for energy efficient measures implemented in participants' homes;
- 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 other Duke similar programs in other jurisdictions.

2.3.2 Process

The process evaluation assessed opportunities for improving the design and delivery of the program in DEO 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 the DEO sponsorship of the program?
  - Is there a need to increase this awareness?
- **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?

[1] The quantification of program impacts was initially attempted through a utility bill regression analysis. However, the program impacts could not be isolated due to the small size of the impact relative to annual consumption. Therefore, the impact analysis relied on engineering algorithms to assess the program's savings impacts. Please see section 3.5 for additional detail.

    - 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 goals outlined:

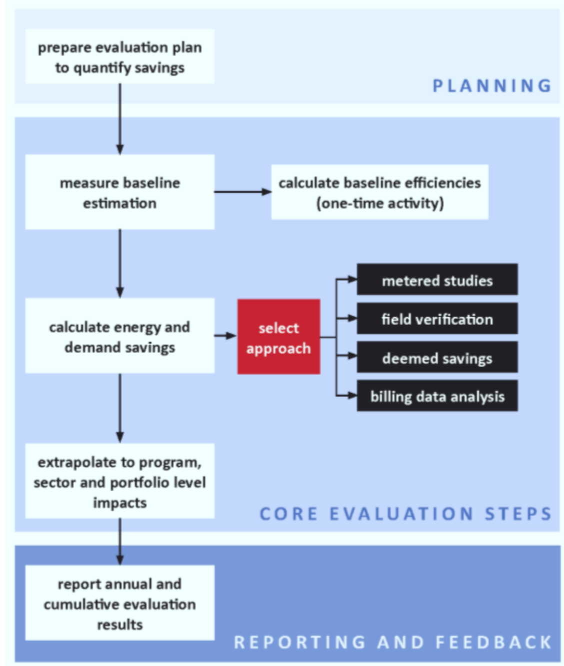
- **Task 1 –** Develop and manage evaluation work plan to describe the processes that will be followed to complete the evaluation tasks outlined in this project;
- **Task 2 –** Conduct a process review to determine how successfully the programs are being delivered to participants and to identify opportunities for improvement;
- **Task 3 –** Verify gross and net energy and peak demand savings resulting from the NTC program through verification activities of a sample of 2017-2018 program participants.

2.4.1 Impact Evaluation

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct our evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, included telephone and web-based surveys with program participants, best practice review, and interviews with implementation and program staff.

Figure 2-1 demonstrates the principal evaluation team steps organized through planning, core evaluation activities, and final reporting.

Figure 2-1: Impact Evaluation Process



The evaluation is generally comprised of the following steps, which are described in further detail throughout this report:

- Participant Surveys:
  - The file review for all sampled and reviewed program participation concluded with a telephone and web-based survey with the participating families.
- Process evaluation examines and documents:
  - Program operations
  - Stakeholder satisfaction
  - Opportunities to improve the efficiency and effectiveness of program delivery

To satisfy the evaluation, measurement, and verification (EM&V) objectives for this research effort, the evaluation team reviewed program documents and conducted telephone and 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 2-3 provides a summary of the** activities the evaluation team conducted as part of the DEO NTC program process and impact evaluation.
- Table 2-3 below summarizes the number of surveys and on-site inspections completed. The samples were drawn to meet a 90% confidence and 10% precision level based upon the expected and actual significance (or magnitude) of program participation, the level of certainty of savings, and the variety of measures.

- **Calculate Impacts and Analyze Load Shapes:** Data collected via surveys enabled the evaluation team to calculate gross verified energy and demand savings for each measure.
- **Estimate Net Savings**: Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and incentives. The evaluation team estimated free-ridership and spillover based on self-report methods through surveys with program participants. The ratio of net verified savings to gross verified savings is the net-to-gross ratio as an adjustment factor to the reported savings.

2.4.2 Process Evaluation

Process evaluation examines and documents:

- Program operations
- Stakeholder satisfaction
- Opportunities to improve the efficiency and effectiveness of program delivery

To satisfy the evaluation, measurement, and verification (EM&V) objectives for this research effort, the evaluation team reviewed program documents and conducted telephone and 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 2-3 provides a summary of the activities the evaluation team conducted as part of the DEO NTC program process and impact evaluation.

Table 2-3: DEO NTC Summary of Evaluation Activities

Target Group	2017-2018 Survey Population	Sample	Confidence /Precision	Method
Impact Activities				
Participants	6,463	167	90/6	Telephone/Web Survey
Process Activities				
DEO Program Staff	N/A	1	N/A	Telephone IDI
Implementer Staff: NTC	N/A	1	N/A	Telephone IDI
Implementer Staff: R1	N/A	1	N/A	Telephone IDI
Teachers who attended a NTC workshop	81	19	90/17	Web Survey
Participating teacher follow-up interviews	Unknown	5	N/A	Telephone In-Depth Interview (IDI)
Participants – student families who received a kit and are DEO customers	6,463	167[2]	90/6	Telephone/Web Survey

[2] 95 phone surveys, 72 web surveys

3 Impact Evaluation

3.1 Methodology

The evaluation team's impact analysis focused on the energy and demand savings attributable to the NTC program for the period of August 2017 through May 2018. The evaluation was divided into two research areas: to determine gross and net savings (or impacts). Gross impacts are energy and demand savings estimated at a participant's home that are the direct result of the homeowner's installation of a measure included in the program-provided energy saving kit. Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and funds. The evaluation team verified energy and demand savings attributable to the program by conducting the following impact evaluation activities:

- Review of DEO participant database.
- Completion of telephone and web-based surveys to verify key inputs into savings calculations.
- Estimation of gross verified savings using primary data collected from participants.
- Comparison of the gross-verified savings to program-evaluated results to determine kit-level realization rates.
- Application of attribution survey data to estimate net-to-gross ratios and net-verified savings at the program level.
- Compare the verified savings to the claimed savings to determine which impacts should apply to comply with SB 310.

3.2 Database and Historical Evaluation Review

DEO provided the evaluation team with a program database for the NTC program participation. The program database provided participant contact information including account number, address, phone number, and email address, if available, and whether or not the participant was willing to be contacted. Since DEO was able to provide both phone numbers and email addresses, we were able to design a sampling approach that could take advantage of both phone and web-based surveying.

DEO provided ex-ante, or deemed, savings values at the kit-level; however, it did not have measure-level ex-ante savings available. Because measure-level savings were not provided, realization rates could only be calculated at the kit-level.

Despite the unavailability of measure-level ex-ante savings, the evaluation team conducted a benchmarking review of the uncertainty of ex-ante savings estimates by comparing multiple technical reference manuals (TRMs) and prior Energy Efficiency Education in Schools evaluations conducted in Duke Energy Ohio and other Duke Energy jurisdictions. The details of the benchmarking review are referenced in Table 3-1. The listed savings values include the impact of in-service rates.

Table 3-1: Comparison of Ex-Ante DEO NTC Energy Savings (kWh) to Peer Group Estimates

Measure	Duke Energy Indiana 2015-2016 NTC Education evaluation[1]	Ohio 2010 TRM[2]	Indiana 2016 TRM[3]	Illinois 2017 TRM[54]	Pennsylvania 2016 TRM[5]
9 Watt LED	N/A	17.7	18.2	18.0	20.2
Nightlight	7.5	N/A	10.2	N/A	11.3
1.5 GPM Showerhead	142.4	100.5	93.1	161.5	177.4
1.0 GPM Bathroom Faucet Aerator	19.1	13.8	10.7	7.1	7.4
1.5 GPM Kitchen Faucet Aerator	57.0	9.1	69.8	48.8	72.8
Water Temperature Gauge Card	13.7	N/A	N/A	13.4	27.2
Outlet Insulating Gaskets	1.9	N/A	N/A	N/A	N/A

[1]Duke Energy Indiana Energy Efficiency in Schools Program evaluation. Nexant. July 28, 2017

[2]State of Ohio Technical Reference Manual. August, 2010.
[3]Indiana Technical Reference Manual, version 2.2. January, 2016.
[4]Illinois Statewide Technical Reference Manual for Energy Efficiency, version 6.0, February, 2017.
[5]State of Pennsylvania Technical Reference Manual. June, 2016.

While Table 3-1 does illustrate variation in deemed savings among each source for each given measure, much of this variation reflects different in-service rate assumptions. Also of note is that the Ohio TRM does not differentiate parameter assumptions between bathroom and kitchen faucet aerators (the Ohio TRM varies savings only on flow rate). For this reason, the evaluation team ultimately used assumptions outlined by the Indiana and Pennsylvania TRMs (see section 3.4.4) to capture different usage patterns between each aerator location.

3.3 Sampling Plan and Achievement

To provide representative results and meet program evaluation goals, a sampling plan was created to guide all evaluation activity. A random sample was created to target 90/10 confidence and precision at the program level, assuming a coefficient of variation (C_v) equal to 0.5. After reviewing the program database, the evaluation team identified a population of 6,463 participants within our defined evaluation period.

Based on the population of 6,463 participants, the evaluation team established sub-sample frames for phone and web-based survey administration. As illustrated in Table 3-2 below, we completed a total of 167 surveys. This sample size resulted in an achieved confidence and precision of 90/6.3.

Table 3-2: DEO NTC Impact Sampling

Survey Mode	Population*	Sampled Participants	Achieved Confidence/ Precisions**
Phone	2,084	72	90/6.3
Web-based	3,503	95	
Total	**5,587**	**167**	

*Sampling population represents participants not flagged as "do not contact"
**Based on full population of 6,463 participants

3.4 Description of Analysis

3.4.1 Telephone and web-based surveys

The evaluation team performed telephone and web-based surveys to gain key pieces of information used in the savings calculations. Results of the 167 completed surveys were used to inform our program-wide assumptions as detailed in Table 3-3.

Table 3-3: Participant Data Collected and Used for Analysis

Measure	Data Collected	Assumption
9 Watt LEDs Nightlight	Units Installed	In-Service Rate
	Units Later Removed	
	Room Where Installed	Hours of Use
	Original Lamp Removed	Baseline Wattage
1.5 GPM Showerhead 1.0 GPM Bathroom Faucet Aerator 1.5 GPM Kitchen Faucet Aerator	Units Installed	In-Service Rate
	Units Later Removed	
	Hot Water Fuel Type	% Electric DHW
Water Temperature Gauge Card	Gauge Cards Used	In-Service Rate
	Thermostats Reverted	
	Hot Water Fuel Type	% Electric DHW
Outlet Insulating Gaskets	Units Installed	In-Service Rate
	Units Later Removed	

3.4.2 In-Service Rate

The in-service rate (ISR) represents the ratio of equipment installed and operable to the total pieces of equipment distributed and eligible for installation. For example, if 15 telephone surveys were completed for customers receiving 1 LED each, and five customers reported to still have the LED installed and operable, the ISR for this measure would be five out of 15 or 33%. In some instances equipment was installed but may have been removed later due to homeowner preferences. In these cases the equipment is no longer operable and therefore contributes negatively to the ISR. In-service rates for each measure from all 167 eligible survey respondents are detailed in Table 3-4.

Table 3-4: DEO NTC In-Service Rates

Measure	Distributed	Installed	Removed	ISR
9 Watt LEDs[1]	334	267	3	79%
Nightlight	167	139	7	79%
1.5 GPM Showerhead	167	70	5	39%
1.0 GPM Bathroom Faucet Aerator	167	49	3	28%
1.5 GPM Kitchen Faucet Aerator	167	48	3	27%
Water Temperature Gauge Card	167	38	0	23%
Outlet Insulating Gaskets[2]	2,004	351	2	17%

[1]Note that two 9 watt LEDs were included in each kit.

[2]Note that 12 outlet insulating gaskets were included in each kit. The evaluation team calculated the ISR based on the total count of equipment distributed and installed.

3.4.3 Lighting

The two lighting measures in the kit include a 9W LED and an LED nightlight. Equation 3-1 and Equation 3-2 outline the algorithms utilized to estimate savings accrued by the lighting measures, with key parameters defined in Table 3-5.

Equation 3-1: Lighting Measures Energy Savings

$$\Delta kWh = \frac{Watts_{BASE} - Watts_{EE}}{1000\frac{W}{kW}} \times HOU \times (1 + IE_{kWh}) \times 365.25\frac{days}{year} \times ISR$$

Equation 3-2: Lighting Measures Demand Savings

$$\Delta kW = \frac{Watts_{BASE} - Watts_{EE}}{1000\frac{W}{kW}} \times CF \times (1 + IE_{kW}) \times IS$$

Table 3-5: Inputs for Lighting Measures Savings Calculations

Input	Units	Value	Source
$Watts_{BASE}$	Watts	LED: 39.6 Nightlight: 3.1	LED: Federal minimum standards; Survey responses Nightlight: Survey responses
$Watts_{EE}$	Watts	LED: 9 Nightlight: 0.03	Equipment specifications
HOU	Hours	LED: 2.7 Nightlight: 12	Duke Energy Ohio 2017 Residential LED Hours of Use Study;Tennessee Valley Authority 2016 TRM; Survey responses; Equipment specifications
CF	N/A	LED: 0.10 Nightlight: 0.00	LED: Duke Energy Ohio 2017 Residential LED Hours of Use Study Nightlight: Pennsylvannia 2016 TRM
IE_{kWh}	N/A	+7%	Ohio 2010 TRM
IE_{kW}	N/A	+21%	Ohio 2010 TRM
ISR	N/A	LED: 79% Nightlight: 79%	Survey responses

The evaluation team paid careful attention to the effects of the Energy Independence and Security Act (EISA), which mandated higher-efficiency technologies for incandescent bulbs. In the analysis of LED bulbs, the evaluation team used participant-reported lamp types and assigned the EISA-compliant bulb that would produce the same lumen output as the 9W LEDs from the kits. This resulted in the use of a 53W baseline for halogen lamps, a 43W baseline for incandescent and CFLs, and a 9W baseline for LEDs. Nightlights, however, are not affected by EISA, and as such were evaluated using a baseline wattage dependent on what the participant specified as the removed lamp.

Hours of use (HOU) for LED lighting was based mainly on the Duke Energy Ohio 2017 Residential LED Hours of Use Study, which estimated hours of use for 9 different room types. Two additional room types, den and garage, were not included in the DEO Residential LED Hours of Use Study, but were added from the Tennessee Valley Authority 2016 TRM. Based on installation locations from survey responses the evaluation estimated an average lighting hours of use of 2.69.

Using the engineering algorithm and assumptions described above, we determined the gross energy and demand savings value for each lighting measure provided in the kit as summarized in Table 3-6.

Table 3-6: DEO NTC Energy Savings, Lighting Measures

Kit Measure	Gross per kit energy savings (kWh)	Gross per kit demand savings (kW)
9W LED*	50.9	0.006
Nightlight	11.5	0.000

*Reflects savings for two 9 watt LEDs bulbs

3.4.4 Water Heating

The four water heating measures in the kit include a low-flow kitchen faucet aerator, a low-flow bathroom faucet aerator, a low-flow showerhead, and a water temperature gauge card which encouraged participants to set back their hot water heater thermostats. The equations below outline the algorithms utilized to estimate savings accrued by the domestic water heating measures with parameters defined in Table 3-7.

Equation 3-3: Aerator Energy Savings

$$\Delta kWh = ISR \times ELEC \times \left[\frac{\Delta GPM \times T_{person/day} \times N_{persons} \times 365 \frac{days}{year} \times DF \times \Delta T \times 8.3 \frac{BTU}{gal \cdot °F}}{\#_{faucets} \times 3{,}412 \frac{BTU}{kWh} \times RE} \right]$$

Equation 3-4: Showerhead Energy Savings

$$\Delta kWh = ISR \times ELEC \times \left[\frac{\Delta GPM \times T_{person/day} \times N_{persons} \times 365 \frac{days}{year} \times N_{showers-day} \times \Delta T \times 8.3 \frac{BTU}{gal \cdot °F}}{\#_{showers} \times 3{,}412 \frac{BTU}{kWh} \times RE} \right]$$

Equation 3-5: Water Heater Setback Energy Savings

$$\Delta kWh = ISR \times ELEC \times \left[\frac{A_{tank} \times \Delta T \times 8760 \frac{hrs}{yr}}{R_{tank} \times RE \times 3{,}412 \frac{Btu}{kWh}} + \frac{V_{HW} \times \left(8.3 \frac{lb}{gal}\right) \times \left(365 \frac{days}{yr}\right) \times \left(1 \frac{Btu}{°F \cdot lb}\right) \times \Delta T}{\left(3412 \frac{Btu}{kWh}\right) \times EF_{WH}} \right]$$

Equation 3-6: Water Heating Measures Demand Savings

$$\Delta kW = ETDF \times \Delta kWh$$

Table 3-7: Inputs for Water Heating Measures Savings Calculations

Input	Units	Value	Source
ISR	N/A	Bath: 28% Kitchen: 27% Shower: 39% Setback: 23%	Survey responses
ELEC	N/A	Bath: 42% Kitchen: 47% Shower: 45% Setback: 38%	Survey responses
ΔGPM	GPM	Bath: 1.2 Kitchen: 0.7 Shower: 1.0	Product specification sheet compared against federal code minimum
$T_{person/day}$	Minutes	Bath: 1.6 Kitchen: 4.5 Shower: 7.8	Indiana 2016 TRM
$N_{persons}$	Persons	Bath: 4.2 Kitchen: 3.7 Shower: 4.2	Survey responses
$N_{showers\text{-}day}$	Showers per Day	Shower: 0.6	Indiana 2016TRM
DF	N/A	Bath: 90% Kitchen: 75% Shower: 100%	Pennsylvania 2016 TRM
ΔT	°F	Bath: 22.2 Kitchen: 22.2 Shower: 43.2 Setback: 10.0	Ohio 2010 TRM; Indiana 2016 TRM
$\#_{faucets}$	Units	Bath: 2.28 Kitchen: 1.0 Shower: 2.1	Bathroom: 2013 RASS Data[1] Kitchen: Pennsylvania 2016 TRM Showerhead: Ohio 2010 TRM
ETDF	N/A	Bath: 0.00015 Kitchen: 0.000025 Shower: 0.00016	Ohio 2010 TRM; Pennsylvania 2016 TRM; Survey Responses; Ratio of calculated lighting measure demand to energy savings
RE	N/A	98%	Ohio 2010 TRM
A_{tank}	Ft^2	24.99	Pennsylvania 2016 TRM
R_{tank}	$°F \cdot ft^2 \cdot hr/BTU$	8.3	Pennsylvania 2016 TRM
V_{HW}	GPD	7.3	Pennsylvania 2016 TRM
EF_{WH}	N/A	0.904	Pennsylvania 2016 TRM

[1]Duke Energy 2013 Residential Appliance Saturation Survey. Ohio respondents.

The evaluation team determined that the 2016 Indiana and Pennsylvania's TRM provided the most applicable and rigorous algorithm by including factors such as standby losses and water volume savings, differentiating between kitchen and bathroom water use, and more comprehensive algorithms. Where the Ohio 2010 TRM made appropriate distinctions, the evaluation team used the Ohio TRM parameter assumptions due to its geographic relevance to the DEO territory. However, where the Ohio TRM lacked granularity, the evaluation team elected to use the Indiana or Pennsylvania TRM as the secondary data source for estimating savings.

Using the applicable engineering algorithm and assumptions described above, the gross energy and demand savings value were estimated for each domestic hot water measure provided in the kit as summarized in Table 3-8.

Table 3-8: DEO NTC Gross Energy Savings, Water Heating Measures

Kit Measure	Gross per unit energy savings (kWh)	Gross per unit energy savings (kW)
1.5 GPM Showerhead	63.9	0.010
1.0 GPM Bathroom Faucet Aerator	7.3	0.001
1.5 GPM Kitchen Faucet Aerator	22.5	0.001
Water Temperature Gauge Card	13.9	0.002

3.4.5 Air Infiltration

Equation 3-7 and Equation 3-8 outline the algorithms utilized to estimate savings accrued by the outlet insulating gaskets. The parameters are defined in Table 3-9.

Equation 3-7: Air Infiltration Energy Savings

$$\Delta kWh = ISR \times exterior\ to\ interior\ wall\ adjustment\ factor \times gaskets \times \frac{\Delta CFM}{gasket} \times \frac{kWh}{CFM}$$

Equation 3-8: Air Infiltration Demand Savings

$$\Delta kW = \frac{\Delta kWh}{8{,}760}$$

Table 3-9: Inputs for Air Infiltration Measures Savings Calculations

Input	Units	Value	Source
ISR	N/A	17.4%	Survey responses
Exterior to Interior Wall Adjustment Factor*	%	0.31	National Association of Home Builders[1]
Gaskets per kit	N/A	12	Duke Energy Kit Materials
ΔCFM/gasket	CFM	.307	2015 DEK NEED Evaluation Final Report
kWh/CFM	kWh/CFM	22.76	2016 Duke Energy Progress RASS Data, 2008 DEK NEED Evaluation Final Report

*The exterior to interior wall adjustment factor takes into consideration that only outlet gaskets installed on exterior walls achieve enegy savings since infiltration reductions only occur in areas that communicate directly with unconditioned space.[3]

[1]Derived from Table 4 of the National Associations of Builders report, "Spaces in New Homes." October 1, 2013.

Since very few regional or national studies exist that document outlet gasket savings this analysis used parameters estimated from a prior evaluation of the Energy Efficiency Education in Schools program conducted in the Duke Energy Kentucky service territory. This previous evaluation estimated reduction in infiltration as a factor of cubic feet per minute (CFM) due to the installation of a gasket. We also considered the previous evaluation's modeled energy savings for reduced infiltration and calibrated the savings value based on the saturation of heating and cooling equipment technologies reported in Duke Energy's 2016 residential appliance saturation study to ensure the savings value represented the NTC program participants. All Ohio responses recorded in the saturation study were used for model calibration.

Using the engineering algorithm described above, we determined the gross energy and demand savings value for outlet insulating gaskets provided in the kit as summarized in Table 3-10.

Table 3-10: DEO NTC Gross Energy Savings, Air Infiltration Measures

Kit Measure	Gross per kit energy savings (kWh)	Gross per kit energy savings (kW)
Outlet Gaskets*	4.5	0.001

*Reflects savings for the 12 outlet gaskets per kit

[3] CL&P and UI Program Savings Documentation, Connecticut Light & Power, Program Year 2008.

3.4.6 Behavioral Analysis

Similarly to how we conducted the impact evaluation of the actual kit measures, the evaluation team estimated the behavioral impacts using the results of the completed surveys in conjunction with engineering algorithms. The survey contained the following questions from which we gauged what sort of behavioral changes were induced by the kit:

- Since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy, what new behaviors has your child adopted to help save energy in your home?
- Since receiving your energy kit from Duke Energy, what new behaviors have you adopted to help save energy in your home?

Survey participants were encouraged to answer as an open-response, rather than choosing behaviors from a list. The typical responses included turning off lights when not in a room, turning off electronics when not in use, taking shorter showers, turning off water when brushing teeth or washing hands, turning off heating and air conditioning when not home, changing thermostat settings, and using fans instead of air conditioning.

The evaluation team estimated the initial impacts of these behavioral changes for the proportion of participants who confirmed taking action (i.e., the in-service rate for the behavioral change) using engineering algorithms similar to those algorithms used to estimate the impacts of the kit measures. We then adjusted these initial savings according to the results of some key survey questions such as:

- 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 your decision to make changes in your energy using behaviors?
- Did you read the information about how to save energy in the booklet that came in the kit?
- During the school year, did you receive any Home Energy Reports from Duke Energy?

The savings calculation methodologies and adjustment factors are detailed in the following subsections.

3.4.6.1 Adjustment factors

Several adjustments were made to the initial calculated savings associated with each behavior to more accurately reflect the extent to which the behaviors were a result of the energy saving kit.

In-Service Rate (ISR)

Similar to kit measure ISRs, the behavioral ISR reflects what percentage of the known population is expected to have adopted this behavior. Separate ISR values were calculated for parent and children adoption rates, which are summarized in Table 3-11.

Table 3-11: Behavioral Savings In-Service Rates

Behavior	Child Adoption Rate	Parent Adoption Rate
Turn off lights	45%	16%
Turn off electronics	19%	10%
Take shorter showers	15%	10%
Turn off heat / CAC	N/A	11% / 13%
Change thermostat settings	N/A	7%
Use fans instead of CAC	N/A	22%

Kit Influence

We then adjusted the savings by how the level of reported influence the kit had on each respondent's behavioral changes. Participants were asked to rate how heavily the kit influenced their behavioral changes on a scale of 0 to 10. The kit influence adjustment factor was set at the weighted average of participant responses as shown in Table 3-12.

Table 3-12: Behavioral Savings Kit Influence Adjustment Factor

Influence Score	Response Rate
0	0.9%
1	0.0%
2	2.7%
3	1.8%
4	2.7%
5	3.5%
6	8.8%
7	16.8%
8	23.0%
9	8.8%
10	31.0%
Weighted	**78%**

Kit Informational Materials

The energy saving kit came with some literature on various other ways participants could save energy in their homes. While participants did self-report the level of influence the kit had on their decision, many respondents who claimed to be influenced by the program also responded that they did not read the kit informational materials, which seems counterintuitive. Nexant used the kit informational materials adjustment factor to correct for apparent bias in the self-reported answers on kit influence. Nexant found that 113 out of 167 respondents read the provided literature and set the adjustment factor at 68%.

MyHER Program Overlap

Duke Energy runs a simultaneous behavioral-based energy saving program in which participants elect to receive regular My Home Energy Reports (MyHER). The report summarizes a customer's consumption and benchmarks it against other energy users of similar home characteristics and demographics. The goal of the program is to influence participants to change their energy consumption habits through increased knowledge.

Participation in the MyHER program does not exclude customers from also receiving the kit from this NTC program. Because of this, the evaluation team used the MyHER program overlap adjustment factor to adjust the behavioral savings to account for the percentage of influence that came from the alternate MyHER program. Based on survey results regarding the MyHER program participation and influence, we estimated the overlap to be 13%, and set the adjustment factor at 87%[4].

Persistence

While behavioral changes designed to increase energy efficiency or conservation can result in immediate impacts, the initial activity is expected to wane in the absence of consistent intervention. This decay of energy savings resulting from a change in behavior has been carefully documented through random control trials of Home Energy Report programs such as Duke Energy's MyHER program or program's implemented in other jurisdictions by Oracle (formally Opower). The rate at which energy savings persists after a customer receives a report depends on the frequency and longevity that a customer receives follow-up reports.

Because the kit provides information to educate and encourage participants to reduce their energy impacts, the evaluation team felt it was prudent to estimate a persistence rate based on this one-time exposure. We relied on a literature review to estimate how savings may persist based on the NTC program design. Typical persistence rates for Home Energy Report programs ranges from 80% - 90%, i.e., a participant's estimated savings from behavioral changes is expected to decay approximately 10% - 20% per year if no more Home Energy Reports are provided. This persistence rate is based on two consecutive years of receiving monthly reports. However, if a participant receives minimal follow-up after the initial report, the persistence of any initial behavioral impacts is expected to dissipate rapidly. Because participants in the NTC program are treated only once with regard to behavioral changes, the evaluation team estimated a persistence rate of 28%[5]. This estimate is based on research which

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[4] Based on survey responses, the evaluation team found that approximately 34% of respondents reported receiving a report from the MyHER program. Of those respondents, 93% affirmed reading the report; however, only 43% claimed to have taken a behavioral action to increase their energy conservation.

[5] The persistence rate is calculated based on the ratio of the daily estimated savings impact (0.114 kWh) to the the daily rate of decay of savings (0.409 kWh). This ratio is 28%.

modeled the persistence of customers who received four quarterly Home Energy Reports after which treatment was ceased[6]. For this evaluation, we calculated the persistence rate as the ratio of the expected average behavioral savings per day (0.114 kWh) to the decay coefficient (0.409 kWh) associated with customers receiving four quarterly reports. Therefore, it is expected the initial impact generated from behavioral changes in the NTC program would fully dissipate approximately three to four months after receiving the kit.

Adjustment Factor Summary

Table 3-13 below provides the adjustment factors which are applied to the behavioral savings described in Section 3.4.6.2.

Table 3-13: Behavorial Savings Adjustment Factors

Adjustment Factor	Percent
In-service rate	Varies by measure
Kit influence	78%
Kit informational materials	68%
MyHER program overlap	87%
Persistence	28%

3.4.6.2 Behavioral Savings Calculations

Turn off lights

The evaluation team calculated the savings associated with the behavior of turning off lights after exiting a room by estimating the likely reduction in lighting operating hours. The reduction in hours was used in lieu of the hours of use term in the standard lighting equations (Equation 3-1 and Equation 3-2) as illustrated in Equation 3-9 and Equation 3-10.

Equation 3-9: Turn Off Lights Energy Savings

$$\Delta kWh = \frac{Watts_{BASE}}{1000\frac{W}{kW}} \times HOU_{reduced} \times (1 + IE_{kWh}) \times 365.25\frac{days}{year} \times Adj.Factors$$

Equation 3-10: Turn Off Lights Demand Savings

$$\Delta kW = ETDF * kWh\ savings \times Adj.Factors$$

The calculations assumed the wattage of the lamps associated with the reported behavorial change was equivalent to the average reported baseline lamp wattage found in the lighting

[6] Allcott, H, Rogers, T., The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation. American Economic Review 2014, 104(10): 3003-3037.

analysis of 39.6 watts.. The hours of use term in the standard lighting equations relied on survey responses as to where the light bulbs were installed. Each possible room within the home had an associated daily hours of use as provided by the DEO 2017 Residential LED Lighting Hours of Use Study and the TVA 2016 TRM. The likely reduction in operating hours was determined by calculating each possible difference in lighting hours between room types (e.g. the difference in the living room HOU and the dining room HOU) as shown below in Figure 3-1.

Figure 3-1: Calculation of Likely Lighting HOU Reduction

Possible Reduction in Hours		Living Room	Dining Room	Bedroom	Kitchen	Bathroom	Den	Hallway	Basement	Outdoors	Don't Know
		3.17	**3.39**	**1.91**	**4.33**	**1.40**	**2.30**	**1.50**	**2.88**	**4.40**	**1.93**
Living Room	**3.17**	0.00	0.22	0.00	1.16	0.00	0.00	0.00	0.00	1.23	0.00
Dining Room	**3.39**	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	1.01	0.00
Bedroom	**1.91**	1.26	1.48	0.00	2.42	0.00	0.39	0.00	0.97	2.49	0.02
Kitchen	**4.33**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
Bathroom	**1.40**	1.77	1.99	0.51	2.93	0.00	0.90	0.10	1.48	3.00	0.53
Den	**2.30**	0.87	1.09	0.00	2.03	0.00	0.00	0.00	0.58	2.10	0.00
Hallway	**1.50**	1.67	1.89	0.41	2.83	0.00	0.80	0.00	1.38	2.90	0.43
Basement	**2.88**	0.29	0.51	0.00	1.45	0.00	0.00	0.00	0.00	1.52	0.00
Outdoors	**4.40**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Don't Know	**1.93**	1.24	1.46	0.00	2.40	0.00	0.37	0.00	0.95	2.47	0.00

The evaluation team calculated the likely reduction in daily runtime to be 0.59 hours, or 214 hours annually. The savings were calculated and adjusted based on this key assumption.

Energy savings were calculated at 9.1 kWh (before applying adjustment factors). Because this behavioral change was completed by both children and parents, we applied adjustment factors and calculated adjusted savings separately for children and parents using their respective ISR. The parameter inputs and final savings are detailed in Table 3-14.

Table 3-14: Behavioral Savings Achieved by Turning off Lights (per home)

Input	Units	Value	Source	
Watts	Watts	39.6	Federal minimum standards	
$HOU_{Reduced}$	Hours	0.59	DEO 2017 Residential LED Lighting Hours of Use Study; Tennessee Valley Authority 2016 TRM	
IE_{kWh}	N/A	7%	Ohio 2010 TRM	
Energy to Demand Factor (ETDF)	N/A	0.00012	Ohio 2010 TRM; DEO 2017 Residential LED Lighting Hours of Use Study; Survey Responses; Ratio of calculated lighting measure demand to energy savings	
Energy Savings	**kWh**	**9.1**	**Calculated from algorithm**	
Demand Savings	**kW**	**0.001**	**Calculated from algorithm**	
Adjustment Factors				
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
Child: 45% Parent: 16%	78%	87%	68%	28%
			Savings from child behavior:	**0.5 kWh; 0.0001 kW**
			Savings from parent behavior:	**0.2 kWh; 0.000 kW**
			Total Energy Savings:	**0.7 kWh**
			Total Demand Savings:	**0.0001 kW**

Turn off electronics

The evaluation team used evaluations for “Smart Strips” or “Controlled Power Strips” in order to estimate savings achieved by turning off electronics when not in use. Smart strips are multi-plug power strips with the ability to automatically disconnect specific connected loads depending upon the power draw of a control load which is also plugged into the strip. Power is disconnected from the controlled outlets when the control load power draw is reduced below a certain adjustable threshold, thus turning off all accompanying appliances plugged into the strip.

We researched current studies on smart strip savings (summarized in Table 3-15) and used the average value as the calculated savings amount for this behavioral change.

Table 3-15: Smart Strip Savings

Source	Savings (kWh)
Ameren Missouri Evaluation	52.00
Duke Energy Potential Study	74.46
Illinois 2016 TRM	79.75
Mid-Atlantic 2016 TRM	47.4
Pennsylvania 2016 TRM	61.05
Average	**62.93**

The demand savings were calculated from the energy savings using an assumed hours of use value of 7,300 and an assumed coincidence factor of 90%, both from the Pennsylvania 2016 TRM. Equation 3-11 and Equation 3-12 present the algorithms used to calculate energy and demand savings for the behavior change of turning off electronics.

Equation 3-11: Turn Off Electronics Energy Savings

$$\Delta kWh = Average\ of\ deemed\ savings \times Adj.Factors$$

Equation 3-12: Turn Off Electronics Demand Savings

$$\Delta kW = kWh\ savings/HOU \times CF \times Adj.Factors$$

Energy savings (before applying adjustment factors) were calculated at 62.9 kWh. Because this behavioral change was completed by both children and parents, we applied adjustment factors and calculated adjusted savings separately for children and parents using their respective ISR. The final savings are detailed in Table 3-16.

Table 3-16: Behavioral Savings Achieved by Turning off Electronics

Input	Units	Value	Source	
Coincidence factor (CF)	N/A	0.9	Pennsylvania 2016 TRM	
HOU	hours	7,300	Pennsylvania 2016 TRM	
Energy Savings	**kWh**	**62.9**	**Average of TRMs and prior studies (see Table 3-15)**	
Demand Savings	**kW**	**0.008**	**Calculated from algorithm**	
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
Child: 19% Parent: 10%	78%	87%	68%	28%
			Savings from child behavior:	**1.5 kWh; 0.0002 kW**
			Savings from parent behavior:	**0.8 kWh; 0.0001 kW**
			Total Energy Savings:	**2.3 kWh**
			Total Demand Savings:	**0.0003 kW**

Take shorter showers

To determine savings achieved by a reduction in shower time, the evaluation team estimated how much time could be reduced based on actual shower length data. To do this, we utilized data provided by Aquacraft's 2011 Analysis of Water Use in New Single-Family Homes[7] (summarized in left two columns of Table 3-17.

We set the target shower length equal to the typical length used in national energy efficiency evaluations (7.8 to 8.4 minutes[8]) and calculated how much opportunity existed in the data for people to reduce their shower times to the national average. Energy and demand savings were calculated based on Equation 3-13 and Equation 3-14, respectively.

Equation 3-13: Take Shorter Shower Energy Savings

$$\Delta kWh = ELEC \times GPM_{retrofit} \times T_{person/day} \times N_{showers-day} \times 365\frac{days}{year} \times \left[\frac{\Delta T \times 8.33\frac{BTU}{gal \cdot {}^{\circ}F}}{3,412\frac{BTU}{kWh} \times RE}\right] \times Adj.Factors$$

Equation 3-14: Take Shorter Shower Demand Savings

$$\Delta kW = ETDF \times Energy\ Savings \times Adj.Factors$$

[7] http://www.aquacraft.com/wp-content/uploads/2015/10/Analysis-of-Water-Use-in-New-Single-Family-Homes.pdf

[8] Based on reported shower times from 2016 Indiana TRM, 2015 Illinois TRM, 2012 TVA Saturation Survey, 2015 Maine TRM, and the 2016 Pennsylvania TRM.

Table 3-17: Reduction in Shower Time Data and Calculation

Shower Length (minutes)	Responses	Possible Reduction (minutes)
2	0%	-
4	2%	-
6	17%	-
8	35%	GOAL
10	24%	2
12	14%	4
14	4%	6
16	2%	8
18	0%	10
20	1%	12
	Weighted Average	**3.47**

We calculated the likely reduction in shower length to be 3.47 minutes per shower, or 12.7 hours per person annually. The savings were calculated and adjusted based on this key assumption as detailed in Table 3-18.

Table 3-18: Behavioral Savings Achieved by Taking Shorter Showers

Input	Units	Value	Source	
GPM	GPM	1.88	Survey responses, Federal minimum standards	
$T_{person/day}$	Minutes	3.47	Aquacraft 2011 Report	
$N_{persons/day}$	Showers/Person/Day	0.6	Indiana 2016 TRM	
365	Days/Year	365	-	
ΔT	°F	43.2	Indiana 2016 TRM; Ohio 2010 TRM	
ELEC	%	43%	Duke Energy 2016 RASS Data	
RE	N/A	98%	Ohio 2010 TRM	
Energy to Demand Factor (ETDF)	N/A	0.00016	Ohio 2010 TRM; Pennsylvania 2016 TRM; Survey Responses; Ratio of calculated lighting measure demand to energy savings	
Energy Savings	**kWh**	**65.8**	**Calculated**	
Demand Savings	**kW**	**0.010**	**Calculated**	
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
15% (Child) 10% (Parent)	78%	87%	68%	28%
			Savings from child behavior:	**1.3 kWh; 0.0002 kW**
			Savings from parent behavior:	**0.8 kWh; 0.0001kW**
			Total Energy Savings:	**2.1 kWh**
			Total Demand Savings:	**0.0003 kW**

Turn off furnace or central air conditioner (CAC) or use fan instead of CAC

To emulate the impacts of the behavior of customers who turned off the heating or cooling mode of their HVAC system, the evaluation team used the effects of a smart thermostat as a proxy. A smart thermostat is a Wi-Fi enabled programmable thermostat that typically includes multiple functionalities that allow for a reduction in energy use. Most notably the devices are a part of the home's network and regularly check to see what other items are connected to the network as well as utilize motion detectors. In the event that no users are actively connected to the home's network and minimal movement is detected, the thermostat will go into auto away mode. Given this functionality, the evaluation team believes this measure to be an appropriate proxy for the behavior observed by participants of turning off their furnace or air conditioner.

Equation 3-15 and Equation 3-16 present the algorithms used to calculate energy savings for reduced cooling and heating loads. Demand savings were deemed as zero based on assumptions provided in multiple TRMs including the 2016 Indiana TRM and 2016 Pennsylvania.

Equation 3-15: Turn off CAC or use fan mode energy savings algorithm

$$\Delta kWh_{cool} = EUI_{cool} \times Area \times Tstat_{cool} \times Adj.Factors$$

Equation 3-16: Turn off furnace energy savings algorithm

$$\boldsymbol{\Delta kWh_{heat} = EUI_{heat} \times Area \times Tstat_{heat} \times ELEC \times Adj.Factors}$$

The evaluation team researched current studies on smart thermostat savings (summarized in Table 3-19). The baseline for all selected studies was a manual mercury thermostat. The median savings observed in the data was then applied to the annual electric heating and cooling consumption for homes in Ohio as provided in the US Energy Information Administration's 2009 Residential Energy Consumption Survey (RECS).

Table 3-19: Smart Thermostat Savings

Study Location	Cooling Savings	Heating Savings
Vectren Indiana[1]	13.9%	12.5%
NIPSCO[2]	16.1%	13.4%
National Grid[3]	10%	N/A
Median	**13.9%**	**13.0%**

[1]Evaluation of 2013–2014 Programmable and Smart Thermostat Program for Vectren Corporation. The Cadmus Group, January 2015
[2]Evaluation of the 2013–2014 Programmable and Smart Thermostat Program for Northern Indiana Public Service Company. The Cadmus Group, January 2015
[3]Evaluation of 2013- 2014 Smart Thermostat Pilots: Home Energy Monitoring, Automatic Temperature Control, Demand Response. The Cadmus Group, July 2015

The calculated savings for turning off the air conditioning and for using fans instead of air conditioning are based on the cooling savings only, while the calculated savings for turning off the furnace is based on the heating savings only. We calculated and adjusted savings based on the key assumptions as detailed in Table 3-20 and Table 3-21.

Table 3-20: Behavioral Savings Achieved by Changing AC Use Patterns

Input	Units	Value	Source	
Cooling Energy Use Intensity (EUI_{cool})	kWh/ft^2	0.5612	2009 RECS Data, Ohio and Indiana	
Average Cooled Area ($Area_{cool}$)	ft^2	1,343	2009 RECS Data, Ohio and Indiana	
T-stat $savings_{cool}$	%	13.9%	Multiple Smart Thermostat Studies as noted above	
Energy Savings	**kWh**	**104.8**	**Calculated**	
Demand Savings	**kW**	**0.000**	**Deemed**	
Turning off Air Conditioning when Not Home				
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
13%	78%	87%	68%	28%
			Total Energy Savings:	**1.7 kWh**
			Total Demand Savings:	**0.000 kW**
Using Fans Instead of Air Conditioning				
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
22%	78%	87%	68%	28%
			Total Energy Savings:	**2.9 kWh**
			Total Demand Savings:	**0.000 kW**

Table 3-21: Behavioral Savings Achieved by Changing Heating Use Patterns

Input	Units	Value	Source	
Heating Energy Use Intensity	kWh/ft^2	0.6465	2009 RECS Data, Ohio and Indiana	
Average Heated Area	ft^2	1,943	2009 RECS Data, Ohio and Indiana	
Savings	%	13.0%	Multiple Smart Thermostat Studies as noted above	
ELEC	%	45%	Duke Energy 2016 RASS Data	
Energy Savings	**kWh**	**73.8**	**Calculated**	
Demand Savings	**kW**	**0.000**	**Deemed**	
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
11%	78%	87%	68%	28%
			Total Energy Savings:	**1.0 kWh**
			Total Demand Savings:	**0.000 kW**

Adjust thermostat set points

The evaluation team again relied on current smart thermostat studies to estimate the savings achieved by adjusting thermostat set points. An additional function of smart thermostats is their ability to learn set points by trending regular changes made by the user in a trial period following installation. The evaluation team believes this increased precision in thermostat set points to be analogous to the behavioral change analyzed here.

Equation 3-17 presents the algorithm used to calculate energy savings for reduced cooling and heating loads. Demand savings were deemed as zero based on assumptions provided in multiple TRMs including the 2016 Indiana TRM and 2016 Pennsylvania.

Equation 3-17: Adjust thermostat set points energy savings algorithm

$$\Delta kWh_{cool} = (EUI_{cool} \times Area \times Tstat_{cool}) + (EUI_{heat} \times Area \times Tstat_{heat} \times ELEC) \times Adj.Factors$$

In our review of smart thermostat data, we also explored studies with mixed baselines (manual and programmable thermostats) in order to better isolate the impact of set point adjustments as opposed to the auto-away function. The sources and their associated savings are detailed in Table 3-22.

Table 3-22: Smart Thermostat Savings

Study Location	Cooling Savings	Heating Savings
Vectren Corporation[1]	N/A	5.0%
NIPSCO[2]	N/A	7.8%
Xcel Energy[3]	4.6%	N/A
Commonwealth Edison[4]	4.8%	6.7%
Median	**4.7%**	**6.7%**

[1]Evaluation of 2013–2014 Programmable and Smart Thermostat Program for Vectren Corporation. The Cadmus Group, January 2015

[2]Evaluation of the 2013–2014 Programmable and Smart Thermostat Program for Northern Indiana Public Service Company. The Cadmus Group, November 2014

[3]In-Home Smart Device Pilot. Public Service Company of Colorado. EnerNOC, Inc., April, 2014

[4]Commonwealth Edison Residential Smart Thermostats. Navigant Consulting, February 2016

The savings were calculated and adjusted based on these key assumptions as detailed in Table 3-23.

Table 3-23: Behavioral Savings Achieved by Changing Thermostat Settings

Input	Units	Value	Source	
Heating Energy Use Intensity	kWh/ft^2	0.6465	2009 RECS Data, Ohio and Indiana	
Average Heated Area	ft^2	1,943	2009 RECS Data, Ohio and Indiana	
ELEC	%	45%	Duke Energy 2016 RASS Data	
Heating Savings	%	6.7%	Multiple Smart Thermostat Studies as noted above	
Cooling Energy Use Intensity	kWh/ft^2	0.5612	2009 RECS Data, Ohio and Indiana	
Average Cooled Area	ft^2	1,343	2009 RECS Data, Ohio and Indiana	
Savings	%	4.7%	Multiple Smart Thermostat Studies as noted above	
Energy Savings	**kWh**	**73.6**	**Calculated**	
Demand Savings	**kW**	**0.000**	**Calculated**	
ISR	**Influence**	**MyHER**	**Kit Info.**	**Persistence**
7%	79%	87%	68%	28%
			Total Energy Savings:	**0.7 kWh**
			Total Demand Savings:	**0.000 kW**

Summary of behavioral impacts

Table 3-24 below presents the total energy savings derived from the behavioral component of the program.

Table 3-24: Energy savings from behavioral impacts

Behavior	kWh savings
Turn off lights	0.7
Turn off electronics	2.3
Take shorter showers	2.1
Turn off furnace	1.0
Turn off AC	1.7
Use fan mode	2.9
Adjust thermostat set points	0.7
Total	**11.5**

*Total may not sum to due to rounding

3.5 Billing Regression Analysis

While the NTC program provides participants with kits that include energy efficiency measures, the program also teaches children and families ways to conserve electricity which can lead to behavioral savings. In addition to engineering analysis, the evaluation team attempted to estimate energy savings by analyzing energy use patterns before and after participation in the NTC program – commonly referred to as billing analysis. After a thorough investigation, which is described in more detail below, we concluded that, absent a randomized control trial (RCT), billing analysis was unable to reliably detect energy savings associated with the kit or education effort. When the percent change in household energy use is small, as with the education and kit, the only reliable way to estimate energy savings using billing analysis is through a randomized control trial with large treatment and control groups and pre-and post-data. The most critical component of a well-designed RCT is to guarantee there are no differences between the treatment and control groups. This is necessary to ensure that the analysis is able to accurately estimate the counterfactual – or what would have happened absent the treatment. If inherent differences exist between the treatment group and control group, any changes in the post-treatment period could be due to these differences, rather than the treatment itself. In order to verify that effects are purely the result of the treatment intervention, the two groups must be ostensibly identical in every way except for the intervention.

Guaranteeing homogeneity between treatment and control groups is not achievable with an opt-in enrollment. The fact that one group of customers chose to enroll in the program while the other did not implies that some intrinsic difference between them does exist. These difference may include:

- Behavioral preferences or predispositions for energy efficiency measures
- Information about the program that is not accessible to non-enrollees
- Higher energy needs and therefore a greater incentive to curb their consumption

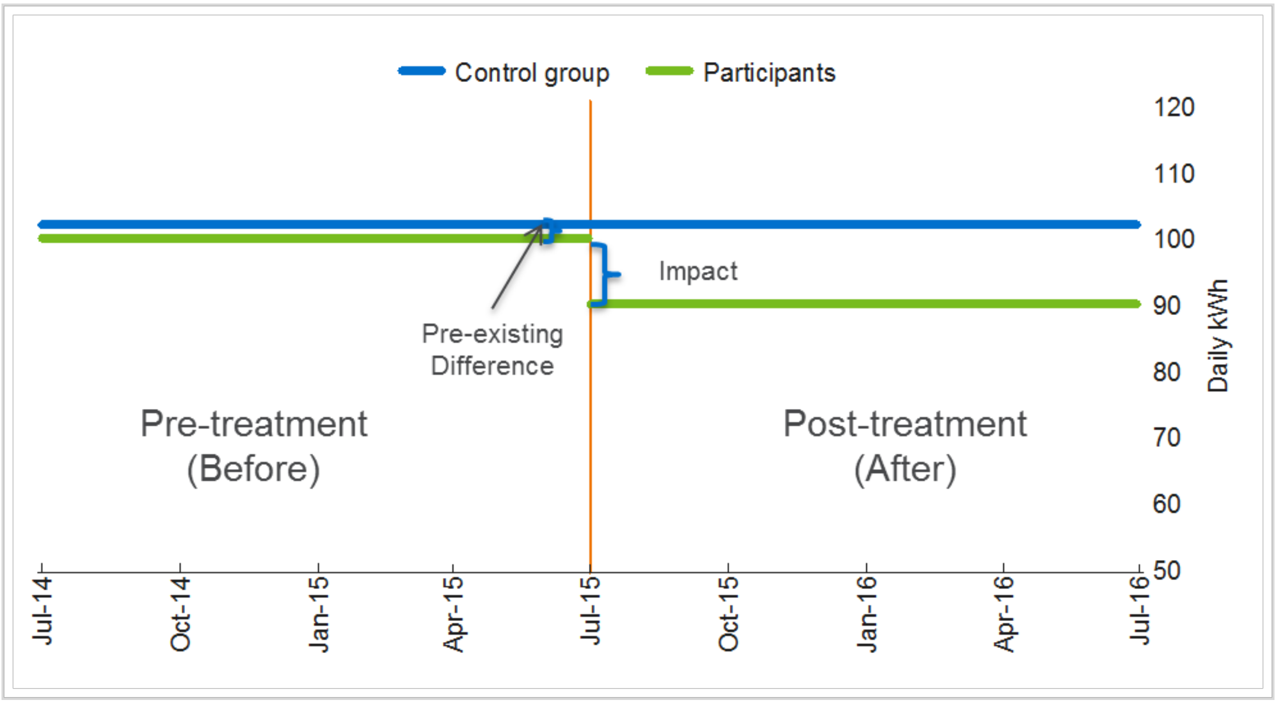
Any of these characteristics are likely to contribute to consumption responses or patterns that cannot be attributable to the program intervention. In order to be effective, a RCT includes randomly selected customers in the treatment and control groups, thereby ensuring that the analysis avoids adverse effects of selection bias and/or lurking confounding variables. Due to these variables RCTs are impractible for opt-in programs. Thus, the evaluation team's recommendation is to rely on the engineering analysis and findings as the source of the verified gross and net savings for the program. Below we discuss how we attempted to complete a billing analysis and how we ultimately determined such an analysis was not feasible.

To estimate energy savings with billing data, it is necessary to estimate what energy consumption would have occurred in the absence of NTC program —the counterfactual or baseline. To infer that the education component of the program led to energy savings, it is necessary to systematically eliminate plausible alternative explanations for differences in electricity use patterns such as random chance.

The basic framework for the analysis the evaluation team used is illustrated in Figure 3-2 and relies on both a control group and pre- and post-data. The analysis is implemented via the difference-in-differences technique which removes any pre-existing differences between the participant and the control group. If the kit and behavioral changes leads to reductions in consumption, we should observe:

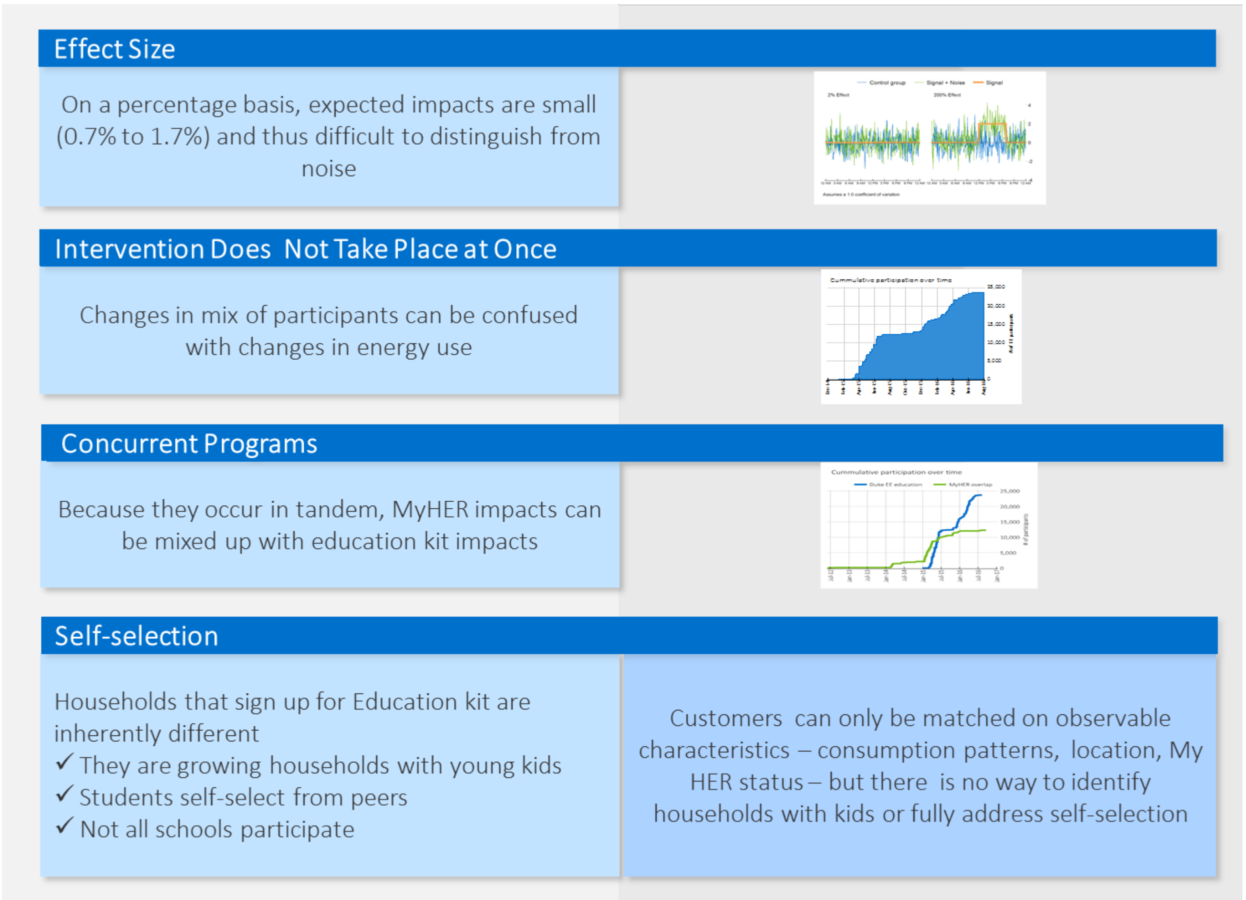
- A change in consumption for households that participated in the NTC program
- No similar change for the control group
- The timing of the change should coincide with the receipt of kits

Figure 3-2: Framework for Billing Analysis with a Control Group and Pre-Post Data and Expected Results



While the NTC program did not have a randomly assigned control group, the evaluation team did develop a comparison group to use in its analysis. However, there were several key challenges to producing reliable energy savings estimates using billing analysis, which are summarized in Figure 3-3. The two challenges that could not be addressed despite the use of a comparison group were the small effect size and selection bias. On a percentage basis, the expected energy savings from each kit were less than 2% of annual household energy consumption, and therefore it proved difficult to isolate the impacts of the program from other potential explanations, including random chance. Second, households that signed up for the kit had young children that self-selected from their peers. Households with young children are typically in the growth period of a household life cycle and, thus, may have higher year-to-year energy consumption. Despite using a comparison group, it could only account for observable characteristics – pre-treatment energy use patterns, geographic location, and concurrent participation in the DEO's My Home Energy Report (MyHER) program. There was no way to identify households with young children in the comparison group without postponing the evaluation to identify future participating schools from which a comparison group could be developed. As result, while the participant and comparison group may have had similar energy use patterns in the pre-treatment period, their energy use trajectories were not necessarily the same absent program participation due to differences in the household life cycles.

Figure 3-3: Billing Analysis Evaluation Challenges



In order to assess if the billing analysis produced reliable results, we implemented a series of placebo pressure tests. The approach consisted of including fake transitions prior to actual participation in the program and assessing if the models detected an effect when using data from the fake "pre" period to estimate the counterfactual for the fake "post" period. Because the transition was fictitious and actual post periods were excluded, we knew impacts were actually zero and any estimated impacts were due to modeling error. The evaluation team used two years of pre-treatment data for the placebo test and each participant's enrollment date was faked to have occurred between three to nine months prior to actual participation, in increments of one month. The placebo tests were implemented using both a pre-post panel regression model with fixed effects and time effects (but not the comparison group) and a difference-in-differences panel regression that made use of the comparison group.

Figure 3-4 shows the results from the placebo pressure tests. Rather than produce zero impacts, the models estimated that the fake transitions led to changes in energy use when in fact no intervention had taken place. Moreover, the models incorrectly concluded that the erroneous impacts were statistically significant in several instances – an example of false precision. The pre-post model without a comparison group consistently estimated both energy savings and increases, when impacts were in fact zero. The difference-in-differences model that made use of the comparison group had less variable results, but it estimated energy increases in the range of roughly 2% when no intervention had taken place. Hence, neither method produced reliable energy savings estimates.

Figure 3-4: Placebo Pressure Test Results (Pre-Post)

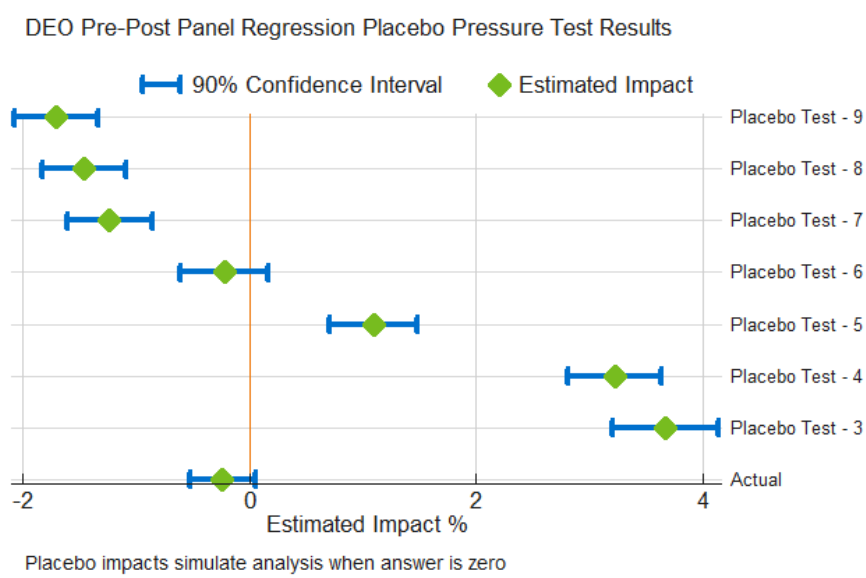
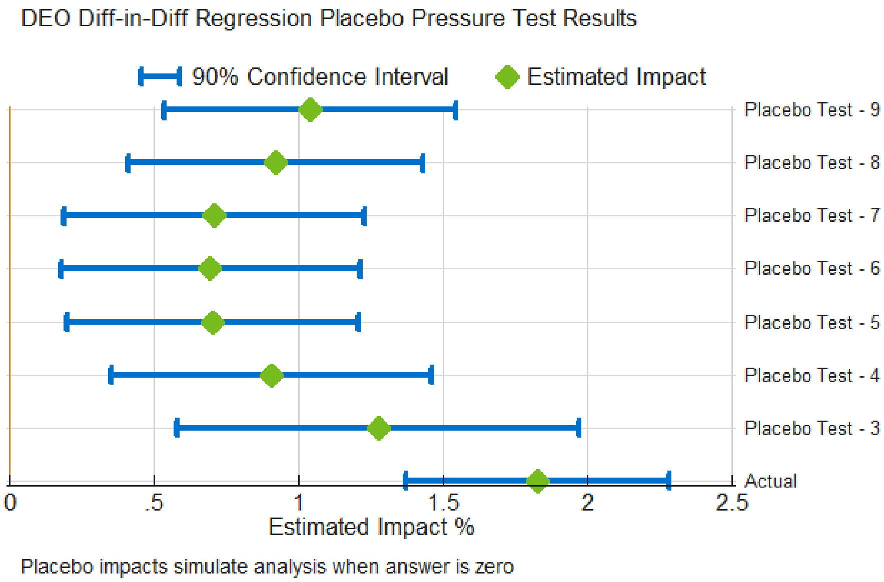


Figure 3-5: Placebo Pressure Test Results (Difference in Differences)



Appendix F provides additional detail including comparison of the program participants and comparison group.

The evaluation team's conclusion is not that there were no energy savings generated by the NTC program, but rather that billing analysis was not the correct tool for estimating the small percent energy savings from the program. Thus, the evaluation team's recommendation is to rely on the engineering analysis and findings as the source of our verified gross and net savings for the programs.

3.6 Targeted and Achieved Confidence and Precision

We developed the NTC program evaluation plan with the goal of achieving a target of 10% relative precision at the 90% confidence interval for the program as a whole. The evaluation team was able to achieve this target through the combination of web-based and phone surveys to ultimately achieve a precision of +/- 6.3% at the 90% confidence level (Table 3-25)

Table 3-25: Targeted and Achieved Confidence and Precision

Program	Targeted Confidence/Precision	Achieved Confidence/Precision
DEO NTC	90/10.0	90/6.3

3.7 Results

Measure-level and kit-level energy savings values are detailed in Figure 3-6 and

Table 3-26.

Figure 3-6: 2017-2018 DEO NTC Gross Verified Energy Savings

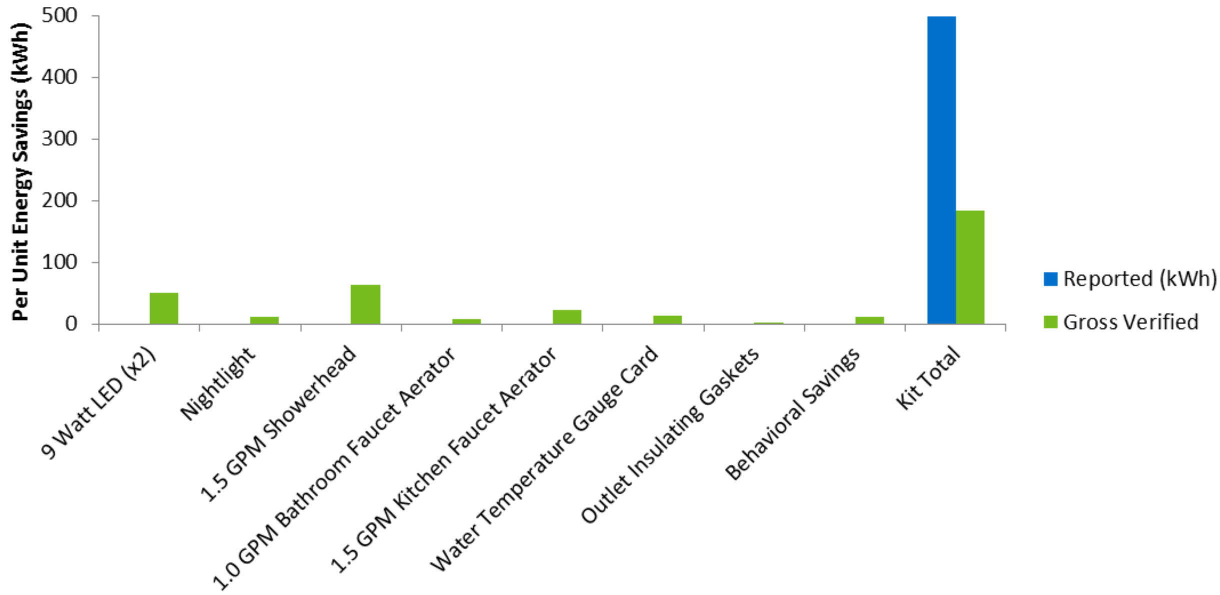


Table 3-26: Measure-Level Reported and Verified Gross Energy Savings

Measure	Reported Energy Savings, per unit (kWh)	Realization Rate	Verified Gross Energy Savings, per unit (kWh)	Total Verified Gross Energy Savings (kWh)
CFL (18W)	N/A	N/A	50.9	328,805
Nightlight			11.5	74,041
Low-flow Showerhead			63.9	412,945
Low-flow Bathroom Aerator			7.3	47,159
Low-flow Kitchen Aerator			22.5	145,343
Water Heater Setback			12.9	83,647
Outlet Gaskets			4.5	29,196
Behavioral Changes			11.5	74,461
Total	**499.0**	**37.1%**	**185.0**	**1,195,598**

Measure-level and kit-level demand savings are detailed in Table 3-27.

Table 3-27: Measure-Level Reported and Verified Demand Gross Savings

Measure	Reported Demand Savings, per unit (kW)	Realization Rate	Verified Gross Demand Savings, per unit (kW)	Total Verified Gross Demand Savings (kW)
CFL (18W)	N/A	N/A	0.006	37.8
Nightlight			0.000	0.0
Low-flow Showerhead			0.010	64.2
Low-flow Bathroom Aerator			0.001	6.9
Low-flow Kitchen Aerator			0.001	3.7
Water Heater Setback			0.002	13.0
Outlet Gaskets			0.001	3.3
Behavioral Changes			0.001	4.5
Total	**0.134**	**15.4%**	**0.021**	**133.4**

The impact evaluation for the 2017-2018 program resulted in a program energy realization rate of 112% and a demand realization rate of 156% as presented in Table 3-28.

Table 3-28: 2017-2018 Energy Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified
Energy (kWh)	499.0	37.1%	185.0
Demand (kW)	0.134	15.4%	0.021

Table 3-29 presents the reported and verified energy and demand savings for the 2017-2018 program year.

Table 3-29: 2017-2018 Program Level Energy Savings

Measurement	Reported	Realization Rate	Gross Verified
Energy (kWh)	3,225,037	37.1%	1,195,598
Demand (kW)	867.7	15.4%	133.4

3.7.1 Senate Bill 310 Compliance

As noted in Section 1.2.1.1, DEO may claim alternate savings values for each program measure per the terms of Ohio Senate Bill 310 in order to comply with its energy savings goals. The relevant language from Senate Bill 310 is provided in Appendix C.

Table 3-30 provides the gross savings per measure that DEO will claim per SB 310 for the Energy Efficiency Education School Kit for the 2017-2018 program year.

Table 3-30: SB 310 Compliance Gross Savings per Measure

Program	Claimed Gross Savings (kWh)	Claimed Gross Savings (kW - summer)	Claimed Gross Savings (kW - winter)	Source
Energy Efficiency Education School Kit	499.0	0.134	0.132	DEO program reported savings

4 Net-to-Gross Methodology and Results

The evaluation team used student family survey data to calculate a net-to-gross (NTG) ratio for the NTC program. NTG reflects the effects of free ridership (FR) and spillover (SO) on gross savings. Free ridership refers to the portion of energy savings that participants would have achieved in the absence of the program through their own initiatives and expenditures (U.S. DOE, 2014).[9] Spillover refers to the program-induced adoption of additional energy-saving measures by participants who did not receive financial incentives or technical assistance for the additional measures installed (U.S. DOE, 2014). The evaluation team used the following formula to calculate the NTG ratio:

$$NTG = 1 - FR + SO$$

The evaluation team calculated the mean FR separately for water end-use measures and light bulbs, and aggregated those values to the program level. The team calculated spillover at the program level only.

4.1 Free Ridership

Free ridership estimates how much the program influenced participants to install the energy-saving items included in the energy efficiency kit. Free ridership ranges from 0 to 1, 0 being no free ridership and 1 being total free ridership, with values in between representing varying degrees of partial free ridership.

The evaluation team used participant survey data to estimate free ridership. The survey used several questions to identify items that a given participant installed and did not later uninstall:

- For items that came one to a kit (showerhead, kitchen and bathroom faucet aerators, and night light), the survey asked whether the participant installed the item and, if so, whether the participant later uninstalled the item.
- For insulator gaskets, which came 12 to a kit, the survey asked how many the participant installed and if the participant later uninstalled them.
- For the LEDs, the survey first asked whether the participant installed one, both, or neither. The survey then asked whether the participant uninstalled the bulbs.

The evaluation team's methodology for calculating free ridership consists of two components, free ridership change (FRC) and free ridership influence (FRI), both of which range from 0 to .5 in value.

[9] The U.S. Department of Energy (DOE) (2014). *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 23: Estimating Net Savings: Common Practices.* Retrieved August 29, 2016 from http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf.

$$FR = FRC + FRI$$

4.1.1 Free Ridership Change

FRC reflects what participants reported they would have done if the program had not provided the items in the kit. For each respondent, the survey assessed FRC for each measure that the respondent installed and did not later uninstall.

Specifically, the survey asked respondents which, if any, of the currently installed items they would have purchased and installed on their own within the next year if DEO had not provided them. For each measure, the evaluation team assigned one of the FRC values shown in the Table 4-1, based on the respondents' responses.

Table 4-1: Free Ridership Change Values

What Respondent Would Have Done Absent the Program*	FRC Value
Would ***not*** have purchased and installed the item within the next year	0.00
Would have purchased and installed the item within the next year	0.50
Don't know	0.25

*Survey response to: If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?

4.1.2 Free Ridership Influence

FRI assesses how much influence the program had on a participant's decision to install (and keep installed) the items in the kit. The survey asked respondents to rate how much influence five program-related factors had on their respective decisions to install the measures, using a scale from 0 ("not at all influential") to 10 ("extremely influential"). The program-related factors included:[10]

- The fact that the items were free
- The fact that the items were sent to their home
- Information in the kit about how the items would save energy
- Information that their child brought home from school
- Other information or advertisements from DEO, including its website

Asking respondents to separately rate the influence of each of the five above items had on the decision to install each measure would have been overly burdensome. Therefore, while the survey assessed FRC for each measure, it assessed influence at the end-use level once for all water-saving measures and once for the light bulbs.

[10] To reduce response fatigue, we only asked respondents to rate program influence on their decision to install: a) efficient light bulbs (as a whole), and b) water saving measures (as a whole). Thus, we did not collect separate influence data for each CFL (13W and 18W) nor for each water saving measure (showerhead, bathroom aerator, and kitchen aerator).

For each end-use (water-saving and light bulbs), the highest-rated item for each respondent represents the overall program influence. The evaluation team assigned the following FRI scores, based on that rating (Table 4-2). The evaluation team calculated up to two FRI scores for each respondent: one FRI score for water-saving measures and one FRI score for light bulbs.[11]

Table 4-2: Free Ridership Influence Values

Highest Influence Rating	FRI Value
0	0.50
1	0.45
2	0.40
3	0.35
4	0.30
5	0.25
6	0.20
7	0.15
8	0.10
9	0.05
10	0.00

4.1.3 End-Use-Specific Total Free Ridership

The evaluation team calculated total free ridership by end use, one for water saving measures, one for infiltration measures, and one for light bulbs, by:

- Calculating measure-specific FR scores for each respondent by summing each measure-specific FRC score with the corresponding end-use-specific FRI score.
- Calculating the mean FR score for each measure from the individual measure-specific FR scores.[12]
- Calculating a savings-weighted mean of the measure-specific FR means for water-saving measures and a separate savings-weighted mean of the measure-specific FR means for light bulbs. These two savings-weighted means represent the FR estimates for the two end-uses.

Table 4-3 presents the end-use FR estimates.

[11] Respondents were only asked to rate program influence on end-uses they installed and did not later uninstall. Thus, if a respondent installed both a showerhead and a light bulb, but later uninstalled the light bulb, the evaluation team only asked them to rate program influence on their decision to install the showerhead. Thus in this example, the evaluation team would only calculate a water end-use FRI score for this respondent.

[12] Since respondents were only asked about program influence on their decision to install the light bulbs and water saving items, infiltration measures leveraged the average influence score (FRI) across those two end uses. However, the FRC score used for infiltration measures was specific to that end use.

Table 4-3: End-Use-Level Free Ridership Scores

End-use	End-Use Free Ridership
Light bulbs	0.25
Water saving measures	0.11
Infiltration measures	0.10

4.1.4 Program-Level Free Ridership

The evaluation team estimated program-level free ridership by calculating a savings-weighted mean of the end-use FR scores presented in Table 4-3. Overall free ridership for the NTC kits is an estimated 15%.

4.2 Spillover

Spillover estimates energy savings from additional energy improvements made by participants who are influenced by the program to do so and is used to adjust gross savings. Since behavioral actions are considered gross impacts, spillover calculations only include additional installations of energy saving technologies. The evaluation team used participant survey data to estimate spillover. The survey asked respondents to indicate what energy-saving measures they had implemented since participating in the program. The evaluation team then asked participants to rate the influence the NTC program had on their decision to purchase these additional energy-saving measures on a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential.”

The evaluation team converted the ratings to a percentage representing the program-attributable percentage of the measure savings, from 0% to 100%. The team then applied the program-attributable percentage to the savings associated with each reported spillover measure to calculate the participant measure spillover (PMSO) for that measure. We defined the per unit energy savings for the reported spillover measures based on ENERGY STAR® calculators as well as algorithms and parameter assumptions listed in the in the 2010 Ohio, 2016 Pennsylvania TRM, and outputs from this impact evaluation.

Lighting measures (namely, LEDs and CFLs) were commonly reported spillover measures. Since Duke Energy offered discounted lighting through their Online Savings Store, we asked respondents to confirm they did not use Duke Energy’s website to purchase discounted lighting. As to not double-count these savings, we adjusted lighting spillover savings to account for the proportion of respondents that said they used Duke Energy’s website to purchase discounted lighting measures.

Participant measure spillover (PMSO) is calculated as follows:

$$PMSO = Deemed\ Measure\ Savings * Program\ Attributable\ Percentage$$

Table 4-4 exhibits the PMSO by measure category.

Table 4-4: DEO PMSO, by Measure Category

Measure Category	Total kWh for Category	Percent Share of kWh
LEDs	7,651	88%
CFLs	17	<1%
Appliances	891	10%
Windows	109	1%
Total	**8,667**	**100%**

The evaluation team summed all PMSO values and divided them by the sample's gross program savings to calculate an estimated spillover percentage for the NTC program:

$$Program\ SO = \frac{\sum Program\ PMSO}{\sum Sample's\ Gross\ Program\ Savings}$$

These calculations produced a spillover estimate of 30% for the program.

4.3 Net-to-Gross

Inserting the FR and SO estimates into the NTG formula (NTG = 1 – FR + SO) produces an NTG value for the program of 1.13 (Table 4-5). The evaluation team applied the NTG ratio of 1.13 to program-wide verified gross savings to calculate NTC kit net savings.

Table 4-5: Net-to-Gross Results

Free Ridership	Spillover	NTG
0.15	0.28	1.13

5 Process Evaluation

5.1 Summary of Data Collection Activities

The process evaluation is based on telephone and web interviews and surveys with program and implementer staff, teachers, 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	19	81	90/17
Participating teacher follow-up interviews	Phone in-depth interview	5	Unknown	N/A
Student families who received DEO kit and are customers of DEO	Phone/Web survey	167[1]	5,587	90/6

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 2018, the evaluation team surveyed 19 teachers who attended NTC performances between September 7, 2017 and February 26, 2018. Of the 19 teacher respondents, 9 taught elementary school and 10 taught middle school. We report elementary and middle school findings together unless a meaningful difference emerged between school types.

In May 2018, 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 served to get a deeper understanding of topics uncovered in the web survey and to provide additional details about

[1] 72 phone surveys, 95 web surveys

their experience. The evaluation team completed interviews with five of these teachers. Three taught at elementary schools (one, kindergarten, and two, first grade) and two taught at middle schools (one, fifth grade, and one, seventh and eighth grades).

5.1.2 Survey of Student Families Who Received the DEO Kit

In April and May 2018, the evaluation team surveyed 167 families who received energy efficiency kits from DEO between August 2017 and May 2018 (Table 5-2). During that period, DEO distributed a total of 5,587[2] kits to families who completed the kit request form their child brought home from school. The evaluation team attempted to contact a random sample frame of 5,296 households, sending email survey invitations to 3,736 households and attempting to call 1,560 households for which program records provided an email address and/or a phone number. Ultimately, the data collection effort achieved a 3.0% response rate, providing a sample with 90/6 confidence/precision. Comparisons with census data demonstrate that the sample is largely representative of housing characteristics and ownership status for the region. Respondents reported greater educational attainment, higher income, and larger household than that of the region.[3]

Table 5-2: DEO Student Family Survey Response Rates

Mode	Population Size	Sample Frame Size	Completed Surveys	Response Rate	Confidence/ Precision
Web-based	5,587	3,736	95	2.5%	90/6
Phone		1,560	72	4.6%	
Total		**5,296**	**167**	**3.0%**	

5.2 Process Evaluation Findings

5.2.1 Awareness of DEO Sponsorship of the Program

Teachers and student families were aware of DEO's sponsorship of the program. A majority of teachers (84%) reported they were aware of DEO's sponsorship. The 16 teachers who knew of DEO's sponsorship most often learned about it through another staff member at their school (9) or DEO marketing materials (6) (Table 5-3).

2 The survey sample frame is smaller than the number of distributed kits (N = 6,463) due participants who requested they not be contacted.

3 Region comparisons come from 2016 American Community Survey (Census) 5-year period estimates data for Butler, Warren, Hamilton, Clermont, and Brown counties.

Table 5-3: How Teachers Learned of DEO's Sponsorship (Multiple Responses Allowed; n=16)

Source	Number of Teachers
Another staff person at school	9
Duke Energy marketing materials	6
The National Theatre for Children materials	2
The National Theatre for Children staff	2
Prior performance at school	2
Duke Energy staff	1

Awareness among student families was high, with 150 respondents (90%) stating they knew the kit was sponsored by Duke Energy. Nearly two-thirds (63%) indicated they learned about Duke's sponsorship via the classroom materials their child brought home. Other common ways that families learned about Duke Energy sponsorship were material included in the kit (31%) and communications from their child's teacher or school (21%).

About one-third (31%) of respondents said they knew about the energy-related classroom activities and NTC performance at their child's school. Of those, most (71%) said they found out about the NTC activities from their child.

5.2.2 Parent Awareness of DEO Kit Opportunity

Classroom materials sent home with the student were the key source of awareness of kits for families, with most student families (74%) hearing about the opportunity to receive a Duke Energy kit in that way. Other respondents learned about the kits from various communications from the school (Table 5-4).

Table 5-4: Parents Awareness of Kits

Kit Awareness	Count (n=167)
Classroom materials	74%
School newsletter	17%
Email from teacher/school	10%
School website or web portal	3%
Poster at school	3%
Conversations with teacher	1%
After hour event at school	1%
Other	11%

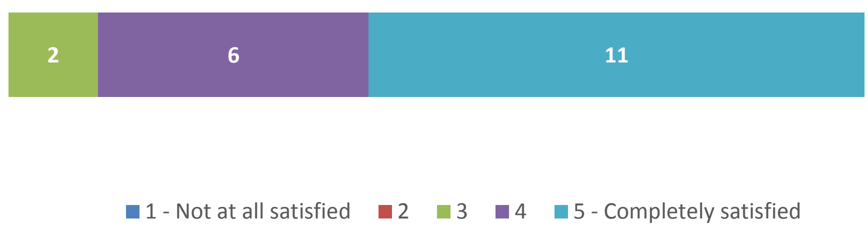
5.2.3 Teacher Experience with the Program

NTC Performance

Teachers were pleased with the NTC performance. They specified that the content was age-appropriate and the performance itself was engaging, and they reported overall high satisfaction with it.

Overall, teachers were largely satisfied with the performance, with 89% (17 of 19) rating their satisfaction as a “4” or “5” on a one-to-five scale. The remaining two respondents were neither satisfied nor dissatisfied providing a response of “3” on the five-point scale.

Figure 5-1: Overall Teacher Satisfaction with NTC Performance (n=19)



More than three-quarters of the surveyed teachers (15 of 19) said the explanation of energy-related concepts was “about right” for most of their students. Of the other four, three teachers (fifth, sixth, and seventh grade) reported the material was too basic while one fifth grade teacher said the vocabulary was too advanced for their students (Table 5-5).

Table 5-5: Manner in Which Performance Explained Energy-Related Concepts (n=19)

Explanation	Number of Teachers	Percent of Teachers
Too advanced	1	5%
About right	15	79%
Too basic	3	16%
Total	19	100%

Comments from the five interviewed teachers corroborated and expanded on the survey findings. The five interviewed teachers identified several themes associated with the performance: conservation (4 mentions), energy (4 mentions), recycling (2 mentions), and actions families could take to conserve resources (2 mentions). Four of the five interviewed teachers mentioned that the performers covered the energy-saver kits and kit request forms, while the fifth did not remember hearing the performers discuss the kits or kit forms.

Three of those interviewed teachers commented on how the material covered in the performance related to what they were teaching. Of those, two liked that the performance reinforced material they were covering in their classroom. The third commented that the overall message that the performers communicated – conservation – was an important lesson for their students that was not provided elsewhere in their curriculum.

Regarding age appropriateness, the comments from the interviewed teachers echoed the findings from the online survey. Four of the five interviewed teachers – those teaching grades K through 5 – said the performance was age appropriate and kept their students' attention. One particularly mentioned liking that the performance was easy to follow and understand. By comparison, the seventh-grade teacher reported that the performance may have been better suited for older Middle School students, such as their class, but some younger students that attended the performance may have struggled with the material.

Three teachers commented on the quality of the performance, specifically that the performance was engaging and the performers were humorous. Two of those three particularly liked that students were brought on stage during the performance and one liked that performers conducted call-and-response with the audience.

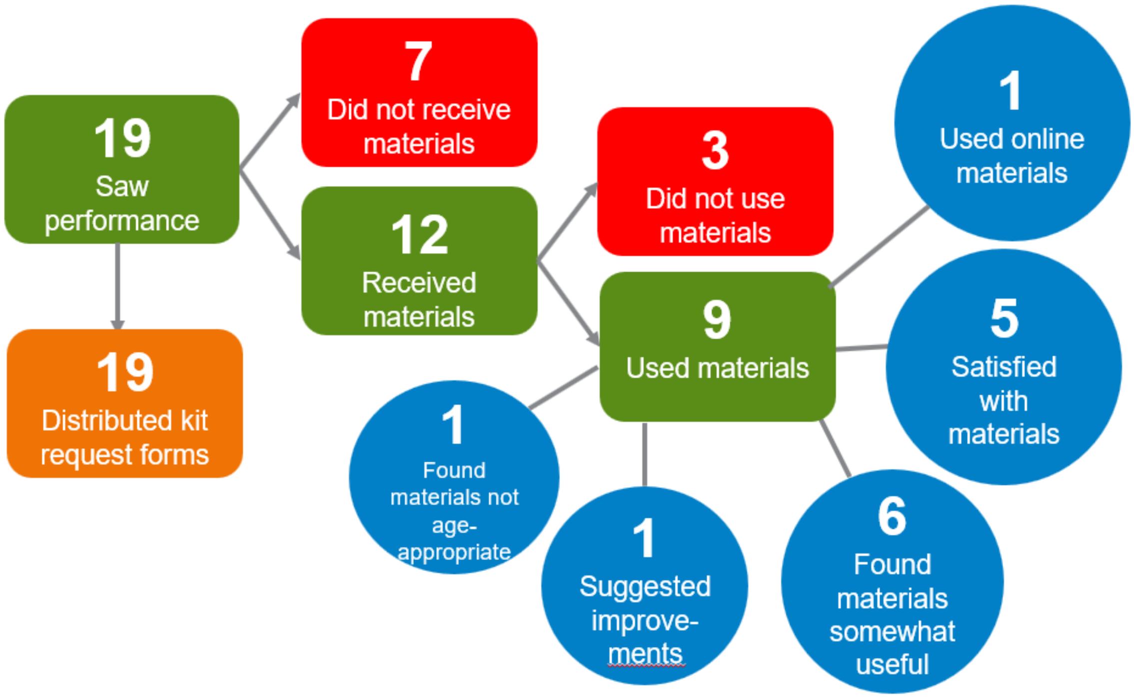
Three surveyed teachers offered suggestions for improving the performance:

- Include more visuals: One suggested providing more visuals such as posters to help students with concepts and vocabulary.
- Provide a toy lanyard: According to one respondent that had seen multiple performances, providing students a toy lanyard that included the kit request form was helpful. Past performances had a toy lanyard and, according to this respondent, these lanyards were popular with students and encouraged them to take the kit form home.
- Have performers in more professional attire: The seventh-grade teacher indicated the performers could have had a more professional appearance – fewer jeans and t-shirts and more business casual attire.

Curriculum and Instructional Materials

A notable percentage of teachers reported not receiving or using the curriculum materials despite reporting that they distributed kit request forms to all students (see section ***Kit Request Forms*** below) and the forms and materials were given to schools simultaneously by NTC. About two-thirds of teachers (12 of 19) reported receiving the curriculum and instructional materials, while five said they did *not* receive the materials and two said they did not know whether they had received them. Of the 12 who reported receiving the materials, three reported not using them "at all" because they did not have time to use them (2 mentions) or because the materials were at "too low a level" for their students.

Figure 5-2: Teachers Use of Forms and Instructional Materials



Of the nine teachers reporting use of the instructional materials, only seven could report on the materials' usefulness, age-appropriateness, alignment with state science standards, or concepts children had trouble understanding. From their comments, the following observations emerged:

- Use of materials was limited: Seven teachers characterized their use as "a little" and two used the materials "moderately." One of these respondents reported using the online aspect of the curriculum.
- Materials were somewhat useful: When asked to rate the usefulness of the materials, from 1 (not at all useful) to 5 (highly useful), four provided the middle rating and the other three gave a rating one level higher or lower.
- Materials were age-appropriate: Six reported the material was age-appropriate, while the fifth-grade teacher reported it was somewhat too advanced.
- Most respondents said they varied in their thoughts about the alignment of materials with state science standards: Three reported the curriculum "completely" or "mostly" aligned with state science standards, three stated it "somewhat" aligned, and one reported the materials did not align at all with the standards.
- No teacher reported any specific concepts or topics children had trouble understanding.

The seven teachers reporting "a little" use explained their rationale for limited use of the material. None of the comments focused on the quality of the materials per se. Rather, the reason for minimal use was because the materials did not align with pre-determined curricula or their teaching priorities at that time.

No teacher specified any concepts the workbooks should have covered to make it more useful Five reported being satisfied with the materials (scored a “4” or “5” on a five-point scale) and three were neither satisfied or dissatisfied with the materials (scored a “3” on a five-point scale).

Three of the five interviewed teachers said they used the curriculum materials. Of those, three used the workbooks in their classroom as part of a lesson and one reported tying the materials to actions kids can take in the classroom, such as turning off lights to save energy. One simply reported sending the materials home with students.

Kit Request Forms

As Figure 5-2 above suggests, there was a disconnect among teachers between the kit request forms and the instructional materials. Teachers largely reported limited use of the instructional materials, yet they reported they distributed all kit request forms, which were connected to the instructional materials. This suggests that teachers viewed the materials as tangential to the kit requests.

Of the surveyed teachers, all 19 distributed the kit request forms to their students and all took actions to encourage or promote the kits to their students. The interviewed teachers reported no challenges related to receiving or distributing the kit request forms, with three of the five reporting receiving the forms ahead of the performance, and all noted ways they encouraged students to receive the kit (Table 5-6).

Table 5-6: Actions Taken to Encourage Students To Receive Kit (multiple responses allowed; n=19)

Actions	Teacher Survey Responses	Interview Mentions
Vocally encouraged students to sign up for a kit	17	4
Emailed parents to encourage them to sign up for a kit	8	3
Pinned up MyEnergyKit.org poster	7	-
Used my classroom web portal to encourage families to sign up for a kit	5	-
Spoke with parents in person to encourage them to sign up for a kit	2	-
Had school or principal send reminders	-	2
Awarded prizes to kids that get parents to request kit	-	1
Explained to students and parents the school would get award from Duke if enough households enrolled for kit	-	1

Six of the 19 surveyed teachers reported following up with students to find out whether their household requested a kit. Of those six teachers, one estimated that 61% to 70% of their students ordered a kit and the other five estimated that fewer than half their student households ordered a kit.[4]; on average, teachers reported that 32% of their students sent for a kit.[5]

5.2.4 Student Family Experience with the Program

Installation and Use Rates

Almost all participants used at least one measure in the kit, and use of the measures varied by type. Ninety-six percent of the surveyed kit recipients installed at least one measure, installing an average of three measures from their kit. Most kit recipients installed the lighting measures; far fewer used the water related measures, which were also uninstalled more often than lighting measures. Most of the respondents who chose to uninstall kit measures reported dissatisfaction with the measure performance.

The majority of those installing light bulbs (74%) said they installed both bulbs included in the kit and they typically replaced incandescent bulbs.

Of those who did not install all items in the kit, fewer than half (38%) said they do not plan to install any of the items they had not yet installed. Respondents said they would not install the remaining items because the currently installed item is still working, they already had an efficient measure installed, or they had not "gotten around to it."

Measure Satisfaction

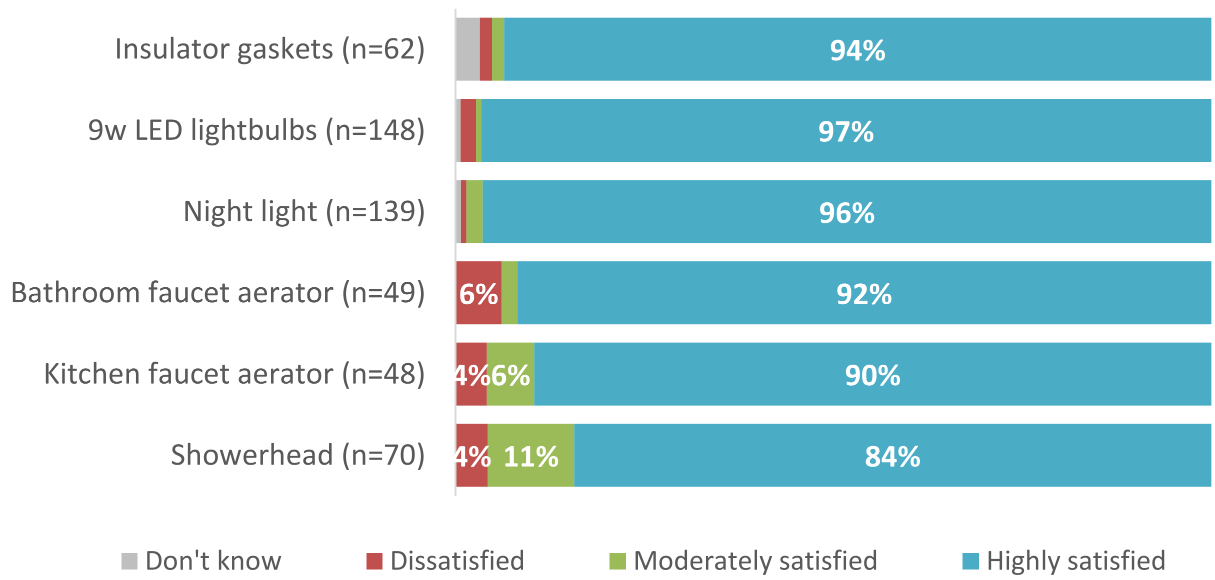
Nearly all kit recipients reported high satisfaction with the items they installed from their kit (

Figure **5-3**). To best gauge the experience with the measures, we asked respondents to rate their satisfaction with all measures they installed, including those they later uninstalled. Respondents explained that any dissatisfaction they had with water measures was due to low water pressure.

[4] One respondent each reported 0-10%, 11-20%, 21-30%, 31-40%, 41-50%.

[5] 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%.

Figure 5-3: Kit Recipient Satisfaction with Measures They Installed*



* Respondents rated their satisfaction with the measures on a 0 (“very dissatisfied”) to 10 (“very satisfied”) scale. Dissatisfied indicates 0-3 ratings, moderately satisfied indicates 4-6 ratings, and highly satisfied indicates 7-10 ratings.

Energy Saving Educational Materials in the Kit

Most respondents reported reading the educational materials included in the kit, and most reported they were very helpful. 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 (68%) respondents said they read the booklet, most of whom (81%) found it highly helpful.[6] The other respondents rated the booklet as moderately helpful (16%) or not very helpful (3%). Those not finding the booklet helpful stated they already knew the information presented in the booklet.

Additional Energy Saving Actions

Parents and children reported adopting new energy-saving actions since their involvement in the program. Half of parents reported taking an energy-saving action and more than half (57%) of respondents 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 (45%), and parents reported changing thermostat settings (Table 5-7). More than three-quarters

[6] 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”). Eighty one percent of respondents who reported reading the booklet gave a rating of 7 or higher. 16% gave ratings of 5 or 6, and 3% gave ratings of 0 through 4.

(78%) of respondents reporting new energy saving behaviors said the DEO-sponsored kit and materials were "highly influential" in their adoption of those behaviors.[7]

Table 5-7: New Behaviors Adopted by Parents and Children Since Involvement in Program (multiple responses allowed; n=167)

New Behaviors Child Has Adopted	Parents	Children
Adopted new behaviors since receiving kit	50%	57%
Changed thermostat settings to use less energy	22%	-
Turn off lights when not in a room	16%	45%
Takes shorter shower	14%	15%
Turn off electronics when not using them	13%	19%
Turning water heater thermostat down	11%	-
Using fans instead of air conditioning	10%	-
Turning off air conditioning when not home	10%	-
Turning off furnace when not home	7%	-
Other reason	7%	10%
Refused	0%	1%

The kit measures drove a desire for more energy efficiency equipment. Most student families reported a desire to receive more kit measures (89%) specifying interest in LEDs (76%), nightlights (53%), gasket insulators (17%), showerheads (14%), bathroom aerators (13%), and kitchen aerators (10%). Their preference for requesting additional measures was by internet (67%) or using pre-paid postcards (32%).

Many respondents reported they want to purchase additional products. More than half (61%) of respondents reported an interest in purchasing at least one of the following products or services:

- New efficient lighting (46%)
- Energy efficient appliances (21%)
- Air leak sealing (19%)
- Efficient windows (14%)
- Connected or smart thermostats (14%)
- Insulation (14%)

The kit motivated some respondents to purchase energy efficient equipment or services. More than a quarter (29%) of respondents reported purchasing or installing additional energy

[7] 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"). Seventy-eight percent of respondents (or, 90 of 115) who reported behavior changes gave a rating of 7 or higher.

efficiency measures since receiving their kit. Efficient light bulbs were the most commonly reported measure (mentioned by 29 respondents), with 28 respondents specifying LEDs and one mentioning CFLs. Six respondents reported getting a Duke Energy rebate for their measure, four of whom received rebates for purchasing LEDs, one who received a rebate for buying an energy efficient appliance, and another who received an incentive for their efficient heating or cooling equipment. Most (29 of 48) respondents said the Duke Energy schools program was at least partially influential on their decision to purchase and install additional energy saving measures (Table 5-8).

Table 5-8: Additional Energy Saving Measures Purchased (multiple responses allowed)

	Count of Respondents Reporting Purchases After Receiving the Kit	Count That Received Duke Rebates for the Purchase/Measure	Count Reporting at Least Some DEO Program Influence on Purchase*
At least one measure	48	6	29
Bought LEDs	28	4	22
Bought energy efficient appliances	14	1	8
Added insulation	12	0	6
Other	10	0	1
Sealed air leaks	6	0	5
Bought efficient heating or cooling equipment	5	1	1
Bought efficient windows	5	0	0
Installed an energy efficient water heater	3	0	2
Moved into an ENERGY STAR home	1	0	0
Sealed ducts	1	0	0
Bought CFLs	1	0	1

*Respondents that rated the influence of the DEO program as 7 or higher on 10 point scale where 1 was not at all influenced and 10 was highly satisfied.

6 Conclusions and Recommendations

The evaluation findings, led to the following conclusions and recommendations for the program.

Conclusion 1: NTC performances satisfy teachers by engaging students. It is less clear that the performances are linked to classroom learning, awareness at home, or change in behavior. Teachers reported high satisfaction with the performance and recalled that the performance engaged students. However, curriculum materials were not always distributed or remembered by teachers and use of the materials was limited and those that did use the materials determined they were, at best, "moderately useful."

Parents were often not aware the performance occurred and about half of parents reported changes in their or their children's energy use behavior since receiving the kits but those changes in behavior were limited.

> **Recommendation:** Find ways to increase use of materials, such as:
>
> - making sure teachers are aware that NTC aligns their materials with state science standards, and
> - concentrating scheduled performances around the time schools are covering similar topics, such as around Earth Day

Conclusion 2: There is an opportunity to greater emphasize the kits and get more families to request and install kits. About one-third of teachers follow-up with students to see if parents requested kits, but there is great variation in how much emphasis teachers place on promoting the kits. Additionally, two-thirds of parents did not know kits were associated with a performance and instructional materials.

> **Recommendation:** Provide schools with information or pre-written messaging that they can use to communicate the value of the kits to parents.

Conclusion 3: The program influences families to save energy. Families save energy they would not have saved without receiving the kits and nearly all respondents installed at least one kit measure. Very few would have installed the kit measures without the prompt from their child and about one-fifth of parent respondents indicated a spillover action. Over half of parent respondents said they or their children adopted new energy saving behaviors since receiving the kit

> **Recommendation:** Continue engaging student family households with the Education program.

Conclusion 4: The Education program could be a good "gateway" program to generate

even more energy savings. Kit recipients could be good targets for other Duke Energy efficiency program promotions, as they:

- demonstrated willingness to save energy in their home
- expressed interest in installing additional kit items or other energy saving measures (many of which Duke Energy currently incents)
- are highly likely to read any information included with the kit
- are predominantly single family homeowners

Recommendations: Leverage kits to promote other Duke Energy efficiency programs, such as targeting these households for direct mail campaigns or including information on Smart $aver or the Online Savings Store in the kit.

Appendix A Summary Form

Description of program

The Energy Education in Schools Program is an energy efficiency program that provides free in-school performances by the National Theatre for Children (*n*TC) that teach elementary and middle 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 DEO and 2) lesson plans associated with the content in the student workbooks.

Date	August 30, 2018
Region(s)	Ohio
Evaluation Period	August 1, 2017 – May 31, 2018
Annual Gross kWh Savings	1,195,598 kWh
Per Kit kWh Savings	185.0 kWh per kit
Annual Gross kW Savings	133.4 kW
Net-to-Gross Ratio	1.13
Process Evaluation	Yes
Previous Evaluation(s)	Yes

Evaluation Methodology

Impact Evaluation Activities

- *167 telephone/web surveys and analysis of 8 unique measures.*

Impact Evaluation Findings

- *Realization rate = 37% for energy impacts; 15% for demand impacts*
- *Net-to-gross ratio = 1.13*

Process Evaluation Activities

- *167 telephone/web surveys with student families and analysis of 8 unique measures.*
- *19 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 and parents aware of DEO sponsorship of the kits*
- *Parents largely learning abut BEO kits from materials from their children.*
- *Student families are highly satisfied with kit items.*
- *The NTC program is successfully influencing families to adopt energy saving behaviors.*

Appendix B Measure Impact Results

Table B-1: Program Year 2017-2018 per Unit Verified Impacts by Measure – Key Measure Parameters

Measure Category	Gross Energy Savings (kWh)	Gross Demand (kW)	Realization Rate (Energy)	Free Ridership	Spillover	Net to Gross Ratio	M&V Factor (Energy) (RR x NTG)	Measure Life
9 Watt LEDs*	50.9	0.006	N/A	.25			N/A	5
Nightlight	11.5	0.000	N/A	0.13			N/A	8
1.5 GPM Showerhead	63.9	0.010	N/A	.12			N/A	10
1.0 GPM Bathroom Faucet Aerator	7.3	0.001	N/A	0.09			N/A	9
1.5 GPM Kitchen Faucet Aerator	22.5	0.001	N/A	0.08			N/A	9
Water Temperature Gauge Card	12.9	0.002	N/A	0.13			N/A	4
Outlet Insulating Gaskets	4.5	0.001	N/A	0.10			N/A	15
Behavioral Changes	11.5	0.001	N/A	-	-	-	N/A	0.3
Total	**185.0**	**0.021**	**37.1%**	**0.15**	**0.28**	**1.13**	**42.0%**	**-**

*Represents two 9 watt LEDs

Table B-2: SB 310 Compliance Gross Savings per Measure

Program	Claimed Gross Savings (kWh)	Claimed Gross Savings (kW - summer)	Claimed Gross Savings (kW - winter)	Source
Energy Efficiency Education School Kit	499.0	0.134	0.132	DEO program reported savings

Appendix C Senate Bill 310 Legislation on Energy Efficiency Accounting

130th General Assembly Senate Bill Number 310

Sec. 4928.662. For the purpose of measuring and determining compliance with the energy efficiency and peak demand reduction requirements under section 4928.66 of the Revised Code, the public utilities commission shall count and recognize compliance as follows:

(A) Energy efficiency savings and peak demand reduction achieved through actions taken by customers or through electric distribution utility programs that comply with federal standards for either or both energy efficiency and peak demand reduction requirements, including resources associated with such savings or reduction that are recognized as capacity resources by the regional transmission organization operating in Ohio in compliance with section 4928.12 of the Revised Code, shall count toward compliance with the energy efficiency and peak demand reduction requirements.

(B) Energy efficiency savings and peak demand reduction achieved on and after the effective date of S.B. 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method. For new construction, the energy efficiency savings and peak demand reduction shall be counted based on 2008 federal standards, provided that when new construction replaces an existing facility, the difference in energy consumed, energy intensity, and peak demand between the new and replaced facility shall be counted toward meeting the energy efficiency and peak demand reduction requirements.

(C) The commission shall count both the energy efficiency savings and peak demand reduction on an annualized basis.

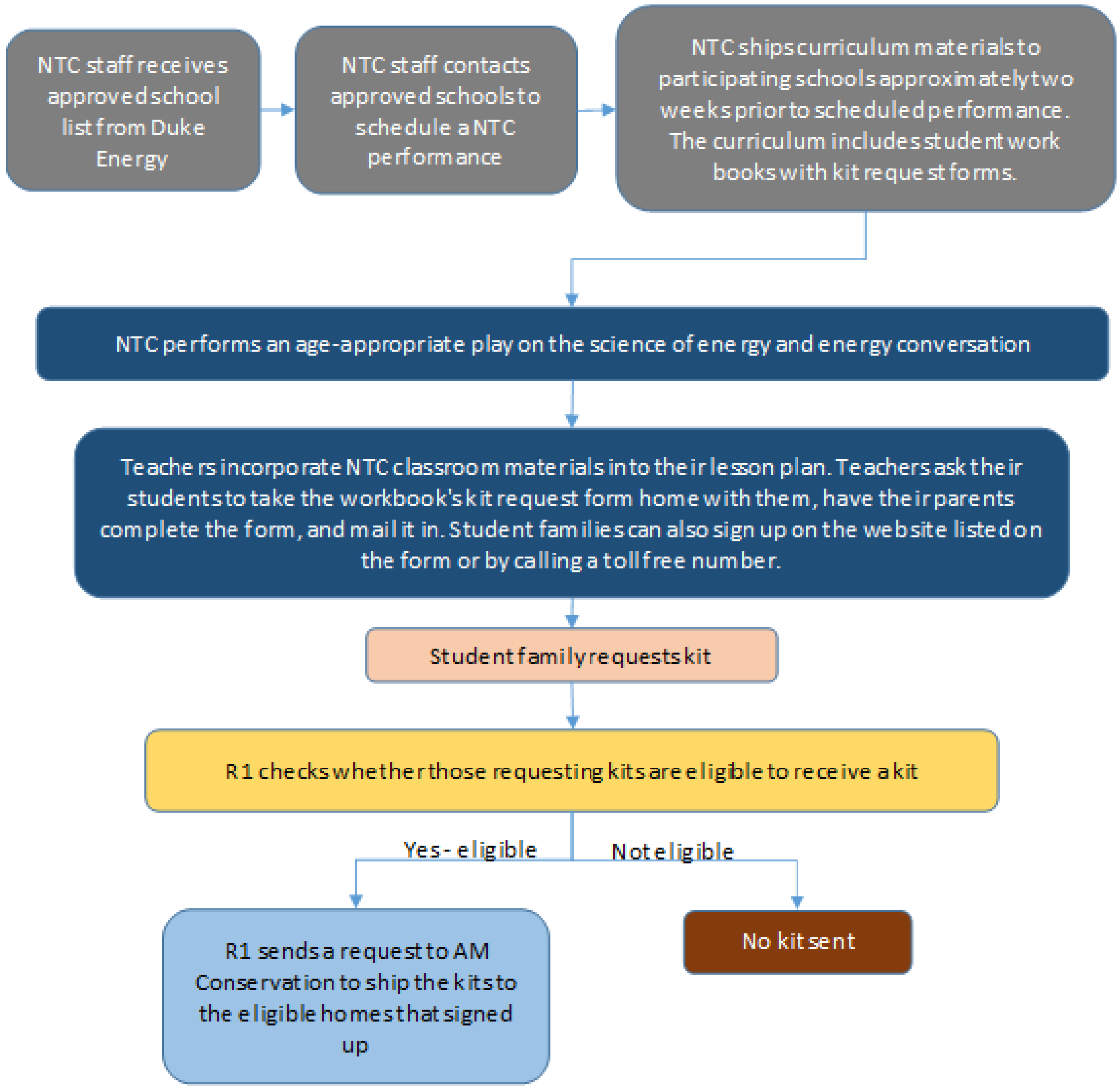
(D) The commission shall count both the energy efficiency savings and peak demand reduction on a gross savings basis.

(E) The commission shall count energy efficiency savings and peak demand reductions associated with transmission and distribution infrastructure improvements that reduce line losses. No energy efficiency or peak demand reduction achieved under division (E) of this section shall qualify for shared savings.

(F) Energy efficiency savings and peak demand reduction amounts approved by the commission shall continue to be counted toward achieving the energy efficiency and peak demand reduction requirements as long as the requirements remain in effect.

(G) Any energy efficiency savings or peak demand reduction amount achieved in excess of the requirements may, at the discretion of the electric distribution utility, be banked and applied toward achieving the energy efficiency or peak demand reduction requirements in future years.

Appendix D Program Process Flow Chart



Appendix E Program Performance Metrics

This appendix provides key program performance metrics, or PPIs. See Section 5.2 for the underlying results and more detailed findings.

Figure E-1: Program Experience PPIs

	Student Families		Teachers	
Awareness PPIs	%	n	%	n
Aware of DEO sponsorship	90%	167	84%	19
Learned of DEO sponsorship via program collateral	70%	167	44%	16
Learned of DEO sponsorship via teachers	19%	167	56%	16
Read Energy Saver Booklet	68%	167	-	
Rated Energy Saver Booklet as highly informative	81%	113	-	
Satisfaction PPIs				
NTC performance	-		89%	19
Usefulness of classroom materials	-		22%	9
Overall satisfaction with classroom materials	-		56%	9
Bathroom faucet aerator	92%	49	-	
Insulator gaskets	94%	62	-	
Night light	96%	139	-	
Light bulbs	97%	148	-	
Showerhead	84%	70	-	
Kitchen faucet aerator	90%	48	-	
Program influence on behavior PPIs				
Installed at least one kit measure	96%	167	-	
Plan to install measure[s] (of those that did not install any measures)	14%	7	-	
Respondents reporting spillover	18%	167	-	
Adopted new energy saving behaviors: parents	50%	167	-	
Adopted new energy saving behaviors: children	57%	167	-	
Challenges and opportunities for improvement PPIs				
Used NTC materials in classroom	-		47%	19
Suggested improvements to NTC performance	-		32%	19
Distributed kit forms to classroom	-		100%	19
Mentioned challenges/concerns with instructional materials	-		26%	19
Suggested curriculum improvements	-		21%	19

***Program collateral includes NTC materials and DEO marketing materials**

Figure E-2: Student Family Demographics Reach PPIs

Housing Type

Detached	78%
Attached	19%
Mobile	3%

Ownership Status

Own	75%
Rent	25%

Household Size

One to two	11%
Three	25%
Four	32%
Five+	31%

Education

High school or less	16%
Some college	26%
Bachelors Degree	35%
Graduate Degree	21%
Refused / Don't know	3%

Income

< $30k	11%
$30k to < $60k	26%
$60k to < $75k	11%
$75k to < $100k	14%
$100k+	20%
Refused / Don't know	19%

Appendix F Billing Regression Analysis

This appendix provides additional detail regarding the billing regression analysis. Absent a randomized control trial, billing analysis can be unreliable when the percent energy savings are small. In order to assess if the billing analysis produces reliable results, the evaluation team implemented a series of placebo pressure tests. Rather than produce zero impacts, the billing analysis incorrectly concluded that the fake transitions led to changes in energy use when in fact no intervention had taken place. Moreover, the models incorrectly concluded that the erroneous impacts were statistically significant in several instances – an example of false precision. The evaluation team's conclusion is not that there were no energy savings generated by the NTC program, but rather that billing analysis was not the correct tool for estimating the small percent energy savings from the program. Thus, the evaluation team's recommendation is to rely on the engineering analysis and findings as the source of our verified gross and net savings for the programs.

The appendix includes:

1. A side by comparison of energy use, MyHER program penetration, and share of participants enrolling for the NTC kits over time for participants, and the comparison group. This includes both the pre- and post-intervention data and does not include any energy modeling.

2. Visual comparison of the side-by-side comparisons

3. The placebo tests output for the difference-in-differences panel regression model

4. The placebo tests output for the pre-post panel regression model

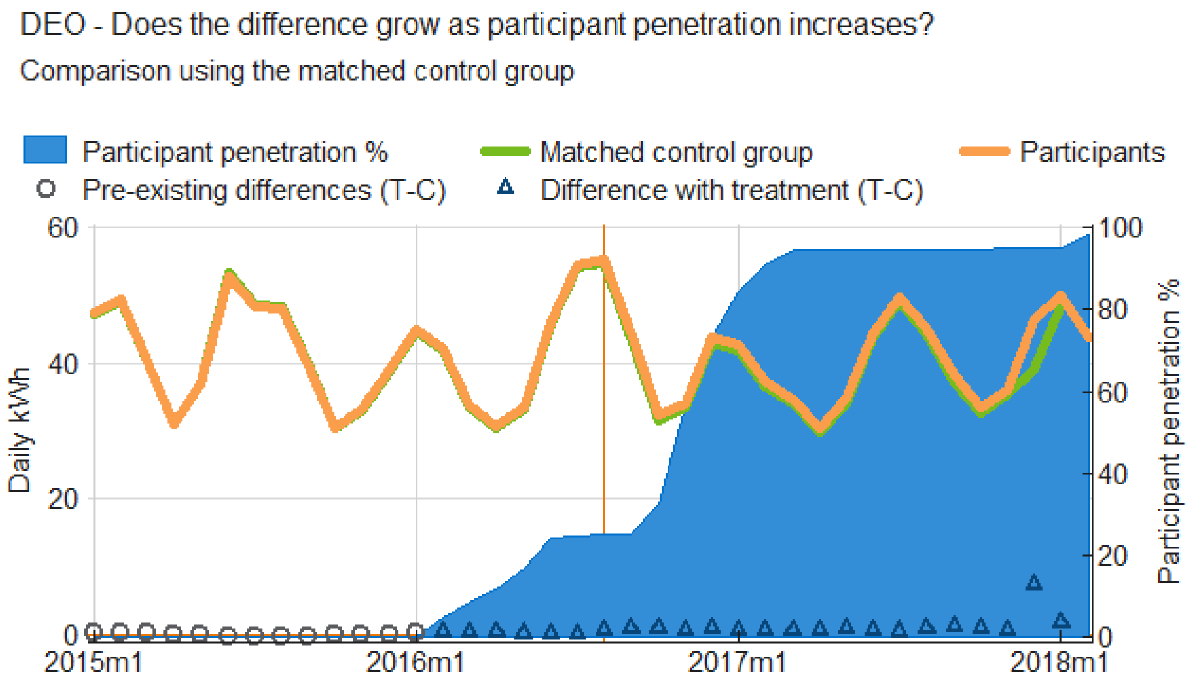
Table E-1: Side-by-side Comparison of Control and Treatment Groups

Year and month	Daily kWh		Diff	% Diff	Kit Penetration %)	
	Control	Treated			Treat	Control
Aug-15	47.2	47.4	0.15	0.32%	0.0%	0.0%
Sep-15	49.2	49.5	0.30	0.61%	0.0%	0.0%
Oct-15	40.1	40.2	0.16	0.39%	0.0%	0.0%
Nov-15	30.9	30.9	-0.05	-0.16%	0.0%	0.0%
Dec-15	36.9	36.8	-0.14	-0.39%	0.0%	0.0%
Jan-16	53.2	52.8	-0.39	-0.74%	0.0%	0.0%
Feb-16	48.6	48.3	-0.31	-0.65%	0.0%	0.0%
Mar-16	48.2	48.0	-0.25	-0.52%	0.0%	0.0%
Apr-16	39.8	39.6	-0.24	-0.59%	0.0%	0.0%
May-16	30.4	30.4	0.01	0.02%	0.0%	0.0%
Jun-16	33.0	33.1	0.12	0.37%	0.0%	0.0%
Jul-16	38.9	39.0	0.10	0.25%	0.0%	0.0%
Aug-16	44.7	45.0	0.26	0.58%	0.0%	0.0%
Sep-16	41.9	42.3	0.41	0.98%	0.0%	4.8%
Oct-16	33.5	33.8	0.25	0.76%	0.0%	8.5%
Nov-16	30.3	30.6	0.26	0.85%	0.0%	11.6%
Dec-16	33.2	33.4	0.22	0.68%	0.0%	17.0%
Jan-17	45.9	46.0	0.07	0.16%	0.0%	24.2%
Feb-17	54.3	54.4	0.14	0.26%	0.0%	24.8%
Mar-17	54.7	55.3	0.58	1.06%	0.0%	25.1%
Apr-17	43.8	44.8	0.95	2.18%	0.0%	25.2%
May-17	31.6	32.4	0.86	2.72%	0.0%	32.7%
Jun-17	33.4	34.1	0.66	1.99%	0.0%	56.6%
Jul-17	42.9	43.8	0.86	2.00%	0.0%	73.2%

* *Only includes customers with pre-treatment data from Aug 2015 to July 2016

*Billing periods were calendarized (calendar month)

Figure E-1: Visual Comparison of Control and Treatment Groups



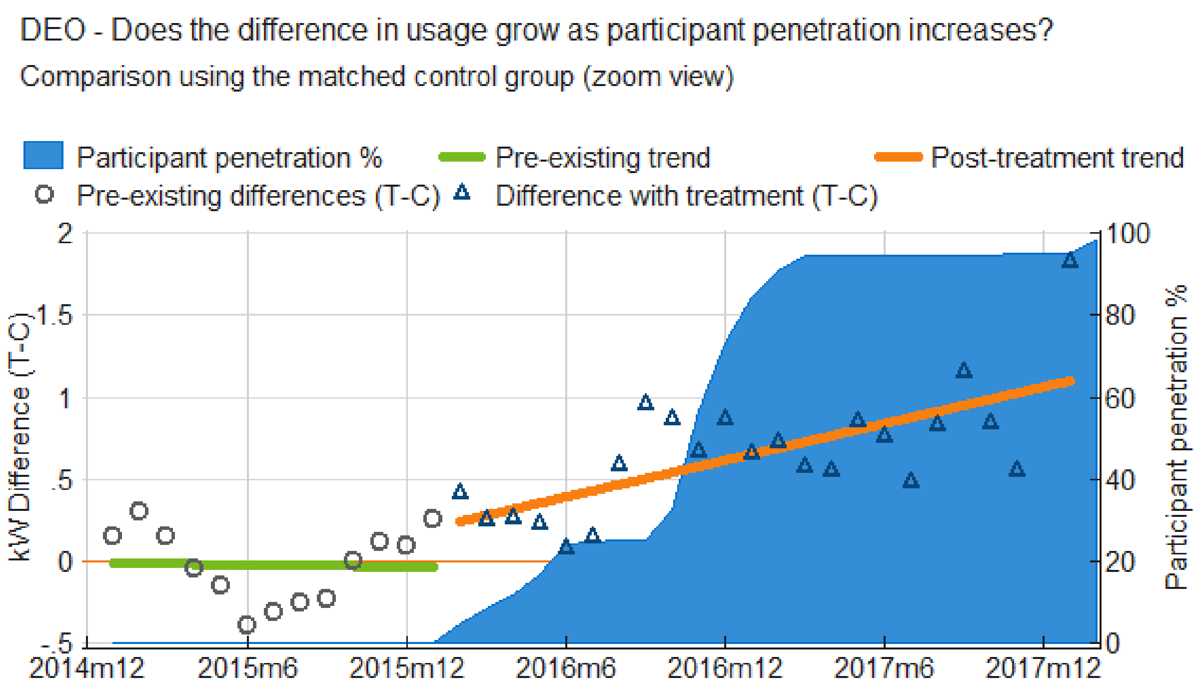


Figure E-2: Difference-in-Differences Panel Regression Model Placebo Test Results – 3 Months Prior

Linear regression, absorbing indicators

Number of obs	=	208654
F(25, 196663)	=	3073.94
Prob > F	=	0.0000
R-squared	=	0.7658
Adj R-squared	=	0.7516
Root MSE	=	12.8915

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo3_post	-.364102	.1825384	-1.99	0.046	-.7218729	-.0063312
pseudo3_partxpost	.5530396	.1840277	3.01	0.003	.1923496	.9137296
daily_cdd	2.831688	.2017315	14.04	0.000	2.436299	3.227077
daily_hdd	.5230988	.0544245	9.61	0.000	.4164281	.6297696
moyr						
665	11.01995	.4033729	27.32	0.000	10.22935	11.81055
666	3.59942	.5976492	6.02	0.000	2.428042	4.770798
667	5.68894	.4413343	12.89	0.000	4.823935	6.553944
668	2.016586	.1893677	10.65	0.000	1.645429	2.387742
669	2.123724	.5503516	3.86	0.000	1.045048	3.2024
670	1.007154	.3963439	2.54	0.011	.2303299	1.783979
671	4.960485	.4485865	11.06	0.000	4.081266	5.839703
672	2.292841	1.138738	2.01	0.044	.0609416	4.524739
673	2.580989	.8456628	3.05	0.002	.9235101	4.238468
674	1.584749	.4009732	3.95	0.000	.7988508	2.370646
675	-.5464753	.4031449	-1.36	0.175	-1.33663	.2436791
676	1.323135	.3311472	4.00	0.000	.6740942	1.972175
677	-.7194359	.7252278	-0.99	0.321	-2.140865	.7019932
678	.8362288	1.203508	0.69	0.487	-1.522618	3.195076
679	-1.085107	1.400051	-0.78	0.438	-3.829173	1.658959
680	4.915139	.3003677	16.36	0.000	4.326425	5.503852
681	2.541861	.4954612	5.13	0.000	1.570769	3.512953
682	.8548292	.4514336	1.89	0.058	-.0299698	1.739628
683	3.235289	.9583452	3.38	0.001	1.356955	5.113623
684	4.308369	.7801593	5.52	0.000	2.779276	5.837463
685	1.797004	.6691109	2.69	0.007	.4855622	3.108445
686	0	(omitted)				
687	0	(omitted)				
_cons	22.84999	1.002471	22.79	0.000	20.88517	24.81481
account	F(11965, 196663) =		47.310	0.000	(11966 categories)	

Figure E-3: Difference-in-Differences Panel Regression Model Placebo Test Results – 4 Months Prior

```
Linear regression, absorbing indicators         Number of obs     =    219801
                                                F(  25, 207810)   =   3495.55
                                                Prob > F          =    0.0000
                                                R-squared         =    0.7673
                                                Adj R-squared     =    0.7539
                                                Root MSE          =   12.7173
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo4_post	-.1897996	.1677591	-1.13	0.258	-.5186034	.1390041
pseudo4_partxpost	.4083771	.152556	2.68	0.007	.1093711	.707383
daily_cdd	-72.75119	25.12389	-2.90	0.004	-121.9934	-23.50899
daily_hdd	.5038717	.0347533	14.50	0.000	.4357561	.5719873
moyr						
664	329.7371	110.297	2.99	0.003	113.5577	545.9164
665	498.1714	162.6535	3.06	0.002	179.3746	816.9683
666	583.4713	193.4904	3.02	0.003	204.2348	962.7077
667	520.8867	171.9906	3.03	0.002	183.7893	857.9841
668	377.791	125.6312	3.01	0.003	131.5569	624.0252
669	1.192642	.3057062	3.90	0.000	.5934657	1.791819
670	1.071267	.4871749	2.20	0.028	.1164164	2.026118
671	.9615277	1.028301	0.94	0.350	-1.053916	2.976972
672	-1.400675	1.420617	-0.99	0.324	-4.185049	1.383699
673	-1.226014	1.260956	-0.97	0.331	-3.697457	1.245429
674	-2.487782	.9576459	-2.60	0.009	-4.364744	-.6108192
675	15.33815	5.762459	2.66	0.008	4.043877	26.63243
676	143.0275	47.70631	3.00	0.003	49.52434	236.5307
677	626.1379	209.1189	2.99	0.003	216.2701	1036.006
678	811.7208	270.2266	3.00	0.003	282.0833	1341.358
679	882.2906	294.45	3.00	0.003	305.1759	1459.405
680	431.6064	142.5516	3.03	0.002	152.2088	711.004
681	76.57855	25.24432	3.03	0.002	27.10031	126.0568
682	.2305701	.3725729	0.62	0.536	-.4996636	.9608038
683	-.6240843	1.321101	-0.47	0.637	-3.21341	1.965242
684	.3838673	1.22611	0.31	0.754	-2.019277	2.787012
685	0	(omitted)				
686	0	(omitted)				
_cons	27.24874	.8411785	32.39	0.000	25.60005	28.89743
account	F(11965, 207810) =		49.903	0.000	(11966 categories)	

Figure E-4: Difference-in-Differences Panel Regression Model Placebo Test Results – 5 Months Prior

```
Linear regression, absorbing indicators          Number of obs     =     230946
                                                 F(  26, 218954)   =    3160.94
                                                 Prob > F          =     0.0000
                                                 R-squared         =     0.7562
                                                 Adj R-squared     =     0.7428
                                                 Root MSE          =    13.1393
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo5_post	-.0446925	.165674	-0.27	0.787	-.3694093	.2800244
pseudo5_partxpost	.3207594	.1402662	2.29	0.022	.0458412	.5956776
daily_cdd	4.955672	27971.23	0.00	1.000	-54817.96	54827.87
daily_hdd	.7467779	198.3419	0.00	0.997	-387.9984	389.492
moyr						
663	2.437191	2108.663	0.00	0.999	-4130.489	4135.363
664	-6.406698	118755.8	-0.00	1.000	-232764.8	232752
665	.5631496	176690.7	0.00	1.000	-346308.8	346309.9
666	-9.268762	210837.6	-0.00	1.000	-413245.8	413227.2
667	-5.386146	186924.3	-0.00	1.000	-366372.4	366361.6
668	-5.316296	135478.1	-0.00	1.000	-265538.9	265528.3
669	3.371587	2212.281	0.00	0.999	-4332.644	4339.387
670	.6905199	527.2036	0.00	0.999	-1032.615	1033.996
671	3.876004	1274.957	0.00	0.998	-2495.007	2502.759
672	-2.344994	1875.892	-0.00	0.999	-3679.047	3674.357
673	-.7365853	705.1844	-0.00	0.999	-1382.88	1381.407
674	1.355157	2033.917	0.00	0.999	-3985.07	3987.78
675	-.671125	4723.676	-0.00	1.000	-9258.957	9257.614
676	-.7090353	49943.05	-0.00	1.000	-97887.83	97886.41
677	-15.09323	228266.4	-0.00	1.000	-447411.4	447381.3
678	-18.61098	296269.9	-0.00	1.000	-580700.2	580663
679	-22.68324	323238.8	-0.00	1.000	-633562.6	633517.2
680	-3.881654	154269.7	-0.00	1.000	-302368.6	302360.8
681	2.139517	25033.24	0.00	1.000	-49062.38	49066.65
682	-.0272612	401.0725	-0.00	1.000	-786.1192	786.0646
683	-.6404774	1034.633	-0.00	1.000	-2028.496	2027.215
684	1.479781	134.959	0.01	0.991	-263.0365	265.9961
685	0	(omitted)				
_cons	19.30146	5386.217	0.00	0.997	-10537.55	10576.15
account	F(11965, 218954) =		49.784	0.000	(11966 categories)	

Figure E-5: Difference-in-Differences Panel Regression Model Placebo Test Results – 6 Months Prior

```
Linear regression, absorbing indicators          Number of obs     =     242083
                                                 F(  26, 230091)   =    2725.41
                                                 Prob > F          =     0.0000
                                                 R-squared         =     0.7263
                                                 Adj R-squared     =     0.7121
                                                 Root MSE          =    14.4829
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo6_post	.2024143	.1764582	1.15	0.251	-.1434393	.5482678
pseudo6_partxpost	.3114801	.1419095	2.19	0.028	.0333411	.5896191
daily_cdd	.6674793	10853.93	0.00	1.000	-21272.76	21274.09
daily_hdd	.4130057	.0243837	16.94	0.000	.3652142	.4607971
moyr						
662	-1.502603	.4409545	-3.41	0.001	-2.366862	-.6383434
663	-4.089144	374.2751	-0.01	0.991	-737.6587	729.4804
664	2.832189	47975.69	0.00	1.000	-94028.29	94033.96
665	18.17614	70585.5	0.00	1.000	-138327.6	138363.9
666	13.31519	83902.83	0.00	1.000	-164434.1	164460.7
667	13.56481	74615.13	0.00	1.000	-146230.2	146257.3
668	5.986562	54591.35	0.00	1.000	-106991.7	107003.6
669	-3.708338	470.4836	-0.01	0.994	-925.8441	918.4275
670	-4.042102	594.3835	-0.01	0.995	-1169.018	1160.934
671	.2278884	.5872153	0.39	0.698	-.9230384	1.378815
672	-.6908217	.2500233	-2.76	0.006	-1.180861	-.2007824
673	-1.06015	.3638383	-2.91	0.004	-1.773264	-.3470361
674	-3.642489	.6773375	-5.38	0.000	-4.970053	-2.314925
675	-5.409818	2874.618	-0.00	0.998	-5639.587	5628.767
676	-1.044249	20957.82	-0.00	1.000	-41077.82	41075.73
677	9.975504	90655.42	0.00	1.000	-177672.3	177692.3
678	16.97913	117054.4	0.00	1.000	-229406.6	229440.5
679	16.87267	127519.3	0.00	1.000	-249917.7	249951.5
680	10.01225	61900.35	0.00	1.000	-121313.1	121333.1
681	-1.802352	11256.28	-0.00	1.000	-22063.83	22060.22
682	-4.39273	503.9341	-0.01	0.993	-992.0905	983.3051
683	-.608704	.4135694	-1.47	0.141	-1.419289	.2018814
684	0	(omitted)				
_cons	29.87049	1.070315	27.91	0.000	27.7727	31.96828
account	F(11965, 230091) =		45.031	0.000	(11966 categories)	

Figure E-6: Difference-in-Differences Panel Regression Model Placebo Test Results – 7 Months Prior

Linear regression, absorbing indicators			
	Number of obs	=	252627
	F(25, 240636)	=	2756.90
	Prob > F	=	0.0000
	R-squared	=	0.7163
	Adj R-squared	=	0.7022
	Root MSE	=	15.0038

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo7_post	.4075659	.1795465	2.27	0.023	.0556594	.7594724
pseudo7_partxpost	.3090003	.1380418	2.24	0.025	.0384419	.5795587
daily_cdd	-10.58984	22.73414	-0.47	0.641	-55.14816	33.96847
daily_hdd	.6481079	.0555768	11.66	0.000	.5391789	.757037
moyr						
661	-2.234472	.4500392	-4.97	0.000	-3.116537	-1.352407
662	.5294142	.6276187	0.84	0.399	-.7007021	1.75953
663	1.973827	.7480466	2.64	0.008	.5076749	3.439978
664	60.4079	98.58436	0.61	0.540	-132.8149	253.6307
665	99.59545	145.8519	0.68	0.495	-186.2705	385.4614
666	108.7514	173.6991	0.63	0.531	-231.6944	449.1971
667	99.34247	154.2515	0.64	0.520	-202.9864	401.6714
668	70.81104	112.3531	0.63	0.529	-149.398	291.0201
669	2.871128	.674877	4.25	0.000	1.548386	4.193869
670	1.046957	.3459166	3.03	0.002	.3689693	1.724944
671	3.77116	.974492	3.87	0.000	1.861181	5.681139
672	-.8910907	.2008297	-4.44	0.000	-1.284712	-.4974697
673	.0828076	.4443822	0.19	0.852	-.7881699	.9537851
674	.8742537	1.175819	0.74	0.457	-1.430321	3.178828
675	2.325662	4.744682	0.49	0.624	-6.973791	11.62511
676	27.31604	42.24698	0.65	0.518	-55.48695	110.119
677	112.2396	187.886	0.60	0.550	-256.0119	480.4912
678	146.5694	243.175	0.60	0.547	-330.0473	623.1861
679	157.366	265.0952	0.59	0.553	-362.2137	676.9457
680	82.28884	127.69	0.64	0.519	-167.9802	332.5579
681	16.43732	21.96126	0.75	0.454	-26.60618	59.48083
682	0	(omitted)				
683	0	(omitted)				
_cons	21.45462	2.111603	10.16	0.000	17.31594	25.59331
account	F(11965, 240636) =		44.978	0.000	(11966 categories)	

Figure E-7: Difference-in-Differences Panel Regression Model Placebo Test Results – 8 Months Prior

```
Linear regression, absorbing indicators          Number of obs     =     250133
                                                 F(  24, 238143)   =    2998.11
                                                 Prob > F          =     0.0000
                                                 R-squared         =     0.7172
                                                 Adj R-squared     =     0.7030
                                                 Root MSE          =    14.8641
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo8_post	.4893619	.1776934	2.75	0.006	.1410874	.8376364
pseudo8_partxpost	.3920758	.1321446	2.97	0.003	.1330758	.6510758
daily_cdd	6.519931	.4315263	15.11	0.000	5.674151	7.365712
daily_hdd	.6931044	.0159209	43.53	0.000	.6618999	.7243089
moyr						
661	-2.523789	.243782	-10.35	0.000	-3.001596	-2.045983
662	1.056664	.2232061	4.73	0.000	.6191861	1.494142
663	2.608276	.404775	6.44	0.000	1.814928	3.401625
664	-13.58495	1.475739	-9.21	0.000	-16.47736	-10.69254
665	-9.963437	2.342246	-4.25	0.000	-14.55418	-5.372696
666	-21.76134	2.856949	-7.62	0.000	-27.36089	-16.1618
667	-16.53434	2.491668	-6.64	0.000	-21.41794	-11.65073
668	-13.53639	1.714391	-7.90	0.000	-16.89655	-10.17623
669	3.433672	.4270985	8.04	0.000	2.59657	4.270774
670	1.104344	.3272899	3.37	0.001	.4628642	1.745823
671	4.587413	.2940534	15.60	0.000	4.011076	5.16375
672	-.8366763	.1899909	-4.40	0.000	-1.209053	-.4642992
673	.4339816	.2110714	2.06	0.040	.0202872	.847676
674	1.437186	.3185962	4.51	0.000	.8127456	2.061626
675	-1.21979	.2652283	-4.60	0.000	-1.73963	-.699949
676	-4.397521	.5036774	-8.73	0.000	-5.384716	-3.410327
677	-29.05173	3.148462	-9.23	0.000	-35.22264	-22.88083
678	-36.3163	4.193998	-8.66	0.000	-44.53642	-28.09617
679	-42.01587	4.609394	-9.12	0.000	-51.05016	-32.98158
680	-13.68498	2.018687	-6.78	0.000	-17.64155	-9.728407
681	0	(omitted)				
682	0	(omitted)				
_cons	19.70571	.572852	34.40	0.000	18.58293	20.82848
account	F(11965, 238143) =		44.450	0.000	(11966 categories)	

Figure E-8: Difference-in-Differences Panel Regression Model Placebo Test Results – 9 Months Prior

```
Linear regression, absorbing indicators           Number of obs    =    245856
                                                  F(  23, 233867)  =   3106.84
                                                  Prob > F         =    0.0000
                                                  R-squared        =    0.7168
                                                  Adj R-squared    =    0.7022
                                                  Root MSE         =   14.8680
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo9_post	.4822052	.1785756	2.70	0.007	.1322018	.8322087
pseudo9_partxpost	.4398733	.1300583	3.38	0.001	.1849624	.6947841
daily_cdd	3.448411	.0590388	58.41	0.000	3.332697	3.564126
daily_hdd	.593215	.0100019	59.31	0.000	.5736114	.6128186
moyr						
661	-1.881522	.221171	-8.51	0.000	-2.315011	-1.448033
662	-.1137988	.1908085	-0.60	0.551	-.4877785	.2601809
663	-.0039984	.2776543	-0.01	0.989	-.5481937	.5401968
664	-3.636811	.2361548	-15.40	0.000	-4.099668	-3.173953
665	6.215797	.2666842	23.31	0.000	5.693103	6.738491
666	-1.90041	.3028029	-6.28	0.000	-2.493896	-1.306924
667	.7091925	.2767203	2.56	0.010	.1668278	1.251557
668	-1.88064	.2444037	-7.69	0.000	-2.359665	-1.401616
669	.6715725	.2909093	2.31	0.021	.1013977	1.241747
670	-.9319142	.2406277	-3.87	0.000	-1.403538	-.4602902
671	2.730395	.2224011	12.28	0.000	2.294494	3.166295
672	-1.01809	.2094791	-4.86	0.000	-1.428663	-.6075161
673	-.7167673	.2001565	-3.58	0.000	-1.109069	-.3244658
674	-.8225609	.2228861	-3.69	0.000	-1.259412	-.3857099
675	-3.009781	.2254112	-13.35	0.000	-3.451581	-2.567981
676	-1.740513	.2001508	-8.70	0.000	-2.132804	-1.348223
677	-7.307266	.2943458	-24.83	0.000	-7.884177	-6.730356
678	-7.090568	.4156087	-17.06	0.000	-7.905151	-6.275986
679	-9.828041	.4673701	-21.03	0.000	-10.74407	-8.912007
680	0	(omitted)				
681	0	(omitted)				
_cons	23.59334	.3492953	67.55	0.000	22.90873	24.27795
account	F(11965, 233867) =		43.489	0.000	(11966 categories)	

Figure E-9: Pre-Post Panel Regression Model Placebo Test Results – 3 Months Prior

```
Linear regression, absorbing indicators          Number of obs   =     135639
                                                 F(  14, 126706) =    3191.04
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.7754
                                                 Adj R-squared   =     0.7596
                                                 Root MSE        =    12.9102

------------------------------------------------------------------------------
   daily_kwh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
pseudo3_post |   1.540214   .1200687    12.83   0.000     1.304882    1.775547
   daily_cdd |   1.218719    .037695    32.33   0.000     1.144838    1.292601
   daily_hdd |   .2949735   .0216897    13.60   0.000     .2524622    .3374849
             |
       month |
          2  |  -.8716785   .2332085    -3.74   0.000    -1.328763   -.4145938
          3  |  -5.055272   .4473462   -11.30   0.000    -5.932063   -4.178481
          4  |  -7.567331   .5264547   -14.37   0.000    -8.599173   -6.535489
          5  |  -3.792466   .6786095    -5.59   0.000    -5.122529   -2.462403
          6  |   7.035369   .7579337     9.28   0.000     5.549832    8.520905
          7  |   5.737896   .7769411     7.39   0.000     4.215105    7.260687
          8  |   5.961589   .7747037     7.70   0.000     4.443183    7.479995
          9  |   .7050132   .7509354     0.94   0.348    -.7668071    2.176834
         10  |  -6.060406   .6038472   -10.04   0.000    -7.243936   -4.876876
         11  |  -5.773739   .4452196   -12.97   0.000    -6.646362   -4.901116
         12  |  -.8531319   .3451835    -2.47   0.013    -1.529686   -.1765782
             |
       _cons |   33.43913    .785353    42.58   0.000     31.89985     34.9784
-------------+----------------------------------------------------------------
     account |  F(8918, 126706) =    44.020   0.000        (8919 categories)

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   daily_kwh |     16612    41.95991    24.16855  -18.23538    427.807
(44930 missing values generated)
```

Figure E-10 Pre-Post Panel Regression Model Placebo Test Results – 4 Months Prior

```
Linear regression, absorbing indicators         Number of obs     =     143272
                                                F(  14, 134339)   =    3698.04
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7765
                                                Adj R-squared     =     0.7617
                                                Root MSE          =    12.7523
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo4_post	1.402532	.1082629	12.95	0.000	1.190339	1.614725
daily_cdd	1.215016	.0390966	31.08	0.000	1.138387	1.291644
daily_hdd	.2838663	.0216716	13.10	0.000	.2413903	.3263423
month						
2	-1.074388	.2279823	-4.71	0.000	-1.521229	-.6275463
3	-5.398739	.4454213	-12.12	0.000	-6.271756	-4.525721
4	-7.349138	.5255269	-13.98	0.000	-8.379161	-6.319115
5	-4.243251	.6798944	-6.24	0.000	-5.575831	-2.91067
6	7.022881	.759304	9.25	0.000	5.534659	8.511103
7	5.147537	.7804745	6.60	0.000	3.617821	6.677252
8	5.331922	.7777817	6.86	0.000	3.807484	6.85636
9	.2330254	.7509456	0.31	0.756	-1.238814	1.704865
10	-6.549175	.6035209	-10.85	0.000	-7.732065	-5.366285
11	-6.138848	.4421052	-13.89	0.000	-7.005366	-5.27233
12	-1.284503	.3432139	-3.74	0.000	-1.957196	-.6118101
_cons	34.00202	.7828521	43.43	0.000	32.46764	35.53639
account	F(8918, 134339) =		46.496	0.000	(8919 categories)	

Variable	Obs	Mean	Std. Dev.	Min	Max
daily_kwh	24879	43.47097	24.66637	-28.45833	427.807

(53944 missing values generated)

Figure E-11: Pre-Post Panel Regression Model Placebo Test Results – 5 Months Prior

Linear regression, absorbing indicators

Number of obs	=	150842
F(14, 141904)	=	3430.34
Prob > F	=	0.0000
R-squared	=	0.7651
Adj R-squared	=	0.7503
Root MSE	=	13.2124

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo5_post	.4818791	.1035701	4.65	0.000	.2788837	.6848745
daily_cdd	1.371171	.0408559	33.56	0.000	1.291094	1.451247
daily_hdd	.4791779	.0151814	31.56	0.000	.4494226	.5089332
month						
2	-.0328181	.2152507	-0.15	0.879	-.4547052	.3890691
3	-1.085136	.2701181	-4.02	0.000	-1.614562	-.5557097
4	-3.005022	.3933556	-7.64	0.000	-3.775991	-2.234053
5	1.259465	.5199811	2.42	0.015	.2403122	2.278618
6	12.23913	.6035429	20.28	0.000	11.0562	13.42206
7	10.70778	.6376305	16.79	0.000	9.458034	11.95752
8	11.05075	.634489	17.42	0.000	9.807163	12.29434
9	6.361279	.5722979	11.12	0.000	5.239587	7.482972
10	-1.304397	.4445416	-2.93	0.003	-2.17569	-.4331043
11	-2.543413	.3395721	-7.49	0.000	-3.208968	-1.877858
12	1.399787	.2792395	5.01	0.000	.8524833	1.947091
_cons	27.21852	.5599389	48.61	0.000	26.12105	28.31599
account	F(8923, 141904) =		46.339	0.000	(8924 categories)	

Variable	Obs	Mean	Std. Dev.	Min	Max
daily_kwh	33151	43.85409	24.43376	-28.45833	427.807

(62966 missing values generated)

Figure E-12: Pre-Post Panel Regression Model Placebo Test Results – 6 Months Prior

Linear regression, absorbing indicators

Number of obs	=	158327
F(14, 149388)	=	3001.52
Prob > F	=	0.0000
R-squared	=	0.7379
Adj R-squared	=	0.7222
Root MSE	=	14.5472

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo6_post	-.0961046	.1024491	-0.94	0.348	-.2969029	.1046936
daily_cdd	1.504187	.0427584	35.18	0.000	1.420381	1.587992
daily_hdd	.4910848	.0116475	42.16	0.000	.4682559	.5139136
month						
2	.0108734	.1927049	0.06	0.955	-.3668244	.3885712
3	-1.03014	.2483462	-4.15	0.000	-1.516894	-.5433863
4	-2.691816	.3363569	-8.00	0.000	-3.351069	-2.032564
5	1.043138	.4343249	2.40	0.016	.1918702	1.894406
6	11.53982	.5298834	21.78	0.000	10.50126	12.57838
7	10.12577	.5747824	17.62	0.000	8.999211	11.25233
8	10.35456	.5713825	18.12	0.000	9.234663	11.47446
9	6.247446	.4863395	12.85	0.000	5.29423	7.200661
10	-.8895784	.3707333	-2.40	0.016	-1.616208	-.1629485
11	-2.241134	.300441	-7.46	0.000	-2.829993	-1.652276
12	1.532638	.2611807	5.87	0.000	1.020729	2.044547
_cons	26.93322	.4442978	60.62	0.000	26.06241	27.80404
account	F(8924, 149388) =		42.335	0.000	(8925 categories)	

Variable	Obs	Mean	Std. Dev.	Min	Max
daily_kwh	41410	43.33089	23.98231	-28.45833	427.807

(71986 missing values generated)

Figure E-13: Pre-Post Panel Regression Model Placebo Test Results – 7 Months Prior

```
Linear regression, absorbing indicators         Number of obs     =     165418
                                                F(  14, 156487)   =    2952.00
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7303
                                                Adj R-squared     =     0.7149
                                                Root MSE          =    15.0072

------------------------------------------------------------------------------
   daily_kwh |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
pseudo7_post |   -.523992   .0973271    -5.38   0.000    -.7147512   -.3332329
   daily_cdd |   1.598729   .0423022    37.79   0.000     1.515818     1.68164
   daily_hdd |   .5065857   .0125481    40.37   0.000     .4819917    .5311797
             |
       month |
          2  |  -.4452081   .1686337    -2.64   0.008    -.7757266   -.1146896
          3  |  -1.093248   .2538916    -4.31   0.000     -1.59087   -.5956253
          4  |  -2.720162   .3610073    -7.53   0.000    -3.427729   -2.012595
          5  |   .9324257    .462619     2.02   0.044     .0257021    1.839149
          6  |   10.90983   .5558241    19.63   0.000     9.820431    11.99924
          7  |   9.559681   .5971831    16.01   0.000     8.389214    10.73015
          8  |   9.842447   .5953778    16.53   0.000     8.675519    11.00938
          9  |   6.222691    .519448    11.98   0.000     5.204584    7.240799
         10  |  -.7091295   .4033336    -1.76   0.079    -1.499655     .081396
         11  |  -2.259418   .3184382    -7.10   0.000     -2.88355   -1.635286
         12  |   1.459696   .2713035     5.38   0.000     .9279465    1.991445
             |
       _cons |   26.80303   .4877753    54.95   0.000       25.847    27.75906
-------------+----------------------------------------------------------------
     account |   F(8916, 156487) =     42.857   0.000        (8917 categories)

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
   daily_kwh |      49332    42.39418    23.56179  -28.45833    427.807
(81006 missing values generated)
```

Figure E-14: Pre-Post Panel Regression Model Placebo Test Results – 8 Months Prior

```
Linear regression, absorbing indicators          Number of obs     =    163919
                                                 F(  14, 155000)   =   3100.25
                                                 Prob > F          =    0.0000
                                                 R-squared         =    0.7317
                                                 Adj R-squared     =    0.7163
                                                 Root MSE          =   14.8505
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo8_post	-.6087615	.0924133	-6.59	0.000	-.7898897	-.4276334
daily_cdd	1.599819	.040955	39.06	0.000	1.519548	1.68009
daily_hdd	.5033119	.0137144	36.70	0.000	.4764319	.5301919
month						
2	-.3369625	.1741995	-1.93	0.053	-.67839	.0044649
3	-1.049345	.2675151	-3.92	0.000	-1.573669	-.525021
4	-2.719433	.3839339	-7.08	0.000	-3.471936	-1.966931
5	.9196668	.4967708	1.85	0.064	-.0539937	1.893327
6	10.72466	.5954728	18.01	0.000	9.557547	11.89178
7	9.516952	.6359441	14.97	0.000	8.270515	10.76339
8	9.921583	.6344544	15.64	0.000	8.678066	11.1651
9	6.127684	.5602337	10.94	0.000	5.029637	7.22573
10	-.8349257	.428615	-1.95	0.051	-1.675002	.0051509
11	-2.284089	.3347461	-6.82	0.000	-2.940185	-1.627994
12	1.558764	.3055861	5.10	0.000	.9598214	2.157706
_cons	26.91763	.5323305	50.57	0.000	25.87427	27.96098
account	F(8904, 155000) =		42.605	0.000		(8905 categories)

Variable	Obs	Mean	Std. Dev.	Min	Max
daily_kwh	56664	41.65852	23.33438	-28.45833	427.807

(90024 missing values generated)

Figure E-15 Pre-Post Panel Regression Model Placebo Test Results – 9 Months Prior

```
Linear regression, absorbing indicators         Number of obs     =    161441
                                                F(  14, 152539)   =   3085.46
                                                Prob > F          =    0.0000
                                                R-squared         =    0.7316
                                                Adj R-squared     =    0.7159
                                                Root MSE          =   14.8262
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo9_post	-.7105876	.0920485	-7.72	0.000	-.8910008	-.5301744
daily_cdd	1.603265	.0402729	39.81	0.000	1.524331	1.682199
daily_hdd	.4824339	.0137874	34.99	0.000	.4554109	.5094568
month						
2	-.4147939	.1761569	-2.35	0.019	-.7600578	-.06953
3	-1.544152	.2710335	-5.70	0.000	-2.075372	-1.012932
4	-3.438316	.3847635	-8.94	0.000	-4.192444	-2.684187
5	.0291392	.5027738	0.06	0.954	-.9562871	1.014566
6	9.626371	.6072433	15.85	0.000	8.436186	10.81656
7	8.697344	.6492733	13.40	0.000	7.424781	9.969906
8	8.83377	.6471849	13.65	0.000	7.565301	10.10224
9	5.07653	.5689984	8.92	0.000	3.961305	6.191755
10	-1.607557	.4312814	-3.73	0.000	-2.452859	-.7622539
11	-3.074835	.3528942	-8.71	0.000	-3.766501	-2.38317
12	.8830741	.3130888	2.82	0.005	.2694263	1.496722
_cons	27.94885	.5403435	51.72	0.000	26.88979	29.00791
account	F(8887, 152539) =		41.948	0.000	(8888 categories)	

Variable	Obs	Mean	Std. Dev.	Min	Max
daily_kwh	63009	41.59886	23.67356	-28.45833	427.807

Appendix G Instruments

G.1 Program Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program from Duke Energy Ohio. We would like to learn about your experiences in administering this/these program(s) in the 2017-2018 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, 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.

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 & Responsibilities

Q1. Please describe your position at NTC and your role in the Duke Energy Energy Efficiency Education Program.

Q2. How long have you been in this role?

Program Delivery

Q3. Next, I'd like to learn more about how this program was delivered in 2017-2018 school year. Last time we spoke with program staff we got a good understanding of the program delivery model. Have there been any changes in program delivery since the 2015-2016 school year?

[*IF NEEDED*:]

1. Did you adjust your marketing and outreach strategy since the 2015-2016 school year? If so, how?
2. In 2017-2018, was the program for elementary the same as the prior school year (Space Station Conservation)? Has the curriculum or performance changed at all? If so, was any of that at the direction of Duke program staff?
3. What was the program for middle schools last school year? I know in 2015-2016 it was "Conservation Crew" but I don't see that on the NTC website currently.
4. Do you have a copy of the 2017-2018 student and teacher materials you could send me?
5. Are new programs being implemented for the 2017-2018 school year? I see Kilowatt Kitchen and The E-Team on the NTC Playworks website.
6. When was the NTC Playworks website added to the program? What is its purpose? How has the changed the program delivery, goals, or success?
7. From the teacher and student family perspective, has the student family kit

request process changed at all?

Wrap Up

Q4. The last evaluation revealed that the program curriculum may be targeting too wide of an age range to effectively teach all elementary grades. Also, some middle school teachers said the middle school content was too juvenile. However, this did not seem to affect kit distribution. How important is fine-tuning the educational component to NTC? Is that a priority?

Q5. What would you say are the greatest strengths of this program?

Q6. What would you say is the biggest challenge in administering this program?

Q7. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q8. What would you like to learn from the program evaluation?

Those are all of my questions. Thank you very much for your time.

G.2 Teacher Survey

Introduction to Survey (Once Survey is Opened)

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) of students do you teach? *Please select all that apply.*

[MULTIPLE RESPONSE]

1. Pre-K
2. Kindergarten
3. Grade 1
4. Grade 2
5. Grade 3
6. Grade 4
7. Grade 5
8. Grade 6
9. Grade 7
10. Grade 8
11. Grades 9-12
12. Other, please specify: [OPEN-ENDED RESPONSE]

[TERMINATE IF Kindergarten to Grade 8 (options 2-10) aren't selected]

[IF Q1=Kindergarten to Grade 5 AND Q1<> Grade 6 to Grade 8]

Q2. Are you a home room teacher?

[SINGLE RESPONSE]

1. Yes
2. No [→ TERMINATE]

[IF Q1=Grade 6 to Grade 8]

Q3. What subjects do you teach? *Please select all that apply*.

[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 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]

Performance Seen

[IF Performance_Name=Kilowatt Kitchen]

Q5. Did you see The National Theatre for Children performance for elementary school students called *Kilowatt Kitchen* on [PERFORMANCE_DATE]?

1. Yes [SKIP TO Q7]
2. No [→ TERMINATE]
98. Don't know/ Can't recall [→ TERMINATE]

[IF Performance_Name= The E-Team]

Q6. Did you see the National Theatre for Children performance for middle school students called *The E-Team* on [PERFORMANCE_DATE]?

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's Sponsorship

Q7. Before today, were you aware that Duke Energy sponsored the National Theatre for Children performance(s) in your school?

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

[IF Q7 = 1 (YES)]

Q8. 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

Program Experience and Satisfaction

The next few questions are about the performance(s) that National Theatre for Children presented at your school.

Q9. Thinking about how the school performance explained the energy-related concepts, would you say that, on the whole, the explanation was:

[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 Q9 = 1 OR 2]
Q10. What about the performance was too advanced for most of your students?

1. [OPEN ENDED]

Q11. Were there any concepts that the performance(s) did not cover that *should have been* covered?

1. Yes
2. No [SKIP TO Q13]
98. Don't know [SKIP TO Q13]

[IF Q11 = 1 (YES)]
Q12. What concepts were not covered that *should have been* covered?

1. [OPEN ENDED]

Q13. 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) – SHOULD LOOK SOMETHING LIKE THIS:

1. 1 – Not at all satisfied
2. 2

3. 3
4. 4
5. 5 – Completely satisfied
98. Don't know]

The next few questions are about the curriculum or instructional materials that you may have received from the National Theatre for Children around the time of the performance.

Q14. Did you receive curriculum or instructional materials, such as student workbooks, related to energy and energy conservation from National Theatre for Children in the 2017-2018 school year?

1. Yes
2. No [SKIP TO Q24]
98. Don't know [SKIP TO Q24]

[IF Q14 = 1 (YES)]
Q15. 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 Q23]
2. A little
3. Moderately
4. A lot
5. Extensively
98. Don't know [SKIP TO Q24]

[IF Q15 = 2 (A LITTLE)]
Q15a. Why did you only use the workbooks "a little" in teaching your students about energy?

1. [OPEN ENDED]

Q15b. Did you incorporate the National Theatre for Children's online component into your curriculum in the 2015-2016 school year? This is the official website that accompanies the performance and classroom curriculum; it has interactive games that reinforce the concepts taught in the performance and printed curriculum.

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

[IF Q15B= 1 (YES)]
Q15c. How satisfied are you with that online component?

[SINGLE RESPONSE]

1. 1 – Not at all satisfied

2. 2
3. 3
4. 4
5. 5 – Completely satisfied
98. Don't know

[IF Q15 = 2 THROUGH 5]

Q16. Thinking about how the student workbooks explained energy-related concepts, would you say that the material was generally:

[SINGLE RESPONSE; READ EXCEPT OTHER, DK, AND REFUSED OPTIONS]

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 / I'd rather not say

[IF Q15 = 2, 3, 4, OR 5]

Q17. 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; LABEL ONLY END POINTS, 1 AND 5]

[IF Q15 = 2, 3, 4, OR 5]

Q17a. 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 / I'd rather not say

[IF Q15 = 2, 3, 4, OR 5]

Q18. Were there any concepts covered in the curriculum or instructional materials that your students had particular challenges with?

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

99. Refused / I'd rather not say

[IF Q18 = 1 (YES)]
Q19. What concepts did your students have particular challenges with?

1. [OPEN ENDED]

[IF Q15 = 2, 3, 4, OR 5]
Q20. Were there any concepts that the materials did not cover that *should have been* covered?

1. Yes
2. No
98. Don't know
99. Refused / I'd rather not say

[IF Q20 = 1 (YES)]
Q21. What concepts were not covered that *should have been* covered?

1. [OPEN ENDED]

[IF Q15 = 2 THROUGH 5]
Q22. 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)]

[IF Q15 = 1 (NOT AT ALL)]
Q23. Why did you *not* use the curriculum or instructional materials in teaching your students about energy?

1. [OPEN ENDED]

Interactions with NTC Staff

Q24. 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 Q27]
98. Don't know [SKIP TO Q27]

[IF Q24 = 1 (YES)]
Q25. What did those interactions address?

1. [OPEN ENDED]

[IF Q24 = 1 (YES)]
Q26. 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 DK; LABEL ONLY THE END POINTS (1 AND 5)]

Encouragement of Students to Complete Survey, Receive Kit

In addition to the student workbooks provided by the National Theatre for Children there are materials directed at parents that instruct them on how to request a free energy saving kit from Duke Energy. The kit contains energy efficient light bulbs, low flow showerheads, and other items that students and their parents can install in their home to save energy.

Q27. Did you distribute the kit request materials to either your students or directly to their parents?

1. Yes
2. No
98. Don't recall

Q28. Were there any other ways in which you personally promoted the kits to your students and their families? If so, what were they? [*Select all that apply*]

1. Pinned up MyEnergyKit.org poster
2. Vocally encouraged students to sign up for a kit
3. Used my classroom web portal to encourage families to sign up for a kit
4. Emailed parents to encourage them to sign up for a kit
5. Spoke with parents in person to encourage them to sign up for a kit
6. Other (please specify)
7. No other actions taken [*EXCLUSIVE RESPONSE*]
98. Don't recall [*EXCLUSIVE RESPONSE*]

[IF Q27 = 1 (YES) OR Q28=1-6]

Q29. Did you follow up with students or parents later to find out if their household requested a kit?

1. Yes
2. No [SKIP TO Q32]
98. Don't know [SKIP TO Q32]

[IF Q29 = 1 (YES)]

Q30. In your best estimate, what percentage of your student households ordered the Duke Energy 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

[IF Q27 = 2 (NO)]
Q31. Why haven't you distributed the kit request materials to your students or their parents?

1. [OPEN-ENDED]

Challenges and Opportunities for Improvement

Q32. What suggestions do you have to improve the National Theatre for Children performance(s)?

1. [OPEN ENDED]

[IF Q14 = 1 (YES)]
Q33. What suggestions do you have to improve the classroom materials received from the National Theatre for Children?

1. [OPEN ENDED]

[ASK ALL]
Q34. In addition to this survey, we will be conducting 15-minute-long telephone interviews with five teachers, where we will ask them additional questions about their experience with the National Theatre for Children program. Interview participants will be compensated for their time. If selected, would you be willing to participate in a follow-up telephone interview about your experience with the program?

[SINGLE RESPONSE]

1. Yes, I am willing to be interviewed
2. No, I am not willing to be interviewed

That was the last question. Thank you for your time!

G.3 Teacher Interview Guide

Teacher Background

Q1. First, can you tell me what grade and subjects you teach?

NTC Performance

The next few questions are about the performance that National Theatre for Children (or NTC) gave at your school.

Q2. What topics were covered in the performance?

Q3. Do you think any of the topics could have been better emphasized or explained? If so, which ones and why?

Q4. Should any topics be removed from the performance? If so, which ones and why?

Q5. [IF ELEMENTARY SCHOOL TEACHER] What about age appropriateness – was the content appropriate for all ages, from kindergarten through grade-5? If not, what was not age appropriate? How could that be improved?

[IF MIDDLE SCHOOL TEACHER] What about age appropriateness – was the content appropriate for all ages from grade 6 through grade 8? If not, what was not age appropriate? How could that be improved?

Q6. Did the performance keep your students' attention? If not, how could the content be improved to keep the students entertained and attentive?

Q7. What did you like the most about the performance?

Q8. What did you dislike the most?

Q9. 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?

Q10. 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 or the kit forms?

- [If yes] What did they say? Did they hand out kit request forms during the performance?

Q11. How many NTC performances have you seen in your school? When did you see that/these performance(s)? [If they saw multiple NTC performances:] How did the latest performance compare to the prior performance(s)?

Materials/classroom [Ask All]

Q12. 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?

- [If no:] Why not?
- [If yes:] How does the workbook distribution work? Do the students get the workbook at the assembly? Or do they get them in a class?

- [If distributed workbooks:] How did you use the workbooks in your classroom?

Q13. Did you get any teacher-facing instructional material from NTC? [If yes] 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?

Q14. 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]

Q15. 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 (grades K-5/ 6-8?) How effective is it in teaching kids about energy concepts?
- [IF MIDDLE SCHOOL TEACHER AND NOT MENTIONED] What did you think of the comic book for teaching students about energy and energy conservation behaviors? How effective was it? Was it age appropriate? [IF NOT AGE APPROPRIATE] How was it not age appropriate?

Q16. Did anyone or any of the materials you received emphasize the value of the kits to you? If so, what did they say?

Q17. 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?

Q18. What, if anything, did you say or do to encourage your students to take the kit form and have their parents fill it out?

Q19. 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.?)

Suggestions for Improvement [Ask All]

Q20. What suggestions do you have to improve the National Theatre for Children performance(s)?

Q21. What suggestions do you have to improve the classroom materials received from the National Theatre for Children?

Q22. What suggestions do you have to improve the distribution of the kit forms to students?

G.4 Student Parent Survey

Introduction/ Screening

Q1. [PHONE SURVEY] Hi, I'm ______, calling on behalf of Duke Energy. We are calling about an energy efficiency educational program that Duke Energy sponsored in your child's school. In addition to sponsoring classroom activities, Duke Energy sent a kit containing energy saving items to your home.

This kit included lightbulbs, a showerhead, and other items that help you save energy in your home. Do you recall receiving this kit?

1. Yes
2. No [If no: Can I speak with someone who may know something about this kit?]
98. Don't know [If DK: Can I speak with someone who may know something about this kit?]
99. Refused [TERMINATE]

Q1. [WEB SURVEY] We are conducting surveys about an energy efficiency educational program that Duke Energy sponsored in your child's school. In addition to sponsoring classroom activities, Duke Energy sent a kit containing energy saving items to your home.

This kit included lightbulbs, a showerhead, and other items that help you save energy in your home. Do you recall receiving this kit?

1. Yes
2. No [TERMINATE]

Q1_phone. [IF Q1=1 AND VERSION=PHONE]. Do you have a few minutes to answer some questions about the kit, even if you never opened it?

1. Yes
2. No [TERMINATE]

[INTERVIEWER INSTRUCTIONS: *If no adults are able to speak about the kit, thank and terminate.*]

Q1a. Do you work at a school that teaches elementary or middle school grades?

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
3. Information material included in/on the kit
4. Other (specify:___________)
98. Don't know
99. Refused

Q3a. 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

Q4. Did you read the information about how to save energy in the booklet that came in the kit?

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF Q4 = 1]
Q5. On a scale from 0 to 10 where 0 is not at all helpful and 10 is very helpful, how helpful was the information in the kit 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 IF Q4<7]
Q6. What might have made the information more helpful?

Q7. 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?

[*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 Q7=1]
Q9. Where did you hear about this program?
[MULTIPLE RESPONSE]

1. From my child/children
2. From a teacher
3. On Duke Energy website
4. Other, please specify: [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 NEEDED*: The bathroom and kitchen faucet aerators are small metal pieces that you can screw in to 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?

[*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 [-> Q21]

98. Don't know [-> TERMINATE]
99. Refused [-> TERMINATE]

[ASK IF Q10 = 1]
Q12. Which of the items did you install, even if they were taken out later?

[*Interviewer: Record each response, then prompt with the list items*.]

Item	Response
a. Showerhead	1. Yes 2. No 98. DK 99. REF
b. Kitchen faucet aerator	1. Yes 2. No 98. DK 99. REF
c. Bathroom faucet aerator	1. Yes 2. No 98. DK 99. REF
d. Night light	1. Yes 2. No 98. DK 99. REF
e. Energy efficient light bulb(s) (LEDs)	1. Yes 2. No 98. DK 99. REF
f. Insulator gaskets for light switches and electricity outlets	1. Yes 2. No 98. DK 99. REF

[ASK IF Q12E (ENERGY EFFICIENT LIGHT BULB(S)) = 1 (YES)]
Q13. In addition to the night light, there were two LED light bulbs in the kit. Did you install one or both of the LED light bulbs in the kit?

[SINGLE RESPONSE]

1. Yes – I installed both LEDs
2. No – I installed only one LED light bulb
98. Don't know
99. Refused

[ASK IF Q12f = 1]
Q15. How many of the light switch gasket insulators from the kit did you [*if needed: or anyone else*] install in your home?

[SINGLE RESPONSE]

1. None
2. One
3. Two
4. Three
5. Four
98. Don't know
99. Refused

[ASK IF Q12f = 1]
Q16. How many electrical outlet gasket insulators from the kit did you [*if needed: or anyone 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
98. Don't know
99. Refused

[ASK IF ANY PART OF Q12 = 1]
Q17. Overall, how satisfied are you with the item[s] you installed? Please use 0 to 10 scale, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...

DISPLAY IF	Item	Rating
Q12a = 1	a. Showerhead	0-10 with DK, REF
Q12b = 1	b. Kitchen faucet aerator	0-10 with DK, REF
Q12c = 1	c. Bathroom faucet aerator	0-10 with DK, REF
Q12d = 1	d. Night light	0-10 with DK, REF
Q12e = 1	e. Energy efficient lightbulbs (LEDs)	0-10 with DK, REF
Q12f = 1	f. Insulator gaskets	0-10 with DK, REF

[ASK IF ANY ITEMS IN Q17<7]
Q17a. Can you please explain any dissatisfaction you had with [DISPLAY ALL ITEMS IN Q17 THAT ARE <7]?

[OPEN END: RECORD VERBATIM]
[ASK IF ANY PART OF Q12 = 1]
Q18. 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 Q18 = 1]
Q19. Which of the items did you uninstall?

[*Interviewer: Record the response, then prompt with the list items*.]

[MULTIPLE RESPONSE]

1. [DISPLAY IF Q12a = 1] Showerhead

2. [DISPLAY IF Q12b = 1] Kitchen faucet aerator
3. [DISPLAY IF Q12c = 1] Bathroom faucet aerator
4. [DISPLAY IF Q12d = 1] Night light
5. [DISPLAY IF Q12e = 1] Energy efficient light bulbs (LEDs)
6. [DISPLAY IF Q12f = 1] Insulator gaskets
98. Don't know
99. Refused

[ASK IF Q19 1-6 OPTIONS WERE SELECTED]
Q20. Why were those items uninstalled? Let's start with…

[*Interviewer: Read each item*]

[MULTIPLE RESPONSE]

DISPLAY ONLY THOSE 1-6 ITEMS THAT WERE SELECTED IN Q19	Item	Reason
	a. Showerhead	1. It was broken 2. I didn't like how it worked 3. I didn't like how it looked 96. Other: (specify) 98. DK 99. REF
	b. Kitchen faucet aerator	Repeat reason options
	c. Bathroom faucet aerator	Repeat reason options
	d. Night light	Repeat reason options
	e. Energy efficient light bulbs (LEDs)	Repeat reason options
	f. Insulator gaskets	Repeat reason options

[ASK IF ANY PART OF Q12 = 2 OR Q10 = 2]
Q21. You said you haven't installed [INPUT ONLY THOSE ITEMS IN Q12 IF Q12a-f = 2]. Which of those items do you plan to install in the next three months?

[*Interviewer: Record the response, then prompt with the list items*.]

[MULTIPLE RESPONSE] [DISPLAY ALL IF Q10 = 2]

1. [DISPLAY IF Q12a = 2] Showerhead
2. [DISPLAY IF Q12b = 2] Kitchen faucet aerator
3. [DISPLAY IF Q12c = 2] Bathroom faucet aerator
4. [DISPLAY IF Q12d = 2] Night light
5. [DISPLAY IF Q12e = 2] Energy efficient light bulbs (LEDs)
6. [DISPLAY IF Q12f = 2] Insulator gaskets
98. None
99. Refused

[ASK IF ANY 1-6 OPTIONS WERE NOT SELECTED IN Q21 OR OPTION "NONE" WAS SELECTED]

Q22. What's preventing you from installing those items? Let's start with….

[*Interviewer: Read items*]

[MULTIPLE RESPONSE]

DISPLAY IF	Item	Reason
Q21a was not selected	a. Showerhead	Use multiple response options below
Q21b was not selected	b. Kitchen faucet aerator	Use multiple response options below
Q21c was not selected	c. Bathroom faucet aerator	Use multiple response options below
Q21d was not selected	d. Night light	Use multiple response options below
Q21e was not selected	e. Energy efficient light bulbs (LEDs)	Use multiple response options below
Q21f was not selected	f. Insulator gaskets	Use multiple response options below

[MULTIPLE RESPONSE OPTIONS FOR Q22]

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)
11. [DISPLAY IF Q21e was not selected] Already have LEDs
12. [DISPLAY IF Q21a was not selected] Already have efficient showerhead
13. [DISPLAY IF Q21b was not selected] Already have efficient kitchen faucet aerator
14. [DISPLAY IF Q21c 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 Q12 = 1 AND IT'S NOT THE CASE THAT ALL PARTS OF Q19=SELECTED (THAT IS, THEY INSTALLED ANYTHING AND DID NOT UNINSTALL EVERYTHING THEY INSTALLED)]

Q22a. 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 Q12a = 1 AND Q19.1 NOT SELECTED] Yes, I would like another energy-efficient showerhead
2. [IF Q12b = 1 AND Q19.2 NOT SELECTED] Yes, I would like another kitchen faucet aerator
3. [IF Q12c = 1 AND Q19.3 NOT SELECTED] Yes, I would like more bathroom faucet aerators
4. [IF Q12d = 1 AND Q19.4 NOT SELECTED Yes, I would like more energy-efficient night lights
5. [IF Q12e = 1 AND Q19.5 NOT SELECTED] Yes, I would like more energy-efficient light bulbs (LEDs)
6. [IF Q12f = 1 AND Q19.6 NOT SELECTED] 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 Q22a=1-6]
Q22b. 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 Q12d = 1 AND Q19 NIGHT LIGHT OPTION WAS NOT SELECTED]
Q26. 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 Q26 = 1]
Q27. 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 (Q12e = 1 AND Q19 ENERGY EFFICIENT LIGHTS WERE NOT SELECTED)]

Q28. 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 [*Interviewer: describe as an old fashioned light bulb - likely purchased more than two years ago*]
2. All halogen [*Interviewer: describe as bulb that looks like an incandescent, but has a glass tube inside of the bulb*]
   All CFL [*Interviewer: describe as spiral, or twisty shape bulb that fit into ordinary light fixtures*]
3. All LED [*Interviewer: describe as a new bulb type that uses little electricity and lasts a long time*]
4. Some combination [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[ASK IF (Q12e = 1 AND Q19 ENERGY EFFICIENT LIGHT BULBS NOT SELECTED)]

Q29. In what rooms did you install the energy efficient lightbulbs that were included in the kit?

[MULTIPLE RESPONSE] [*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): _______
98. Don't know
99. Refused

Q30. 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 Q30=1]

Q31. Do you know what the old temperature setting on your hot water heater was?

1. Yes (*please type in previous temperature setting here*)
2. No

[ASK IF Q30=1]
Q32. And what was the new temperature setting you set your hot water heater to?

[Record response]

[ASK IF Q30=1]
Q33. Is the new water heater temperature setting still in place?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q33=2]
Q34. Why did you change the water heater temperature a second time?

[Record response]

Q35. 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

Q36. 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 Q12 = 1 AND IT'S NOT THE CASE THAT ALL PARTS OF Q19=SELECTED (THAT IS, THEY INSTALLED ANYTHING AND DID NOT UNINSTALL EVERYTHING THEY INSTALLED)]
Q37. If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?

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

99. Refused

[If Q37 = 1]
Q38. What items would you have purchased and installed within the next year?

[MULTIPLE RESPONSES]

1. [IF Q12a = 1 AND Q19.1 NOT SELECTED] Energy-Efficient Showerhead
2. [IF Q12b = 1 AND Q19.2 NOT SELECTED] Kitchen Faucet Aerator
3. [IF Q12c = 1 AND Q19.3 NOT SELECTED] Bathroom Faucet Aerator
4. [IF Q12d = 1 AND Q19.4 NOT SELECTED] Energy-Efficient Light Bulbs
5. [IF Q12e = 1 AND Q19.5 NOT SELECTED] Energy-Efficient Night Light
6. [IF Q12f = 1 AND Q19.6 NOT SELECTED] Switch/Outlet Gasket Insulators
7. No I would not have purchased any of the items
96. Other, please specify: [OPEN-ENDED RESPONSE]
98. Don't know
99. Refused

[IF Q38.4 IS SELECTED]
Q39. Q39. 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 (Q12a=1 AND Q19.1 NOT SELECTED) or (Q12b=1 AND Q19.2 NOT SELECTED) or (Q12c=1 AND Q19.3 NOT SELECTED)]
Q40. 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…

[*Interviewer: If respondent says “Not applicable - I didn’t get/use that,” then follow up with: “So would you say it was “not at all influential?” and probe to code*]
[MATRIX QUESTION: SCALE]

Elements	**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
The chance to win cash prizes for your household and school	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

[IF Q12e=11 AND Q19.5 NOT SELECTED]

Q41. 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 lightbulbs from the kit? How influential was…

[*Interviewer: If respondent says “Not applicable - I didn’t get/use that,” then follow up with: “So would you say it was “not at all influential?” and probe to code*]
[MATRIX QUESTION: SCALE]

Elements	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
The chance to win cash prizes for your household and school	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 IF MYHER=1]

Q42. I’ve got just a few final questions about other energy saving activities. First, Duke Energy asked us to ask a couple of questions about the Home Energy Reports it sends to some families. These reports provide detailed information on your home’s energy usage and compare your home to similar homes of your neighbors.
During the school year, did you receive any Home Energy Reports from Duke Energy? [*If needed: This is extra information on energy use that is mailed separately from your energy bill.*]

1. Yes
2. No
98. Don't know
99. Refused

[ASK IF Q42=1]

Q43. How often do you read those Home Energy Reports?

1. Never
2. Sometimes
3. Always
98. Don't know
99. Refused

[ASK IF Q43=2-3]

Q44. The Home Energy Reports provide specific recommendations for how you can save energy in your home. Have you completed any of the energy saving recommendations from the Home Energy Reports? If so, which ones? [MULTIPLE RESPONSE] [*Don't read, probe if needed*]

1. Nothing
2. Purchased energy saving products for my home and received a Duke Energy rebate
3. Purchased energy saving products for my home but did not receive a Duke Energy rebate
4. Made energy saving modifications to my home [example if necessary: installed insulation or windows]
5. Adjusted how or when I use energy in my home
6. Looked for additional information on how to save energy
7. Other, please specify:

98. Don't know
99. Refused

[IF MYHER=1 AND Q44=2-7, READ] Now we'd like to ask you about any other actions you or your child may have taken to save energy in your home. So please focus on any other things you or your child has done other than what you just told me.

[IF MYHER=1 AND Q44=1, 98, OR 99, READ] Okay, so you said that you have not followed any of the energy savings recommendations from your Home Energy Report. I'd still like to ask you about any actions you or your child may have taken to save energy in your home since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy.

[IF MYHER≠1, READ] I'd like to ask you about any actions you or your child may have taken to save energy in your home since your child learned about energy conservation at school and signed up for your energy kit from Duke Energy.

Q45. 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. [*IF NEEDED: like turning off the lights when room is unoccupied*]

[MULTIPLE RESPONSE] [*Interviewer: Do not read list. After each response ask, "Anything else?"*]

1. Not applicable - no new behaviors
2. Turn off lights when not in a room
3. Turn off electronics when not using them
4. Take shorter showers
5. Other (specify:____________)

98. Don't know
99. Refused

Q45b. [IF Q45 =2-5] Before receiving the kit, was your child already…

[MATRIX QUESTION]

DISPLAY IF	DISPLAY:	ANSWERS
Q45.2 IS SELECTED	Turning off lights when not in a room	Yes, No, Don't know
Q45.3 IS SELECTED	Turning off electronics when not using them	Yes, No, Don't know
Q45.4 IS SELECTED	Taking shorter showers	Yes, No, Don't know
Q45.5 IS SELECTED	[Q45.5 VERBATIM TEXT]	Yes, No, Don't know

Q46. Since receiving your energy kit from Duke Energy, have you adopted any new behaviors to help save energy in your home? This would only include new energy saving**behaviors** that you have adopted since receiving the kit. [IF NEEDED: like turning off the lights when room is unoccupied]
[MULTIPLE RESPONSE] *[Interviewer: Do not read list. After each response ask, "Anything else?"*]

1. Not applicable - no new behaviors
2. Turn off lights when not in a room
3. Turn off furnace when not home
4. Turn off air conditioning when not home
5. Changed thermostat settings to use less energy
6. Used fans instead of air conditioning
7. Turn off electronics when we are not using them
8. Take shorter showers
9. Turned water heat thermostat down
10. Other (specify:____________)
98. Don't know
99. Refused

Q46b. [IF Q46 =2-10] Before receiving the kit, were you already…

[MATRIX QUESTION]

DISPLAY IF	DISPLAY:	ANSWERS
Q46.2 IS SELECTED	Turning off lights when not in a room	Yes, No, Don't know
Q46.3 IS SELECTED	Turning off furnace when not home	Yes, No, Don't know
Q46.4 IS SELECTED	Turning off air conditioning when not home	Yes, No, Don't know
Q46.5 IS SELECTED	Changing thermostat settings so heating or cooling system uses less energy	Yes, No, Don't know
Q46.6 IS SELECTED	Using fans instead of air conditioning	Yes, No, Don't know

Q46.7 IS SELECTED	Turning off electronics when not using them	Yes, No, Don't know
Q46.8 IS SELECTED	Taking shorter showers	Yes, No, Don't know
Q46.9 IS SELECTED	Turning water heat thermostat down	Yes, No, Don't know
Q46.10 IS SELECTED	[Q46.10 VERBATIM TEXT]	Yes, No, Don't know

[IF Q46 <> 1 or 98]

Q47. 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 your decision to [LIST ALL RESPONSES FROM Q46].

0 – Not at all influential	1	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF

Q47a. Thinking of the near future, are you interested in purchasing any additional products or services to help save energy in your home?

1. Yes
2. No
98. Don't know
99. Refused

[IF Q47a=1]

Q47b. What additional products or services are you interested in purchasing?

[MULTIPLE RESPONSE]

1. Energy efficient appliances
2. Efficient heating or cooling equipment
3. Efficient windows
4. Adding insulation
5. Sealing air leaks
6. Sealing or insulating ducts
7. Efficient lighting (LEDs)
8. Energy efficient water heater
9. Internet connected "smart" thermostat
96. Other, please specify: ____________________
98. Don't know
99. Refused

Q48. 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 Q48 = 1]

Q49. What **products** have you purchased and installed to help save energy in your home?

[*Do not read list. After each response, ask, "Anything else?"*] [MULTIPLE RESPONSE]

1. Bought energy efficient appliances
2. Moved into an ENERGY STAR home [*VERIFY:"Is Duke Energy still your gas or electricity utility?" Yes/No*]
3. Bought efficient heating or cooling equipment
4. Bought efficient windows
5. Added insulation
6. Sealed air leaks [NOT DUCT SEALING – PROBE TO CODE]
7. Sealed ducts
8. Bought LEDs
9. Bought CFLs
10. Installed an energy efficient water heater
11. None – no other actions taken
96. Other, please specify: ____________________
98. Don't know
99. Refused

[ASK IF Q49<>11, 98, OR 99]

Q50. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

[LOGIC] Item	Response
[IF Q49.1 IS SELECTED] 1. Buy energy efficient appliances	Yes No DK REF
[IF Q49.2 IS SELECTED] 2. Move into an ENERGY STAR home	Yes No DK REF
[IF Q49.3 IS SELECTED] 3. Buy efficient heating or cooling equipment	Yes No DK REF
[IF Q49.4 IS SELECTED] 4. Buy efficient windows	Yes No DK REF
[IF Q49.5 IS SELECTED] 5. Buy additional insulation	Yes No DK REF
[IF Q49.6 IS SELECTED] 6. Seal air leaks	Yes No DK REF
[IF Q49.7 IS SELECTED] 7. Seal ducts	Yes No DK REF
[IF Q49.8 IS SELECTED] 8. Buy LEDs	Yes No DK REF
[IF Q49.9 IS SELECTED] 9. Buy CFLs	Yes No DK REF
IF Q49.10 IS SELECTED] 10. Install an energy efficient water heater	Yes No DK REF
[IF Q49.96 IS SELECTED] [Q49 open ended response]	Yes No DK REF

[ASK IF ANY ITEM IN Q49 WAS SELECTED]

Q51. On a scale of 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential", how much influence did the Duke Energy schools program have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] Item	Response
[IF Q49.1 IS SELECTED] 1. Buy energy efficient appliances	0-10 scale with DK and REF
[IF Q49.2 IS SELECTED] 2. Move into an ENERGY STAR home	0-10 scale with DK and REF
[IF Q49.3 IS SELECTED] 3. Buy efficient heating or cooling equipment	0-10 scale with DK and REF
[IF Q49.4 IS SELECTED] 4. Buy efficient windows	0-10 scale with DK and REF
[IF Q49.5 IS SELECTED] 5. Buy additional insulation	0-10 scale with DK and REF
[IF Q49.6 IS SELECTED] 6. Seal air leaks	0-10 scale with DK and REF
[IF Q49.7 IS SELECTED] 7. Seal ducts	0-10 scale with DK and REF
[IF Q49.8 IS SELECTED] 8. Buy LEDs	0-10 scale with DK and REF
[IF Q49.9 IS SELECTED] 9. Buy CFLs	0-10 scale with DK and REF
IF Q49.10 IS SELECTED] 10. Install an energy efficient water heater	0-10 scale with DK and REF
[IF Q49.96 IS SELECTED] [Q49 open ended response]	0-10 scale with DK and REF

[ASK IF Q49.1 IS SELECTED AND Q51.1 <> 0]
Q52. What kinds of appliance(s) did you buy?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Refrigerator
2. Stand-alone Freezer
3. Dishwasher
4. Clothes washer
5. Clothes dryer
6. Oven
7. Microwave
96. Other, please specify: ____________
98. Don’t know
99. Refused

[ASK IF Q52 = 1-96]
Q53. Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q52]

[ASK IF Q52 = 5]
Q54. Does the new clothes dryer use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don’t know
99. Refused

[ASK IF Q49.3 IS SELECTED AND Q51.3 > 0]
Q55. What type of heating or cooling equipment did you buy?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Central air conditioner
2. Window/room air conditioner unit
3. Wall air conditioner unit
4. Air source heat pump
5. Geothermal heat pump
6. Boiler
7. Furnace
8. Wifi-enabled thermostat
96. Other, please specify: _______________
98. Don't know
99. Refused

[ASK IF Q55= 6-7]
Q56. Does the new [INSERT Q55 RESPONSE] use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don’t know
99. Refused

[ASK IF Q55= 1-7, 96]
Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

1. Yes
2. No
98. Don't know
99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN Q55, EXCLUDING wifi-enabled thermostat]

[ASK IF Q49.4 IS SELECTED AND Q51.4 > 0]
Q58. How many windows did you install?

1. [RECORD VERBATIM _______________]
98. Don’t know

99. Refused

[ASK IF Q49.5 IS SELECTED AND Q51.5 > 0]
Q59. Did you add insulation to your attic, walls, or below the floor?

[*Do not read list*] [MULTIPLE RESPONSE]

1. Attic
2. Walls
3. Below the floor
98. Don't know
99. Refused

[ASK IF Q59<>98-99]
[PROGRAMMER: REPEAT Q60 FOR EACH ITEM MENTIONED IN Q59]
Q60. Approximately what proportion of the [ITEM MENTIONED IN Q59] space did you add insulation?

1. [RECORD VERBATIM AS % - INPUT MID-POINT IF RANGE IS OFFERED:] _______________ [IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.8 IS SELECTED AND Q51.8 > 0]
Q61. How many of LEDs did you install in your property?

1. [RECORD VERBATIM:] ___________ [IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.9 IS SELECTED AND Q51.9 > 0]
Q62. How many of CFLs did you install in your property?

1. [RECORD VERBATIM:] ____________ [IF NEEDED: *Your best estimate is fine*]
2. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]
Q63. Does the new water heater use natural gas?

1. Yes - it uses natural gas
2. No – does not use natural gas
98. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]
Q64. Which of the following water heaters did you purchase?

1. A traditional water heater with a large tank that holds the hot water

2. A tankless water heater that provides hot water on demand
3. A solar water heater
4. Other, please specify: _______________
98. Don't know
99. Refused

[ASK IF Q49.10 IS SELECTED AND Q51.10 > 0]
Q65. Is the new water heater an ENERGY STAR model?

[SINGLE RESPONSE]
1. Yes
2. No
98. Don't know
99. Refused

Demographics
Lastly, we have some basic demographic questions for you. Please be assured that your responses are confidential and are for statistical purposes only.
Q66. Which of the following types of housing units would you say best describes your home? It is . . .?

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

Q67. 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

Q68. 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

Q69. 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

Q70. What was your total annual household income for 2017, before taxes?

1. Under $20,000
2. 20 to under $30,000
3. 30 to under $40,000
4. 40 to under $50,000
5. 50 to under $60,000
6. 60 to under $75,000
7. 75 to under $100,000
8. 100 to under $150,000
9. 150 to under $200,000
10. $200,000 or more
98. Don't know
99. Prefer not to say

Q71. 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

Appendix H Survey Results

H.1 Teacher

Q1. What grade(s) of students do you teach?

Response Option	Count	Percent (n=19)
Pre-K	0	0%
Kindergarten	3	16%
Grade 1	3	16%
Grade 2	1	5%
Grade 3	1	5%
Grade 4	0	0%
Grade 5	3	16%
Grade 6	2	11%
Grade 7	4	21%
Grade 8	3	16%
Grades 9 - 12	0	0%

Q2. Are you a home room teacher?

Response Option	Count	Percent (n=19)
Yes	11	58%
No	8	42%

Q3. What subjects do you teach?

Response Option	Count (n=8)
Math	1
Natural sciences	7
English/language arts	0
Social studies/social sciences/history	0
Music	0
Art	0
Physical education	0
Other	0

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)?

Response Option	Count	Percent (n=19)
Yes	11	58%
No	8	42%

Q5. Did you see The National Theatre for Children performance for elementary school students called *Kilowatt Kitchen* on [PERFORMANCE_DATE]?

Response Option	Count	Percent (n=19)
Yes	9	47%
No	10	53%

Q6. Did you see the National Theatre for Children performance for middle school students called *The E-Team* on [PERFORMANCE_DATE]?

Response Option	Count	Percent (n=19)
Yes	10	53%
No	9	47%

Q7. Before today, were you aware that Duke Energy sponsored the National Theatre for Children performance(s) in your school?

Response Option	Count	Percent (n=19)
Yes	16	84%
No	2	10%
Don't know	1	5%

Q8. How did you learn of Duke Energy's involvement with the National Theatre for Children program?

Response Option	Count	Percent (n=16)
Another teacher	9	56%
Duke Energy marketing materials	6	38%
Duke Energy staff	1	6%
The National Theatre for Children staff	2	13%
The National Theatre for Children materials	2	13%
Other	2	13%

Don't know	0	0%

Q9. Thinking about how the school performance explained the energy-related concepts, would you say that, on the whole, the explanation was:

Response Option	Count	Percent (n=19)
Far too advanced for most of your students	0	0%
Somewhat too advanced for most of your students	1	5%
About right for most of your students	15	79%
Somewhat too basic for most of your students	2	11%
Far too basic for most of your students	1	5%
Other	0	0%
Don't know	0	0%

Q10. What about the performance was too advanced for most of your students?

Response Option	Count
Some of the vocabulary was too advanced for my students	1

Q11. Were there any concepts that the performance(s) did not cover that *should have been* covered?

Response Option	Count	Percent (n=19)
Yes	2	10.5
No	15	78.9
Don't know	2	10.5

Q12. What concepts were not covered that *should have been* covered?

Response Option	Count
Conservation	1
More on power lines and how energy gets to our homes and schools.	1

Q13. Please rate your overall satisfaction with the National Theatre for Children performance on the following scale.

Response Option	Count	Percent (n=19)
1 - Not at all satisfied	0	0%
2	0	0%
3	2	11%

4	6	32%
5 - Completely satisfied	11	58%
Don't know	0	0%

Q14. Did you receive curriculum or instructional materials, such as student workbooks, related to energy and energy conservation from National Theatre for Children in the 2017-2018 school year?

Response Option	Count	Percent (n=19)
Yes	12	63%
No	5	26%
Don't know	2	11%

Q15. To what degree did you use the curriculum or instructional materials in teaching your students about energy?

Response Option	Count	Percent (n=12)
Not at all	3	25%
A little	7	58%
Moderately	2	17%
A lot	0	0%
Extensively	0	0%
Not at all	0	0%
Don't know	0	0%

Q15a. Why did you only use the workbooks “a little” in teaching your students about energy?

Response Option	Count (n=7)
Energy is not a concept taught in math. I used the materials to create math questions within the context of my curriculum.	1
It is only a small part of our curriculum - we just simply didn't have a lot of time for it.	1
More time spent on reading and math.	1
They were not totally aligned with our standards.	1
Timing.	1
We did not have enough time in our curriculum year to complete the workbooks.	1
We have a very tight curriculum/class calendar. We just don't have much time to incorporate additional materials.	1

Q15b. Did you incorporate the National Theatre for Children's online component into your curriculum in the 2015-2016 school year? This is the official website that accompanies the performance and classroom curriculum; it has interactive games that reinforce the concepts taught in the performance and printed curriculum.

Response Option	Count	Percent (n=9)
Yes	1	11%
No	8	89%

Q16. Thinking about how the student workbooks explained energy-related concepts, would you say that the material was generally:

Response Option	Count	Percent (n=9)
Far too advanced for most of your students	0	0%
Somewhat too advanced for most of your students	1	11%
About right for most of your students	6	67%
Somewhat too basic for most of your students	0	0%
Far too basic for most of your students	0	0%
Other	0	0%
Don't know	2	22%
I'd rather not say	0	0%

Q17. Please rate how useful the materials were to you in teaching your students about energy.

Response Option	Count	Percent (n=9)
1 - Not at all useful	0	0%
2	1	11%
3	4	44%
4	2	22%
5 - Extremely useful	0	0%
Don't know	2	22%

Q17a. Please rate the degree to which the topics in the workbook aligned with your state's science standards for the grade(s) you teach.

Response Option	Count	Percent (n=9)
Completely aligned	1	11%
Mostly aligned	2	22%
Somewhat aligned	3	33%
Not aligned at all	1	11%
Don't know	2	22%

Q18. Were there any concepts covered in the curriculum or instructional materials that your students had particular challenges with?

Response Option	Count	Percent (n=9)
No	5	56%
Don't know	4	44%

Q20. Were there any concepts that the materials did not cover that *should have been* covered?

Response Option	Count	Percent (n=9)
Yes	1	11%
No	6	67%
Don't know	2	22%

Q21. What concepts were not covered that *should have been* covered?

Response Option	Count
Forms of energy (potential, kinetic) and transformations of energy (ex. potential chemical energy in coal changes into......). This was mentioned but could be explained more.	1

Q22. Please rate your overall satisfaction with curriculum or instructional materials you received from the National Theatre for Children program using the following scale.

Response Option	Count	Percent (n=9)
1 - Not at all satisfied	0	0%
2	0	0%
3	3	33%
4	3	33%
5 - Completely satisfied	2	22%
Don't know	1	11%

Q23. Why did you *not* use the curriculum or instructional materials in teaching your students about energy?

Response Option	Count
Didn't have time.	1
no time in class...passed them out to students to take home and review.	1
Too low a level.	1

Q24. Did you have any interactions with anyone from the National Theatre for Children regarding the curriculum or instructional materials?

Response Option	Count	Percent (n=19)
Yes	0	0%
No	19	100%
Don't know	0	0

Q25. What did those interactions address?

Response Option	Count
Not applicable	0

Q26. Using the scale provided, how satisfied were you with:

Response Option	Count
Not applicable	0

Q27. Did you distribute the kit request materials to either your students or directly to their parents?

Response Option	Count	Percent (n=19)
Yes	19	100%
No	0	0%
Don't know	0	0%

Q28. Were there any other ways in which you personally promoted the kits to your students and their families? If so, what were they?

Response Option	Count	Percent (n=19)
MyEnergyKit.org poster	7	37%
Vocally encouraged students to sign up for a kit	17	89%
Used my classroom web portal to encourage families to sign up for a kit	5	26%

Emailed parents to encourage them to sign up for a kit	8	42%
Spoke with parents in person to encourage them to sign up for a kit	2	11%
Other	3	16%
No other actions taken	0	0%
Don't recall	0	0%

Q29. Did you follow up with students or parents later to find out if their household requested a kit?

Response Option	Count	Percent (n=19)
Yes	6	32%
No	13	68%
Don't know	0	0%

Q30. In your best estimate, what percentage of your student households ordered the Duke Energy kit?

Response Option	Count	Percent (n=6)
0% to 10%	1	17%
11% to 20%	1	17%
21% to 30%	1	17%
31% to 40%	1	17%
41% to 50%	1	17%
51% to 60%	0	0%
61% to 70%	1	17%
71% to 80%	0	0%
81% to 90%	0	0%
91% to 100%	0	0%

Q32. What suggestions do you have to improve the National Theatre for Children performance(s)?

Response Option	Count
I enjoyed the presentation and my students had positive comments about it as well. I requested and received the energy kit. I found it to include very useful information and energy saving ideas.	1
I really thought it was great! It held their attention, and my students learned a lot!	1
It was a very cute concept. It involves a LOT of information. Loved the visual aides. As many of those as possible are always helpful.	1

Response Option	Count
It was a wonderful experience. Very engaging for the students. Enthusiasm of the performers was great.	1
It would be nice if they had a microphone system to help the children hear their conversations a little better! Other than that, our students always enjoy the performance and engage in interesting conversations after the show. They are also interested to follow up with what they learned during the performance! Thanks!	1
It's great! No suggestions.	1
More mature material.	1
More middle school age/curriculum appropriate	1
None	7
None at this time.	1
None. My students enjoyed the performance. Unfortunately, the content is more applicable for other grade level curricula.	1
the content could be less basic.	1
They are amazing - so high energy and engaging of the children and the adults.	1

Q33. What suggestions do you have to improve the classroom materials received from the National Theatre for Children?

Response Option	Count
Have for higher levels.	1
I don't teach science and energy is not a concept taught in math. I include math questions that relate to my curriculum and incorporate energy concepts.	1
I have no suggestions for the National Theatre for Children to improve the classroom materials.	1
More interactive websites (games, quizzes, etc.)	1
More middle school geared.	1
None	5
Provide a quick overview on how we can use them in class.	1
We received way too many - maybe ask in advance how many we need	1

Q34. In addition to this survey, we will be conducting 15-minute-long telephone interviews with five teachers, where we will ask them additional questions about their experience with the National Theatre for Children program. Interview participants will be compensated for their time. If selected, would you be willing to participate in a follow-up telephone interview about your experience with the program?

Response Option	Count	Percent (n=19)

Yes, I am willing to be interviewed	9	47%
No, I am not willing to be interviewed	10	53%

H.2 Student Parent

Q2. Before today, did you know the kit you received was sponsored by Duke Energy?

Response Option	Count	Percent (n=167)
Yes	150	90%
No	16	10%
Don't know	1	1%

Q3. How did you learn that the kit was sponsored by Duke Energy? [Select all that apply]

Response Option	Count	Percent (n=150)
Classroom materials brought home by child	95	63%
My child's teacher/school	32	21%
Information material included in/on the kit	47	31%
Other	12	8%
Don't know	4	3%

Q3. Other…

Response Option	Count
A letter from the school	1
Duke mailer	1
Duke's website	1
Email from the School	1
I guess from my daughter. I let her utilize the program and kit.	1
Internet	1
Letter/Pamphlet	1
Online	1
Read it on the box	1
Son informed him	1
Website	1
Word of mouth	1

Q3a. How did you hear about the opportunity to receive the kit from Duke Energy? [Select all that apply]

Response Option	Count	Percent (n=167)

Classroom materials brought home by child	124	74%
School newsletter	28	17%
Email from my child's teacher/school	17	10%
School website or school web portal	5	3%
In-person conversations with my child's teacher	1	1%
Saw a poster at my child's school	5	3%
After hours event at my child's school	2	1%
Other (please specify in the box below)	19	11%
Don't know	8	5%

Q3a. Other…

Response Option	Count
Nations Bank	1
Duke mailer	1
Facebook Post	3
From the Elementary School	1
I think I received something in the mail or possibly saw it on website... not sure which one	1
Information that came in the mail	3
Listened over the phone to what we had to offer	1
My wife informed me through a pamphlet she got from the school	1
Once the child brought it home	1
Online	1
PTO meeting	1
Webstie/ Neighbor/Babysiter	1
Wife picked up a pamphlit at the elementary school.	1
Word of mouth from children	1
Word of mouth from family/school employee	1

Q4. Did you read the information about how to save energy in the booklet that came in the kit?

Response Option	Count	Percent (n=167)
Yes	113	68%
No	41	25%
Don't know	13	8%

Q5. On a scale from 0 to 10 where 0 is not at all helpful and 10 is very helpful, how helpful was the information in the kit in identifying ways your household could save energy at home?

Response Option	Count	Percent (n=113)
0	0	0%
1	0	0%
2	1	1%
3	2	2%
4	4	4%
5	7	6%
6	7	6%
7	27	24%
8	25	22%
9	10	9%
10 - Very helpful	30	27%

Q6. What might have made the information more helpful?

Response Option	Count
Already aware of info provided	1
Had i spent more time reading it.	1
I already knew and was aware of most of the topics	1
I can't remember because it was six months ago	1
I don't know	1
I don't recall.	1
I'm more of a visual person. More pictures would have been good.	1
If I had the ability to actually implement the ideas given.	1
It's not the information itself, but more so what we were already doing, already had knowledge about saving energy from Duke Letters	1
More pictures	1
Not sure	1
She was already aware of the information.	1
Summarize it to something shorter	1
Teach kids how to be more energy efficient	1
I don't recall.	1

Q7. 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?

Response Option	Count	Percent (n=167)
Yes	51	31%
No	112	67%
Don't know	4	2%

Q9. Where did you hear about this program?

Response Option	Count	Percent (n=51)
From my child/children	36	71%
From a teacher/school administrator	7	14%
On the Duke Energy website	5	10%
Other	9	18%
Don't know	1	2%

Q9a. Other…

Response Option	Count
Card that was sent home	1
From school email or letter	1
In the newsletter	1
School App	1
School flyer	1
School newsletter	1
They sent a letter home	1
Through the information brought home from school	1
We received before, but not from the school, I can't remember how or from whom	1

Q10. Have you or anyone else installed any of those items in your home, even if they were taken out later?

Response Option	Count	Percent (n=167)
Yes	160	96%
No	7	4%
Don't know	0	0%

Q12. Which of the items did you install, even if they were taken out later?

Response Option	Count	Percent (n=160)
Showerhead	70	44%
Kitchen faucet aerator	48	30%
Bathroom faucet aerator	49	31%
Night light	139	87%
Energy efficient light bulb(s) (LEDs)	148	93%
Insulator gaskets for light switches and electricity outlets	62	39%
I never installed any of the items from the kit	0	0%

Q13. In addition to the night light, there were two LED light bulbs in the kit. Did you install one or both of the LED light bulbs in the kit?

Response Option	Count	Percent (n=148)
Yes - I installed both LEDs	123	83%
No - I installed only one LED light bulb	21	14%
Don't know	4	3%

Q15. How many of the light switch gasket insulators from the kit did you [*if needed: or anyone else*] install in your home?

Response Option	Count	Percent (n=62)
None	5	8%
One	7	11%
Two	13	21%
Three	8	13%
Four	19	31%
Don't know	10	16%

Q16. How many electrical outlet gasket insulators from the kit did you [*if needed: or anyone else*] install in your home?

Response Option	Count	Percent (n=62)
None	5	8%
One	2	3%
Two	12	19%
Three	4	6%
Four	9	15%
Five	1	2%

Six	3	5%
Seven	1	2%
Eight	13	21%
Don't know	12	19%

Q17. Overall, how satisfied are you with the item[s] you installed? Please use 0 to 10 scale, where 0 is very dissatisfied and 10 is very satisfied. How satisfied are you with...

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
Showerhead	1%	1%	1%	0%	0%	6%	6%	9%	21%	7%	47%	0%	70
Kitchen faucet aerator	2%	0%	0%	2%	2%	2%	2%	15%	19%	8%	48%	0%	48
Bathroom faucet aerator	4%	0%	2%	0%	0%	2%	0%	8%	24%	14%	45%	0%	49
Night light	0%	0%	0%	1%	0%	2%	0%	4%	10%	12%	71%	1%	139
Energy efficient light bulbs (LEDs)	0%	0%	1%	1%	0%	1%	0%	5%	9%	13%	70%	1%	148
Insulator gaskets	2%	0%	0%	0%	0%	2%	0%	8%	18%	10%	58%	3%	62

Q17a. Can you please explain any dissatisfaction you had with the showerhead?

Response Option	Count
I would like a little more water than what it puts out	1
It's a water savor. It's just what it is	1
Made for poor water pressure	1
Not enough pressure	1
Not enough water pressure	1
The flow isn't as good as the old one	1
The pressure is about the same but the volume & area reached is different	1
The quality was not great	1
Too hard hitting	1
Water too slow	1
We had a rain shower type shower head before. I like this one, just still need to get used to it.	1

Q17b. Can you please explain any dissatisfaction you had with the kitchen faucet aerator?

Response Option	Count
Almost impossible to switch back to stream from spray.	1
Not enough water pressure	1
Not happy with the water flow	1

Response Option	Count
Took me a little while to get on.	1

Q17c. Can you please explain any dissatisfaction you had with the bathroom faucet aerator?

Response Option	Count
Made for extremely poor water pressure	1
Not enough water pressure	1
Reduced my water flow significantly in that sink	1

Q17d. Can you please explain any dissatisfaction you had with the night light?

Response Option	Count
I'm just not overwhelmed with it	1
It wasn't the type of night light my kids needed, needed more light, and it broke pretty easily	1
Not too bright	1
Too bright!!!	1

Q17e. Can you please explain any dissatisfaction you had with the energy efficient light bulbs (LEDs)?

Response Option	Count
Didn't see much benefit	1
The kit registration wanted to know how many lights I have in my house. Why ask how many of you were only going to send 2	1
They don't work well in cold weather	1

Q17f. Can you please explain any dissatisfaction you had with the insulator gaskets?

Response Option	Count
We didn't find them user friendly.	1

Q18. Have you since uninstalled any of the items from the kit that you had previously installed?

Response Option	Count	Percent (n=160)
Yes	16	10%
No	142	89%
Don't know	2	1%

Q19. Which of the items did you uninstall?

Response Option	Count
Showerhead	5
Kitchen faucet aerator	3
Bathroom faucet aerator	3
Night light	7
Energy efficient light bulbs (LEDs)	2
Insulator gaskets	1
Don't know	0

Q20. Why were those items uninstalled? Let's start with…

Q20a. the showerhead?

Response Option	Count
It was broken	0
Didn't like how it worked	4
Didn't like how it looked	1
Other - We sold our house and I wanted to take it with me	1
Other - Replaced with a handheld shower sprayer	1
Other - Would prefer more water	1
Don't know	0

Q20b. the kitchen faucet aerator?

Response Option	Count
It was broken	0
Didn't like how it worked.	1
Didn't like how it looked.	1
Other - I had to remove so that I can connect my portable dishwasher to the kitchen faucet	1
Other - Replaced kitchen sink faucet	1
Don't know	0

Q20c. the bathroom faucet aerator?

Response Option	Count
It was broken	0
Didn't like how it worked	3
Didn't like how it looked	0
Don't know	0

Q20d. the night light?

Response Option	Count
It was broken	0
Didn't like how it worked.	1
Didn't like how it looked.	0
Other - I didn't need it anymore in the location where I had installed it.	1
Other - Night light broke	1
Other - Not needed right now	1
Other - Too bright, not really needed	1
Other - We moved and I wanted to take it with me.	1
Other - Worked great, we just don't want kids to becone used to lights on at night, so took back out.	1
Don't know	0

Q20e. the energy efficient light bulbs (LEDs)?

Response Option	Count
It was broken	0
Didn't like how it worked.	1
Didn't like how it looked.	0
Other – Got new light bulbs and they replaed the LED light bulb	1
Other – Replaced with better LEDs	1
Don't know	0

Q20f. the insulator gaskets?

Response Option	Count
It was broken	0
Didn't like how it worked.	0
Didn't like how it looked.	0
Other - We think the insulation was done wrong so we took them out	1
Don't know	0

Q21. You said you haven't installed [INPUT ONLY THOSE ITEMS IN Q12 IF Q12a-f = 2]. Which of those items do you plan to install in the next three months?

Response Option	Count	Percent (n=154)
Showerhead	30	19%

Kitchen faucet aerator	34	22%
Bathroom faucet aerator	47	31%
Night light	16	10%
Energy efficient lightbulbs (LEDs)	12	8%
Insulator gaskets	39	25%
Im not planning on installing any of these in the next three months.	58	38%

Q22. What's preventing you from installing those items? Let's start with….

Q22. Showerhead…

Response Option	Count	Percent (n=67)
Didn't know what that was	0	0%
Tried it, didn't fit	3	4%
Tried it, didn't work as intended (please explain in the box below)	2	3%
Haven't gotten around to it	2	3%
Current one is still working	29	43%
Takes too much time to install it / No time / Too busy	0	0%
Too difficult to install it, don't know how to do it	0	0%
Don't have the tools I need	1	1%
Don't have the items any longer (threw away, gave away)	1	1%
Already have an efficient showerhead	19	28%
Other (please specify in the box below)	18	27%
Don't know	0	0%

Q22. Kitchen faucet aerator…

Response Option	Count	Percent (n=85)
Didn't know what that was	10	12%
Tried it, didn't fit	16	19%
Tried it, didn't work as intended (please explain in the box below)	4	5%
Haven't gotten around to it	13	15%
Current one is still working	14	16%
Takes too much time to install it / No time / Too busy	1	1%
Too difficult to install it, don't know how to do it	1	1%
Don't have the tools I need	2	2%

Don't have the items any longer (threw away, gave away)	2	2%
Already have an efficient kitchen faucet aerator	12	14%
Other (please specify in the box below)	21	25%
Don't know	0	0%

Q22. Bathroom faucet aerator…

Response Option	Count	Percent (n=71)
Didn't know what that was	8	11%
Tried it, didn't fit	9	13%
Tried it, didn't work as intended (please explain in the box below)	2	3%
Haven't gotten around to it	17	24%
Current one is still working	8	11%
Takes too much time to install it / No time / Too busy	0	0%
Too difficult to install it, don't know how to do it	0	0%
Don't have the tools I need	1	1%
Don't have the items any longer (threw away, gave away)	2	3%
Already have an efficient bathroom faucet aerator	10	14%
Other (please specify in the box below)	18	25%
Don't know	0	0%

Q22. Energy efficient lightbulbs (LEDs)…

Response Option	Count	Percent (n=7)
Didn't know what that was	0	0%
Tried it, didn't fit	0	0%
Tried it, didn't work as intended (please explain in the box below)	0	0%
Haven't gotten around to it	3	43%
Current one is still working	1	14%
Takes too much time to install it / No time / Too busy	0	0%
Too difficult to install it, don't know how to do it	0	0%
Don't have the tools I need	0	0%
Don't have the items any longer (threw away, gave away)	1	14%
Already have LEDs	1	14%
Other (please specify in the box below)	1	14%
Don't know	0	0%

Q22. Night lights…

Response Option	Count	Percent (n=12)
Didn't know what that was	0	0%
Tried it, didn't fit	0	0%
Tried it, didn't work as intended (please explain in the box below)	0	0%
Haven't gotten around to it	3	25%
Current one is still working	1	8%
Takes too much time to install it / No time / Too busy	0	0%
Too difficult to install it, don't know how to do it	0	0%
Don't have the tools I need	1	8%
Don't have the items any longer (threw away, gave away)	1	8%
Other (please specify in the box below)	4	33%
Don't know	2	17%
Didn't know what that was	0	0%

Q22. Insulator gaskets…

Response Option	Count	Percent (n=66)
Didn't know what that was	4	6%
Tried it, didn't fit	5	8%
Tried it, didn't work as intended (please explain in the box below)	0	0%
Haven't gotten around to it	29	44%
Current one is still working	5	8%
Takes too much time to install it / No time / Too busy	4	6%
Too difficult to install it, don't know how to do it	2	3%
Don't have the tools I need	2	3%
Don't have the items any longer (threw away, gave away)	2	3%
Other (please specify in the box below)	16	24%
Don't know	2	3%

Q22a. Thinking of the items you installed, would you be interested in receiving any more of them from Duke Energy? If so, which ones?

Response Option	Count	Percent (n=163)
Yes, I would like another energy-efficient showerhead	24	15%

Yes, I would like another kitchen faucet aerator	17	10%
Yes, I would like more bathroom faucet aerators	21	13%
Yes, I would like more energy-efficient night lights	89	55%
Yes, I would like more energy-efficient light bulbs (LEDs)	127	78%
Yes, I would like more switch/outlet gasket insulators	28	17%
No, I am not interested in receiving any more of the items	18	11%
Don't know	0	10%

Q22b. What would be your preferred way to request these additional items?

Response Option	Count	Percent (n=145)
Internet	97	67%
Telephone	20	14%
Pre-paid postcard	47	32%
Other, please specify	4	3%
Don't know	3	2%

Q26. You said you installed the night light. Did the night light replace an existing night light?

Response Option	Count	Percent (n=132)
Yes	74	56%
No	57	43%
Don’t know	1	1%

Q27. Did the old nightlight have a bulb that you could take out and replace once it burned out?

Response Option	Count	Percent (n=74)
Yes	57	77%
No	14	19%
Don't know	3	4%

Q28. 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?

Response Option	Count	Percent (n=146)
All incandescent (old fashioned light bulb - likely purchased more than two years ago)	74	51%
All halogen (looks like an incandescent, but has a glass tube inside of the bulb)	9	6%

All CFL (spiral or twisty shaped bulb that fits into ordinary light fixtures)	47	32%
All LED (new bulb type that uses little electricity and lasts a long time)	5	3%
Some combination of bulb types (please specify which ones in the box below)	5	3%
Don't know	6	4%

Q29. In what rooms did you install the energy efficient lightbulbs that were included in the kit?

Response Option	Count	Percent (n=146)
Living room	64	44%
Dining room	18	12%
Bedroom	47	32%
Kitchen	25	17%
Bathroom	24	16%
Den	3	2%
Garage	5	3%
Hallway	12	8%
Basement	5	3%
Outdoors	2	1%
Other area (please specify in the box below)	9	6%
Don't Know	1	1%

Q30. Have you adjusted the temperature of your water heater based on the Hot Water Gauge Card included in your kit?

Response Option	Count	Percent (n=167)
Yes	38	23%
No	113	68%
Don't recall seeing the Hot Water Gauge Card	13	8%
Don't know	3	2%

Q31. Do you know what the old temperature setting on your hot water heater was?

Response Option	Count	Percent (n=38)
Yes	5	13%
No	33	87%

Q31a. Temperature setting...

Response Option	Count

Response Option	Count
120	1
135	1
Mild	1
Very hot	1

Q32. And what was the new temperature setting you set your hot water heater to?

Response Option	Count
Below mid	1
120	1

Q33. Is the new water heater temperature setting still in place?

Response Option	Count	Percent (n=38)
Yes	34	90%
No	0	0%
Don't know	4	11%

Q35. What is the fuel type of your water heater?

Response Option	Count	Percent (n=167)
Electricity	63	38%
Natural Gas	90	54%
Other (please specify in the box below)	1	1%
Don't know	13	8%

Q36. How old is your water heater?

Response Option	Count	Percent (n=167)
Less than five years old	56	34%
Five to nine years old	43	26%
Ten to fifteen years old	23	14%
More than fifteen years old	13	8%
Don't know	32	19%

Q37. If you had not received the free efficiency items in the kit, would you have purchased and installed any of these same items within the next year?

Response Option	Count	Percent (n=159)
Yes	62	39%
No	69	43%

Don't know	28	18%

Q38. What items would you have purchased and installed within the next year?

Response Option	Count	Percent (n=23)
Energy-Efficient Showerhead	9	15%
Kitchen faucet aerator	3	5%
Bathroom faucet aerator	4	7%
Energy-Efficient Night light	18	30%
Energy efficient lightbulbs (LEDs)	54	90%
Switch/Outlet Gasket Insulators	3	5%
No I would not have purchased any of the items	0	0%
Other	0	0%
Don't know	0	0%

Q39. If you had not received them for free in the kit, how many LED light bulbs would you have purchased?

Response Option	Count	Percent (n=19)
One	1	2%
Two	32	68%
Don't know	14	30%

Q40. 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…

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
The fact that the items were free	1%	1%	1%	0%	1%	3%	5%	5%	13%	10%	56%	3%	93
The fact that the items were mailed to your house	1%	0%	0%	0%	0%	2%	3%	6%	10%	3%	74%	0%	93
The chance to win cash prizes for your household and school	9%	3%	3%	2%	1%	4%	2%	3%	6%	6%	55%	4%	93
Information in the kit about how the items would save energy	1%	1%	0%	1%	0%	6%	9%	5%	15%	15%	44%	2%	93
Information that your child brought home from school	6%	0%	0%	0%	2%	9%	8%	5%	12%	11%	45%	2%	93
Other information or advertisements from Duke Energy, including its website	8%	2%	5%	4%	1%	6%	5%	10%	15%	11%	27%	4%	93

Q41. 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 lightbulbs from the kit? How influential was…

	0	1	2	3	4	5	6	7	8	9	10	Don't know	Total
The fact that the items were free	1%	0%	0%	0%	1%	5%	1%	1%	8%	11%	71%	0%	146
The fact that the items were mailed to your house	0%	0%	1%	0%	1%	4%	0%	3%	9%	10%	71%	1%	146
The chance to win cash prizes for your household and school	12%	0%	2%	3%	4%	6%	3%	3%	6%	9%	49%	3%	146
Information in the kit about how the items would save energy	1%	1%	2%	3%	1%	8%	9%	6%	18%	12%	38%	1%	146
Information that your child brought home from school	8%	1%	1%	1%	3%	13%	3%	9%	17%	12%	33%	1%	146
Other information or advertisements from Duke Energy, including its website	10%	1%	5%	4%	2%	12%	6%	8%	16%	7%	27%	3%	146

Q42. I've got just a few final questions about other energy saving activities. First, Duke Energy asked us to ask a couple of questions about the Home Energy Reports it sends to some families. These reports provide detailed information on your home's energy usage and compare your home to similar homes of your neighbors.
During the school year, did you receive any Home Energy Reports from Duke Energy?

Response Option	Count	Percent (n=29)
Yes	56	84%
No	5	8%
Don't know	6	9%

Q43. How often do you read those Home Energy Reports?

Response Option	Count	Percent (n=23)
Never	0	0%
Sometimes	8	14%
Always	48	86%
Don't know	0	0%

Q44. The Home Energy Reports provide specific recommendations for how you can save energy in your home. Have you completed any of the energy saving recommendations from the Home Energy Reports? If so, which ones? [MULTIPLE RESPONSE]

Response Option	Count
Nothing	13
Purchased energy saving products for my home and received a Duke Energy rebate	0
Purchased energy saving products for my home but did not receive a Duke Energy rebate	7
Made energy saving modifications to my home (example: installed insulation or windows)	8
Adjusted how or when I use energy in my home	24
Looked for additional information on how to save energy	8
Other (please specify in the box below)	10
Don't know	2

Q45. 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. [*IF NEEDED: like turning off the lights when room is unoccupied*]

Response Option	Count

Response Option	Count
Not applicable - no new behaviors	38
Turn off lights when not in a room	108
Turn off electronics when not using them	41
Take shorter showers	32
Other	22
Don't know	5

Q45a. Other…

Response Option	Count
My child already did many things to save energy - but still needs to remember to turn off lights when leaving a room!	1
Better about using water.	1
Closing doors to keep the air indoors	1
Doesn't let water run when brushing his teeth, and recycles	1
Doesn't run the water when brushing teeth. Closing the door.	1
Less TV and games	1
Make sure the water doesn't stay running	2
Night light helps to fall asleep	1
No children at home	1
Recycling things	1
Running the water less and being aware of the temperature.	1
She was always good at turning on and off lights and faucets	1
Shutting the door, and turning off the water, watching for drips	1
Turns water off when brushing teeth.	7
Unplugging his tablets and games	1

Q45b. [IF Q45 =2-5] Before receiving the kit, was your child already…

Response Option	Count	Percent (n=23)
Turning off lights when not in a room	28	45%
Turning off electronics when not using them	9	19%
Taking shorter showers	7	15%
Other	3	10%

Q46. Since receiving your energy kit from Duke Energy, have you adopted any new behaviors to help save energy in your home? This would only include new energy saving **behaviors** that you have adopted since receiving the kit. [IF NEEDED: like turning off the lights when room is unoccupied]
[MULTIPLE RESPONSE] *[Interviewer: Do not read list. After each response ask, "Anything else?"*]

Response Option	Count
Not applicable - no new behaviors	49
Turning off lights when not in a room	73
Turning off furnace when not home	18
Turning off air conditioning when not home	26
Changed thermostat settings to use less energy	64
Using fans instead of air conditioning	36
Turning off electronics when we are not using them	48
Taking shorter showers	34
Turning water heat thermostat down	21
Other (please specify in the box below)	18
Don't know	3

Q46a. Other…

Response Option	Count
Buying LED light bulbs. Sprinkler hotter water comes out and the sprinkler water stream.	1
Purchasing and Replacing LEDs	4
Don't let the water run as much when I brush my teeth.	1
I was already doing them	1
No children at home	1
The only thing I have really done is educating my children more	1
Turns water off brushing teeth.	1
Use the LED bulbs, aerators, and night light	1
Using all the appliances we sent to her.	1
Using laundry appliances less frequently	1
Using new faucets, LED's, try not to let water run doing dishes, energy efficient appliances	1
Washing machine	1
Watching how long I keep my lights on	1
Wood burning fireplace with an efficient burning process. Try not to leave the water running.	1

Q46b. [IF Q46 =2-10] Before receiving the kit, were you already…

Response Option	Count	Percent (n=58)
Turning off lights when not in a room	47	16%
Turning off furnace when not home	7	7%
Turning off air conditioning when not home	10	10%
Changing thermostat settings so heating or cooling system uses less energy	27	22%
Using fans instead of air conditioning	19	10%
Turning off electronics when not using them	26	13%
Taking shorter showers	10	14%
Turning water heat thermostat down	3	11%
Other	6	7%

Q47. 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 your decision to [LIST ALL RESPONSES FROM Q46].

Response Option	Count	Percent (n=83)
0 – Not at all influential	1	1%
1	0	0%
2	3	3%
3	2	2%
4	3	3%
5	4	4%
6	10	9%
7	19	17%
8	26	23%
9	10	9%
10 - Extremely influential	35	30%
Don't know	2	2%

Q47a. Thinking of the near future, are you interested in purchasing any additional products or services to help save energy in your home?

Response Option	Count	Percent (n=95)
Yes	102	61%
No	38	23%
Don't know	27	16%

Q47b. What additional products or services are you interested in purchasing?

Response Option	Count
Energy efficient appliances	35
Efficient heating or cooling equipment	16
Efficient windows	23
Adding insulation	23
Sealing air leaks	31
Sealing or insulating ducts	15
Efficient lighting (LEDs)	77
Energy efficient water heater	18
Internet connected “smart” thermostat	23
Other	14
Don't know	5

Q48. 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?

Response Option	Count	Percent (n=95)
Yes	48	29%
No	112	67%
Don't know	7	4%

Q49. What **products** have you purchased and installed to help save energy in your home? [MULTIPLE RESPONSE]

Response Option	Count
Bought energy efficient appliances	14
Moved into an ENERGY STAR home	1
Bought efficient heating or cooling equipment	5
Bought efficient windows	5
Added insulation	12
Sealed air leaks	6
Sealed ducts	1
Bought LEDs	28
Bought CFLs	1
Installed an energy efficient water heater	3
None – no other actions taken	0
Other (please specify in the box below)	10
Don’t know	0

Q49a. Other…

Response Option	Count
Another energy efficient shower head	1
Energy-efficient showerhead, water-saving toilet, water-saving/efficient faucets	1
Heated flooring	1
Installed new faucets in the bathrooms to stop water drips	1
New furnace	1
Purchased smart/connected thermostat	2
Washer, dryer, new bathroom, all energy effiecient	1
We tried to install a Smart thermostat, but ever since Duke ended the program, we haven't tried to install it.	1
Weatherstripping around doors	1

Q50. Did you get a rebate from Duke Energy for any of those products or services? If so, which ones?

Response Option	Count
Bought energy efficient appliances	1
Moved into an ENERGY STAR home	0
Bought efficient heating or cooling equipment	1
Bought efficient windows	0
Bought additional insulation	0
Sealed air leaks	0
Sealed ducts	0
Bought LEDs	4
Bought CFLs	0
Installed an energy efficient water heater	0
Other	0
I did not get any Duke Rebates	36
Don't know	6

Q51. On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how much influence did the Duke Energy schools program have on your decision to…

	0 - Not at all influential	1	2	3	4	5	6	7	8	9	10 - Extremely influential	Total
Buy energy efficient appliances	14%	0%	14%	14%	0%	14%	21%	21%	14%	0%	14%	14
Move into an ENERGY STAR home	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	1
Buy efficient heating or cooling equipment	60%	0%	20%	0%	0%	0%	20%	0%	60%	0%	20%	5
Buy efficient windows	80%	0%	0%	20%	0%	0%	0%	0%	80%	0%	0%	5
Add insulation	25%	0%	8%	17%	8%	8%	17%	17%	25%	0%	8%	12
Seal air leaks	17%	0%	0%	0%	0%	33%	17%	33%	17%	0%	0%	6
Seal ducts	100%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	1
Buy LEDs	4%	0%	11%	7%	14%	14%	7%	43%	4%	0%	11%	28
Buy CFLs	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	1
Install an energy efficient water heater	33%	0%	0%	0%	33%	0%	0%	33%	33%	0%	0%	3
Other	60%	20%	10%	0%	0%	10%	0%	0%	60%	20%	10%	10

Q52. What kinds of appliance(s) did you buy?

Response Option	Count
Refrigerator	5
Stand-alone Freezer	0
Dishwasher	2
Clothes washer	6
Clothes dryer	5
Oven	2
Microwave	4
Other	1
Don't know	0

Q53. Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=10)
Refrigerator	5	45%
Stand-alone Freezer	0	0%
Dishwasher	2	18%
Clothes washer	6	55%
Clothes dryer	5	45%
Oven	1	9%
Microwave	3	27%
Other	0	0%

Q54. Does the new clothes dryer use natural gas?

Response Option	Count
Yes- it uses natural gas	0
No – does not use natural gas	5
Don't know	0

Q55. What type of heating or cooling equipment did you buy?

Response Option	Count	Percent (n=1)
Central air conditioner	1	50%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	1	50%
Geothermal heat pump	0	0%
Boiler	0	0%
Furnace	1	0%

Response Option	Count	Percent (n=1)
Wifi-enabled thermostat	0	0%
Other (please specify in the box below)	0	0%
Don't know	0	0%

Q55a. Other…

Response Option	Count
Not applicable	0

Q56. Does the new [INSERT Q55 RESPONSE] use natural gas?

Response Option	Count
No	1

Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=1)
Central air conditioner	0	0%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	1	100%
Geothermal heat pump	0	0%
Boiler	0	0%
Furnace	0	0%
Wifi-enabled thermostat	0	0%
Other (please specify in the box below)	0	0%
Don't know	0	0%

Q58. How many windows did you install?

Response Option	Count
18	1

Q59. Did you add insulation to your attic, walls, or below the floor? [MULTIPLE RESPONSE]

Response Option	Count
Attic	7
Walls	4
Below the floor	2
Don’t know	0

Q60a. Approximately what proportion of the attic space did you add insulation?

Response Option	Count
1:2	1
100	2
100%	1
200	1
Don’t know	0

Q60b. Approximately what proportion of the wall space did you add insulation?

Response Option	Count
60%	1
750	1
Don’t know	0

Q60c. Approximately what proportion of the below the floor space did you add insulation?

Response Option	Count
60%	1

Q61. Do you know how many of LEDs you installed at your property?

Response Option	Count
Yes	26
Don't know	1

Q61a. How many of LEDs did you install in your property?

Response Option	Count
2	2
4	1
5	3
6	1
8	2
10	3
11	1
12	3
13	1
15	2
20	1

Response Option	Count
24	1
25	3
30	2
Don’t know	0

Q62. How many of CFLs did you install in your property?

Response Option	Count
Don’t know	1

Q63. Does the new water heater use natural gas?

Response Option	Count
Yes - it uses natural gas	0
No – does not use natural gas	1
Don’t know	1

Q64. Which of the following water heaters did you purchase?

Response Option	Count
A traditional water heater with a large tank that holds the hot water	1
A tankless water heater that provides hot water on demand	0
A solar water heater	0
Other	1
Don’t’ know	0

Q64a. Other…

Response Option	Count
Planning on purchasing a tankless	1

Q65. Is the new water heater an ENERGY STAR model?

Response Option	Count
Yes	2
No	0
Don’t know	0

Q66. Which of the following types of housing units would you say best describes your home? It is . . .?

Response Option	Count	Percent (n=95)
Single-family detached house	130	78%
Single-family attached home (such as a townhouse or condo)	10	6%
Duplex, triplex or four-plex	8	5%
Apartment or condominium in a building with 5 units or more	14	8%
Manufactured or mobile home	5	3%
Other	0	0%
Don't know	0	0%

Q67. How many square feet of living space are there in your residence, including bathrooms, foyers and hallways (exclude garages, unfinished basements, and unheated porches)?

Response Option	Count	Percent (n=95)
Less than 500 square feet	2	1%
500 to under 1,000 square feet	12	7%
1,000 to under 1,500 square feet	37	22%
1,500 to under 2,000 square feet	41	25%
2,000 to under 2,500 square feet	18	11%
2,500 to under 3,000 square feet	19	11%
Greater than 3,000 square feet	15	9%
Don't know	23	14%

Q68. Do you or members of your household own your home, or do you rent it?

Response Option	Count	Percent (n=95)
Own / buying	126	75%
Rent / lease	41	25%
Occupy rent-free	0	0%
Don't know	0	0%

Q69. Including yourself, how many people currently live in your home year-round?

Response Option	Count	Percent (n=95)
I live by myself	4	2%
Two people	15	9%
Three people	41	25%
Four people	53	32%

Response Option	Count	Percent (n=95)
Five people	29	17%
Six people	19	11%
Seven people	4	2%
Eight or more people	0	0%
Don't know	2	1%

Q70. What was your total annual household income for 2017, before taxes?

Response Option	Count	Percent (n=95)
Under $20,000	11	7%
$20,000 to under $30,000	8	5%
$30,000 to under $40,000	15	9%
$40,000 to under $50,000	12	7%
$50,000 to under $60,000	16	10%
$60,000 to under $75,000	18	11%
$75,000 to under $100,000	23	14%
$100,000 to under $150,000	22	13%
$150,000 to under $200,000	5	3%
$200,000 or more	6	4%
Don’t know	8	5%
Prefer not to say	23	14%

Q71. What is the highest level of education achieved among those living in your household?

Response Option	Count	Percent (n=95)
Less than high school	1	1%
Some high school	3	2%
High school graduate or equivalent (such as GED)	23	14%
Trade or technical school	8	5%
Some college (including Associate degree)	35	21%
College degree (Bachelor’s degree)	58	35%
Some graduate school	1	1%
Graduate degree, professional degree	30	18%
Doctorate	4	2%
Don’t know	0	0%
Prefer not to say	4	2%

APPENDIX I - SMART$AVER NR CUSTOM EVALUATION

FINAL REPORT

Smart $aver® Non-Residential Custom Program Years 2015-2017 Evaluation Report

Submitted to Duke Energy Ohio
in partnership with Tetra Tech

September 5, 2018

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1 Executive Summary

1.1 Program Summary

Duke Energy's Non-Residential Smart $aver® Custom Incentive Program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers in the Duke Energy Ohio (DEO) service territory to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The program is designed to meet the needs of the Company's non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance.

1.2 Evaluation Objectives and High Level Findings

This report presents the results and findings of evaluation activities for Duke Energy Ohio's NR Custom program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Tetra Tech, for the period of August 2015 through December 2017.

1.2.1 Impact Evaluation

The overarching goals for the NR Custom impact evaluation were to:

- Quantify accurate and supportable energy impacts (kWh) and summer and winter demand (kW) savings for energy efficient measures and equipment implemented in participants' facilities.
- Assess the rate of free riders from customer and contractor perspective.
- Determine spillover effects
- Consider and verify measure installation-vintage aligned with measure baseline definitions, i.e. early replacement, burnout on failure, etc.

Evaluation activities included in-depth reviews and on-site verification of a representative sample of projects, in-person or phone interviews with program participants, deploying metering equipment, collecting building automation system/energy management system (BAS/EMS) data, and engineering analyses to estimate gross and net savings for all implemented measures attributed to the NR Custom Program.

1.2.2 Process Evaluation Objectives

Process evaluations are designed to support continuous program improvement by identifying successful program elements that can be expanded upon as well as underperforming/inefficient processes that could be holding back program performance. The process evaluation for the NR Custom Program sought to:

- Assess how participant characteristics compare to segments targeted for the program
- Assess the sources of customer engagement and most effective marketing source
- Assess influence the program has on customers' decisions to install EE measures
- Assess whether sufficient documentation and information are provided to customers
- Assess persistence of program engagement with participants
- Assess satisfaction with the program and its components including suggestions for program changes

To meet these objectives, the evaluation team conducted interviews with key program staff, reviewed program documentation, and utilized telephone surveys to ask program participants and trade allies about their experiences with the program.

1.2.3 High Level Findings

1.2.3.1 Gross Impact Evaluation Key Findings

The impact evaluation results indicate that program internal processes for project review, savings estimation, and installation verification are producing quality estimates of project impacts. Energy realization rates exceed 86% for three of the four strata (Lighting - Large, Lighting - Small, and Non-lighting - Small). The realization rate for the Non-lighting-Large strata was 74.8%. Realization rates for Summer and Winter demand at the program level were 91.6% and 88.1%, respectively. Findings from the gross impact evaluation are summarized in Table 1-1,

Table 1-2, and Table 1-3.

Table 1-1 DEO Program Reported and Verified Gross Energy Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	RR (%)
Lighting	Large (>400 MWh)	24,502,606	27,247,510	111.2%
	Small (<400 MWh)	11,301,697	10,896,832	96.4%
Non-lighting	Large (>1,000 MWh)	38,284,556	28,618,948	74.8%
	Small (<1,000 MWh)	12,831,537	11,150,566	86.9%
Total		**86,920,395**	**77,913,856**	**89.6%**

Table 1-2 DEO Program Reported and Verified Gross Summer Demand Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kW)	RR (%)
Lighting	Large (>400 MWh)	3,513	3,883	110.5%
	Small (<400 MWh)	1,901	1,887	99.2%
Non-lighting	Large (>1,000 MWh)	3,800	2,385	62.8%
	Small (<1,000 MWh)	1,934	2,058	106.4%
	Total	**11,148**	**10,213**	**91.6%**

Table 1-3 DEO Program Reported and Verified Gross Winter Demand Impacts for Projects Completed August 2015 – December 2017

Measure Category	Strata	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	RR (%)
Lighting	Large (>400 MWh)	3,126	3,205	102.5%
	Small (<400 MWh)	1,664	1,482	89.1%
Non-lighting	Large (>1,000 MWh)	3,304	2,143	64.9%
	Small (<1,000 MWh)	1,685	1,789	106.2%
	Total	**9,779**	**8,619**	**88.1%**

Additionally, consistent with Ohio SB310, the higher of the evaluated estimates of energy efficiency impacts or the deemed values are applied prospectively to adjust subsequent impact assumptions until superseded by new EM&V results[1]. The deemed impacts reported for the Smart $aver NR Custom program were found to be greater than the verified savings and therefore the deemed results shall be applied to the rider in the month following the completion of this EM&V report. These results will also be used to estimate future target achievement levels for development of estimated incentives and in future cost-effectiveness evaluations. Table 1-4 below summarizes the program claimed, deemed, and evaluated values.

[1] Per Section 4928.66(B) of the Revised Code from Senate Bill 310, energy efficiency savings and peak demand reduction achieved on and after the effective date of S.B. 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method.

Table 1-4 DEO Program Impact Summary

	Energy kWh	Summer Demand (kW)	Winter Demand (kW)
Gross Claimed Impacts	86,920,395	**11,148**	**9,779**
Deemed Realization Rate	95.0%	95.0%	95.0%
Deemed Savings	**82,574,375**	**10,591**	**9,290**
Evaluated Realization Rate	89.6%	91.6%	88.1%
Evaluated Savings	**77,913,856**	**10,212**	**8,615**

1.2.3.2 Net Impact Evaluation Key Findings

The results of the net impact evaluation show that the gross energy savings are largely attributable to the program's activities. Customers did not report implementing efficient projects outside of the program, which suggests that the program is effective at getting customers to participate when they are considering efficiency projects. The freeridership identified through this evaluation primarily stemmed from customers who reported they planned to complete the same project prior to learning about the program, and would have paid the additional incentive amount to complete the efficient version of the project. Findings from the net impact evaluation are summarized in

Table 1-5.

Table 1-5 Net-to-Gross Evaluation Results

Net-to-Gross Component	Rate
Net of Free-ridership	82.8%
Program-influenced Spillover	0.1%
Net-to-Gross	**82.9%**

1.2.3.3 Process Evaluation Key Findings

Overall, the program is operating as intended, and customers and trade allies are satisfied with their experiences with the program as well as with Duke Energy. Contractors play a key role in the program by making customers aware of the program offerings, and contractors have utilized the program to encourage customers to purchase high efficient equipment. Contractors felt the program was influential in customers moving forward with projects where they would not have otherwise. Participants provide similar feedback, stating they have appreciated the support they received from trade allies and Duke Energy.

Additional high-level findings include the following:

- The primary source of participants' program awareness is Duke Energy. This was followed by their contractor.
- Satisfaction with the program overall and its components is high among participants and trade allies
- The contractor assistance was the most valuable program component as rated by participant respondents
- The program-provided calculators were used by participant and contractor respondents with contractors indicating that the calculators were useful[2].
- Contractors value the program and use the incentives to encourage customers to purchase high efficient equipment
- The tracking database was missing some key information for evaluation activities and program/project tracking

[2] Participant respondents were not asked to rate the usefulness of the calculators (only contractors were).

1.3 Evaluation Conclusions and Recommendations

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

1.3.1 Impact

Conclusion 1: The evaluation team's analysis resulted in a 89.6% realization rate (energy) for the DEO NR Custom Program. The strong realization rate indicates that Duke Energy's internal processes for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts. Reported energy and demand savings could be increased by incorporating interactive factors into ex-ante impact estimates for lighting measures.

Recommendation 1: The evaluation team recommends that Duke continue to operate this program with the current level of rigor. For interior lighting projects, Duke should consider developing and applying deemed interactive factors to quantify the interactive effects between lighting retrofits and their associated HVAC systems.

Conclusion 2: Assumptions used in ex ante energy savings estimates are well-documented, but there are opportunities for improvement on new construction lighting projects and some non-lighting projects.

Recommendation 2: The evaluation team recommends that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet developed by the program. This will provide better transparency when deviations from a lighting power density approach are used in ex-ante energy savings estimates.

Conclusion 3: The NR Custom Program uses T12 baseline fixture wattages in ex-ante energy savings estimates for applicable linear fluorescent to LED tube retrofit measures. This practice is defensible given the availability of high color rendering index (CRI) replacement lamps; however, peer Demand Side Management (DSM) programs no longer credit energy or demand savings beyond a T8 baseline.

Recommendation 3: It is recommended that the Duke NR Custom Program consider using a T8 equivalent when developing ex-ante energy and demand savings estimates for T12 to LED tube retrofit measures.

1.3.2 Process

Conclusion 1: The program is operating as intended and has resulted in high satisfaction across participant and contractor respondents. The most common source of program awareness from customers was from Duke Energy followed by their contractor, which is consistent with how the program is marketed.

Technical assistance from the contractor was the highest rated aspect of the program which highlights the contractors' technical competence and the significant role contractors play in the program. Many customer respondents also commented on how their contractors are knowledgeable which made the entire process easy.

Recommendation 1: Continue program outreach efforts and continue to engage contractors in the program and keep them informed of the program and any future changes to increase awareness among customers and encourage the installation of program-qualifying equipment.

Conclusion 2: As part of the application process, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and Custom-to-go. Over half of contractor and one-third of participant respondents indicated they have used Duke's tools to calculate savings. Contractors who used Duke's provided tools rated their usefulness high. Additionally, participant respondents rated the worksheets and calculators as the second best aspect of the program.

Recommendation 2: Continue to keep the Custom-to-Go and Classic Custom calculators updated and available to customers and contractors who need a tool to estimate savings.

Conclusion 3: Interviews with program staff indicated the pre-approval review process could take as much as six weeks for review. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process. Contractor respondents were slightly less satisfied than participant respondents in the pre-approval process although they still provided high satisfaction scores. While no respondents reported being dissatisfied with the application process, it is something to watch to make sure the length of time to review applications is not taking too long.

Recommendation 3: Monitor the time it takes to review applications to ensure the time does not exceed six weeks.

Conclusion 4: Most customer respondents reported high satisfaction with the application progress although two respondents indicated low satisfaction due to the complexity of the application. One of these respondents indicated that the application is hard to fill out when involving the supplier and vendor, while the other respondent explained that the application requires "*so much information and justification*." When asked if there were any improvement suggestions, five customer respondents felt the paperwork was too complex and felt it could be improved.

Recommendation 4: Maintain streamlined application paperwork to minimize customer burden.

2 Introduction and Program Description

2.1 Program Description

Duke Energy's Non-Residential Smart $aver® Custom Incentives program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers (that have not opted-out) in the Duke Energy Ohio (DEO) service territory to enhance their ability to adopt and install cost-effective energy efficiency projects.

The program is designed to meet the needs of the Company's non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance. The program requires pre-approval prior to the project implementation. Proposed energy efficiency measures may be eligible for customer incentives if they clearly reduce electrical consumption and/or demand.

The two approaches for applying for incentives for this program are Classic Custom and Custom-to-Go. The difference between the two approaches focuses on the method by which energy savings are calculated. The documents required as part of the application process vary slightly.

The custom application forms are located on the company's website under the Smart $aver® Incentives (Business and Large Business tabs). The application forms are offered in Word (doc) and Adobe (pdf) format with the designated worksheet in Excel format for projects saving more than 700,000 kWh annually. Customers can utilize provided calculation tools (Custom-to-Go) for energy management system (EMS) projects savings less than 700,000 kWh annually or request worksheets in another format if preferred. Customers or their vendors submit the forms with supporting documentation. Forms are designed for multiple projects and multiple locations. Custom incentive applications (doc or pdf) are submitted with one or more of the following worksheets:

- Classic Custom approach (> 700,000 kWh or no applicable Custom-to-Go calculator)
  - Lighting worksheet (Excel)
  - Variable Speed Drive (VFD) worksheet (Excel)
  - Compressed Air worksheet (Excel)
  - Energy Management System (EMS) worksheet (Excel)
  - General worksheet (Excel), to be used for projects not addressed by or not easily submitted using one of the other worksheets

- Custom-to-Go Calculators (< 700,000 kWh and applicable Custom-to-Go calculator)
  - Energy Management Systems
  - Lighting
  - Process VFDs
  - Compressed Air

The Company contracts with Alternative Energy Systems Consulting (AESC) to perform technical review of applications. All other analysis is performed internally at Duke Energy, including DSMore runs for every custom measure that is recorded by the program.

2.1.1 Participation Summary

Table 2-1 summarizes program participation and reported energy savings for the full evaluation period of August 2015 through December 2017. There were a total of 195 projects completed during the evaluation period. For the purposes of this report a project is defined as a unique enrollment ID. These 195 projects collectively accounted for a total of 527 unique database line items. Database line items typically represent single-measure projects or an individual measure implemented as part of a multi-measure project. There are also a few instances where a line item in the tracking database represents a unique project site where a common scope of work was completed as part of a larger portfolio of sites (i.e. United Dairy Farmers). Table 2-2 outlines the reported summer and winter demand (kW) for the evaluation period.

Table 2-1 DEO NR Custom Program Participation and Reported Energy Summary

Category & Strata		Database Line Items		Enrollment IDs		Reported Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go Gross kWh	Classic Custom Gross kWh
Lighting	Large (>400 MWh)	11	42	2	14	2,036,415	22,466,191
	Small (<400 MWh)	109	263	54	56	4,375,034	6,926,663
Non-lighting	Large (>1,000 MWh)	-	20	-	17	-	38,284,556
	Small (<1,000 MWh)	2	80	2	50	31,898	12,799,639
Total		**122**	**405**	**58**	**137**	**6,443,347**	**80,477,048**
Grand Total		**527**		**195**		**86,920,395**	

Table 2-2 DEO NR Custom Program Reported Demand Savings Summary

Category & Strata		Enrollment IDs		Reported Summer Demand (kW) Savings		Reported Winter Demand (kW) Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go	Classic
Lighting	Large (>400 MWh)	2	14	478	3,035	146	2,980
	Small (<400 MWh)	54	56	931	971	611	1,054
Non-lighting	Large (>1,000 MWh)	-	17	-	3,800	-	3,304
	Small (<1,000 MWh)	2	50	6	1,928	2	1,682
Total		**58**	**137**	**1,415**	**9,733**	**759**	**9,020**
Grand Total		**195**		**11,148**		**9,779**	

Figure 2-1, Figure 2-2, and Figure 2-3 summarize the distribution of reported energy (kWh) and demand (kW) savings at the program level by technology category.

Figure 2-1 Distribution of Reported Energy Savings from NR Custom Program Projects by Technology

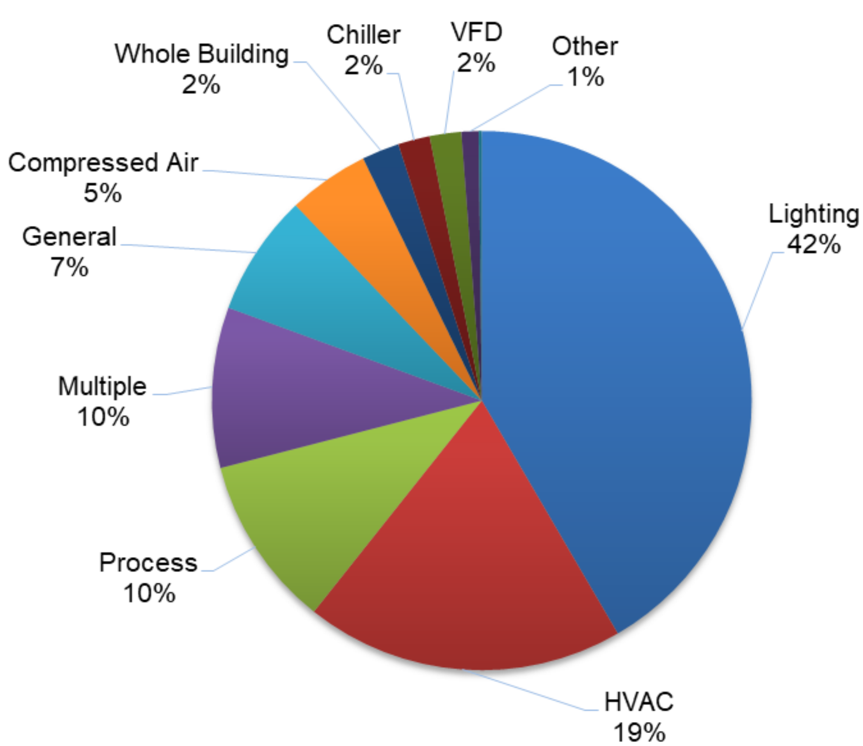


Figure 2-2 Distribution of Reported Summer Demand Savings from NR Custom Projects by Technology

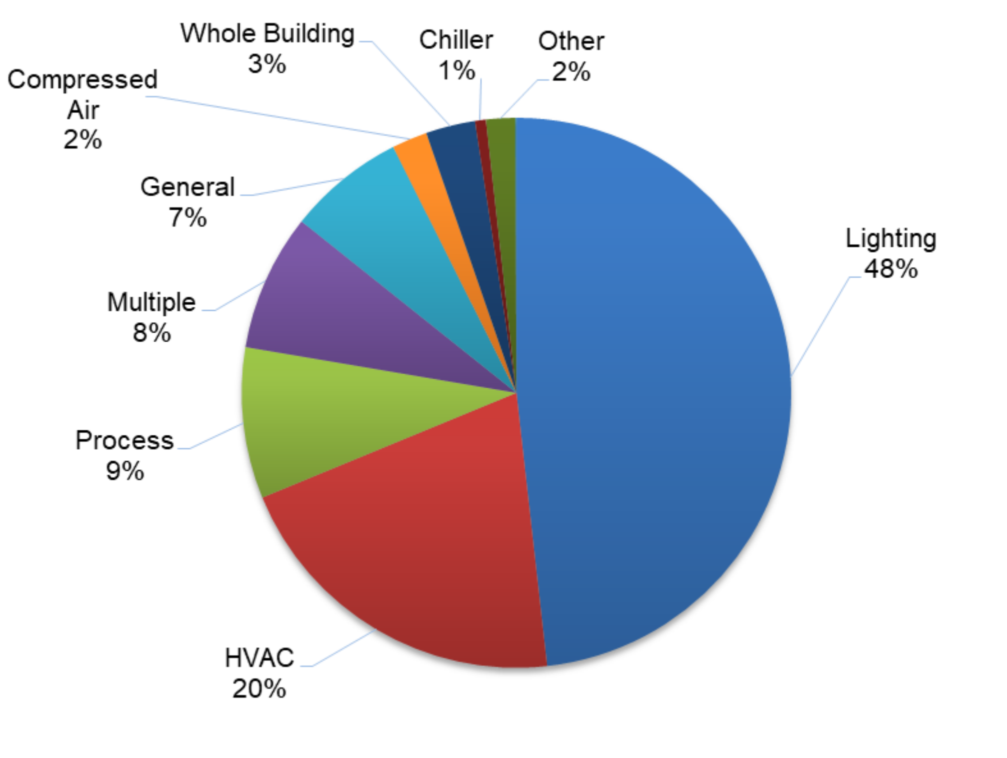
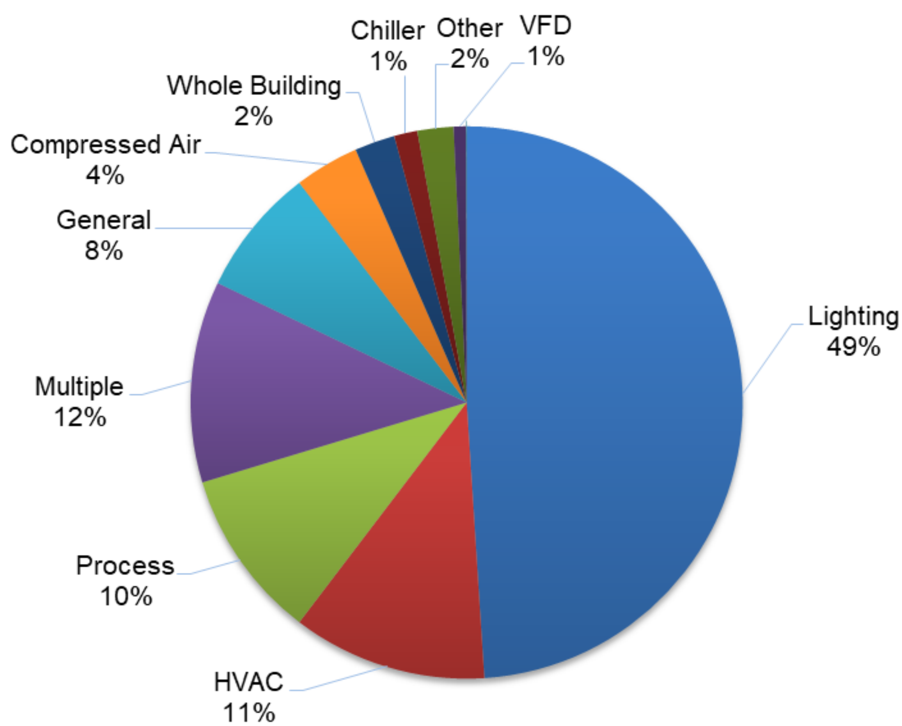


Figure 2-3 Distribution of Reported Winter Demand Savings (kW) from NR Custom Projects by Technology



3 Key Research Objectives

3.1 Gross Impact

The impact evaluation processes followed standard industry protocols and definitions, where applicable, and include the Department of Energy Uniform Methods Protocol[3], as an example. As part of evaluation planning, the evaluation team outlined the following activities for this program evaluation:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for measures and equipment being implemented in customer facilities attributed to the NR Custom Program;
- Assess the rate of free riders from customer and contractor perspectives and determine spillover effects; and,
- Consider and verify measure installation vintage aligns with measure baseline definitions, i.e. early replacement, burnout on failure, new construction etc.

3.2 Net Impact

The goal of the net impact evaluation was to estimate the overall energy impacts that are attributable to the program. This estimate comprises two components: free-ridership and spillover.

Free-ridership is the estimate of what proportion of the program's savings would have happened in the absence of the program. Free-ridership takes into account the customers' plans prior to engaging in the program and the various influences the program can have on the customer such as incentives and other interactions with the program staff, contractors, and marketing materials.

Spillover estimates additional energy savings for efficiency projects that were completed without receiving a program incentive, but were influenced by the program in some other way.

Net program results are calculated through a net-to-gross ratio, as follows:

Net-to-gross = (1 – Free-ridership %) + Spillover %

Net Savings = Net-to-gross (%) * Gross Verified Savings

[3] The DOE's Uniform Methods Project for Determining Energy Efficiency Program Savings can be found at http://www1.eere.energy.gov/office_eere/de_ump.html.

3.3 Process

The evaluation team collected data from a variety of sources to address the researchable questions identified at the beginning of the study. Table 3-1 contains the list of research objectives and the data sources used to investigate each one.

Table 3-1 Process Evaluation Research Questions and Activities

Preliminary Research Questions	Document Review	Interviews with Key Contacts	Participant Survey	Trade Ally Survey
How is the program promoted? How important are account representatives? Are contractors or vendors identifying potential projects?	✓	✓	✓	✓
Understand participant experience. What steps are involved in identifying and scoping projects and obtaining pre-approval? What issues emerge during the process? How are these addressed?		✓	✓	✓
Why do potential projects drop out? Are there opportunities to make the process simpler or more streamlined while maintaining robust quality control (QC)?		✓		✓
Is the uptake of custom vs. custom-to-go projects as expected? How do the projects and/or the customer experience differ between the two participation paths?	✓	✓	✓	✓
What is the customer's decision-making process regarding energy efficiency upgrades or equipment? How influential were various aspects of the program in their decision? How influential was the contractor they worked with?	✓		✓	✓

4 Impact Evaluation

4.1 Approach

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct the evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, include on-site inspections and measurements, utility billing analysis, telephone surveys, documentation review, best practice review, and interviews with implementation staff, trade allies, program participants, and general business customers.

The evaluation team's impact analysis focused on the energy and demand savings attributable to the NR Custom Program for the period of August 2015 through December 2017. A variety of techniques were used to develop independent assessments of gross and net energy savings for each sampled project. All sampled custom projects received both a desk review and on-site verification. Figure 4-1 provides a high-level process flow diagram of all impact evaluation activities and brief summary of each step in the process is provided below.

Figure 4-1 Process Flow Diagram of Impact Evaluation Activities

The evaluation team verified energy and demand savings attributable to the program by conducting the following impact evaluation activities:

- **Sample:** Conduct review of NR Custom Program participant database on a quarterly basis, identify all new projects, and draw representative sample of projects for on-site M&V.
- **Soft Recruit:** Attempt to reach all sampled participants by phone or email, prior to conducting an in-depth review of project documentation or developing a site specific

measurement and verification plan (SSMVP), to inform participants of the ongoing evaluation and request permission to conduct an on-site inspection. Nothing would be formally scheduled during this call.

- **Document (Doc) Review:** Request, receive, and review all project documentation available for those sites successfully recruited.
- **Develop SSMVP:** Develop document providing general overview of the project, reported benefits and costs, proposed level of rigor, M&V equipment, and key data to be gathered in the field.
- **Schedule On-site:** Schedule on-site inspection with participant after Duke team provides comments and approves SSMVP. The purpose of the Duke team reviews were to verify that all measures were included in the plan, reported energy and demand savings were accurate, and proposed M&V approaches were appropriate.
- **On-site M&V:** Verify measure implementation, deploy metering equipment, interview key project personnel, and obtain trend data from existing BAS/EMS systems.
- **Analysis:** Estimate gross verified energy and demand savings for sampled measures and projects using data collected from on-site measurement and verification.
- **M&V Report:** Compare gross-verified energy and demand savings to program-reported values to determine project-level realization rates and summarize findings for each sampled site in M&V report.
- **Gross Verified Savings:** Summarize project-level results to stratum-level for determining program-level realization rates and verified gross energy and demand savings.
- **Net Verified Savings:** Apply attribution survey data to estimate net-to-gross ratios and net-verified savings at the program level.

4.2 Database Review

The program participation database informed many of the evaluation activities including sample design, project-level savings review, and estimating program-level gross verified energy and demand savings. Participation database extracts were requested and received quarterly in real time with the program implementation. After the first round of participation recruitment in 2016, it became evident that a census of participants would need to be incorporated into the "soft-recruiting" effort in order to achieve sample targets from the Evaluation Plan (discussed further in Section 4.3).

Once all newly completed projects were identified, the evaluation team would receive site contact information and sufficient project details so as to initiate preliminary "soft-recruiting" effort by the evaluation team. Once a participant was successfully recruited into the evaluation, the impact team requested detailed project documentation for each project and conducted an in-depth review of all information. While reviewing project documentation, the evaluation team would verify whether parameters such as reported energy and demand savings, energy conservation measure (ECM) quantities, and measure descriptions matched those indicated in the tracking database. Any identified discrepancies between the two sources were then identified in the SSMVP and later resolved based on feedback provided by the Duke program team.

At the conclusion of the project, the evaluation team requested a full database extract for the entire evaluation period (August 2015 through December 2017) for comparison to the compiled database maintained by the evaluation team throughout the course of the evaluation for reconciliation. There were a number of inconsistencies in the database revealed through the reconciliation. Common inconsistencies included:

- Lighting projects where ECM Quantity was indicated as “1” in the tracking database for non one-for-one retrofit measures or measures involving multiple post installation fixture types, but a common baseline fixture type. The actual quantity was usually determined from project documents or the “Measure Name” field within the tracking database itself. [4]
- Inaccurate phone numbers or phone numbers listed as 999-9999, as a generic default. This issue was generally resolved through follow-up information requests.
- No email address for site contact. Also generally resolved through follow-up information requests if participant could not be reached by phone.

The inconsistencies identified do not have a direct impact on overall program performance, but it is recommended that these issues be addressed by the Duke Team internally, when feasible, so as to improve the overall evaluability of the program and eliminate lost effort chasing and correcting them.

4.3 Sampling and Estimation

The gross and net verified energy and demand savings estimates presented in this report from the Duke Energy Ohio Smart $aver Non-residential Custom Program were generally determined through the observation of key measure parameters among a sample of program participants. A census evaluation would involve surveying, measuring, or otherwise evaluating the entire population of projects within a population. Although a census approach would eliminate the sampling uncertainty for an entire program, the reality is that M&V takes many resources both on the part of the evaluation team and the program participants who agree to be surveyed or have site inspections conducted in their business. When a sample of projects is selected and analyzed, the sample statistics can be extrapolated to provide a reasonable estimate of the population parameters. Therefore, when used effectively, sampling can improve the overall quality of an evaluation study. By limiting resource-intensive data collection and analysis to a random sample of all projects, more attention can be devoted to each project surveyed. Sampling also reduces the overall cost of an evaluation compared to a census approach while still maintaining representativeness.

For the NR Custom impact evaluation the most important sampling objective was representativeness – that is that the projects selected in the evaluation were representative of

[4] It should be noted that the baseline and post-retrofit quantities are well-documented elsewhere by the program team outside of the participation tracking database. In fact standard policy is to verify installed equipment quantities prior to issuing payment. The pre- and post-retrofit quantity information isn’t considered by the program to be critical to include in the participation database.

the population they were selected from and would produce unbiased estimates of population parameters. The evaluation team used a ratio estimation technique for this evaluation. This technique assumes that the ratio of the sum of the verified savings estimates to the sum of the reported savings estimates within the sample is representative of the program as a whole. This ratio is referred to as the realization rate, or ratio estimator, and is calculated in Equation 1:

Equation 1: Realization Rate

$$Realization\ Rate = \frac{\sum_i^n Verified\ Savings}{\sum_i^n Reported\ Savings}$$

Where *n* is the number of projects in the evaluation sample. The realization rate is then applied to the claimed savings of each project in the population to calculate gross verified savings.

Stratification

The evaluation team used sample stratification with ratio estimation techniques for the NR Custom Program. Stratification is a departure from simple random sampling (SRS), where each sampling unit (customer/project/rebate/measure) has an identical likelihood of being selected in the sample. Stratified random sampling refers to the designation of two or more sub-groups (strata) from within a program population prior to the selection process.

The evaluation team took great care to ensure that each sampling unit within the population belonged to one (and only one) stratum. In a stratified sample design, the probability of selection is different between strata and this difference must be accounted for when calculating results. The inverse of the selection probability is referred to as the *case weight* and is used in estimation of impacts when stratified random samples are utilized. Consider the following simplified example in Table 4-1 based on a fictional program with two measures; LED lighting and variable frequency drives (VFDs).

Table 4-1 Case Weights Example

Measure	Population Size	Sample Size	Case Weight
LED lamps	15,000	30	500
VFDs	6,000	30	200

Because LED lighting measures are sampled at a higher rate (1-in-200) than VFDs (1-in-500), each sample point carries less weight in the program results than an individual VFD sample point. In general, the evaluation team designed samples so that low case weights were reserved for large and complex measures such as the L-Large and NL-Large strata.

The evaluation team felt that stratification was advantageous and utilized it in the sample design for a variety of reasons:

- Increased precision of the within-stratum variability was expected to be small compared to the variability of the population as a whole. Stratification in this case allows for increased precision and smaller total sample sizes.

- It enabled the evaluation team to ensure that a minimum number of units within a particular stratum were verified.

Presentation of Uncertainty

There is an inherent risk, or uncertainty, that accompanies sampling, because the projects selected in the evaluation sample may not be representative of the program population as a whole with respect to the parameters of interest. As the proportion of projects in the program population that are sampled increases, the amount of sampling uncertainty in the findings decreases. The amount of variability in the sample also affects the amount of uncertainty introduced by sampling. A small sample drawn from a homogeneous population will provide a more reliable estimate of the true population characteristics than a small sample drawn from a heterogeneous population. Variability is expressed using an error ratio for programs that use ratio estimation.

When ratio estimation is utilized, standard deviations will vary for each project in the population. The error ratio is an expression of this variability and is analogous to the coefficient of variation, $C_{v,}$ for simple random sampling.

Equation 2 provides the formula for estimating error ratio.

Equation 2: Error Ratio

$$Error\ Ratio = \frac{\sum_{i=1}^{N} \sigma_i}{\sum_{i=1}^{N} \mu_i}$$

Equation 3 shows the formula used to calculate the required sample size for each evaluation sample, based on the desired level of confidence and precision. Notice that the *Error Ratio* term is in the numerator, so required sample size will increase as the level of variability increases.

Equation 3: Required Sample Size

$$n_0 = (\frac{z * Error\ Ratio}{D})^2$$

Where:

n_0	=	*The required sample size before adjusting for the size of the population*
Z	=	*A constant based on the desired level of confidence (equal to 1.645 for 90% confidence two-tailed test)*
D	=	*Desired relative precision*

The sample size formula shown in Equation 3 assumes that the population of the program is infinite and that the sample being drawn is reasonably large. In practice, this assumption is not always met. For sampling purposes, any population greater than approximately 7,000 may be considered infinite for the purposes of sampling. For smaller, or finite, populations, (such as the Duke Energy Ohio NR Custom participant population) the use of a finite population correction factor (FPC) is warranted. This adjustment accounts for the extra precision that is gained when the sampled projects make up more than about 5% of the program savings. Multiplying the results of Equation 3 by the FPC formula shown in Equation 4 will produce the required sample size for a finite population.

Equation 4: Finite Population Correction Factor

$$fpc = \sqrt{\frac{N - n_0}{N - 1}}$$

Where:

N = *Size of the population*

n_0 = *The required sample size before adjusting for the size of the population*

The required sample size (*n*) after adjusting for the size of the population is given by Equation 5.

Equation 5: Application of the Finite Population Correction Factor

$$n = n_0 * fpc$$

Verified savings estimates always represent the point estimate of total savings, or the midpoint of the confidence interval around the verified savings estimate for the program. Equation 6 shows the formula used to calculate the margin of error for a parameter estimate.

Equation 6: Error Bound of the Savings Estimate

$$Error\ Bound = se * (z - statistic)$$

Where:

se = *The standard error of the population parameter of interest (proportion of realization rate, total energy savings, etc.) This formula will differ according to the sampling technique utilized.*

$z - statistic$ = *Calculated based on the desired confidence level and the standard normal distribution.*

The 90% confidence level is a widely accepted industry standard for reporting uncertainty in evaluation findings. The confidence levels and precision values presented in this report are at the 90% confidence level. The z-statistic associated with 90% confidence is 1.645.

When evaluators or regulators use the term “90/10”, the 10 refers to the relative precision of the estimate. The formula for relative precision shown in Equation 7:

Equation 7: Relative Precision of the Savings Estimate

$$Relative\ Precision_{Verified\ Savings} = \frac{Error\ Bound_{(kWh\ or\ kW)}}{Verified\ Impact_{(kWh\ or\ kW)}}$$

An important attribute of relative precision to consider when reviewing achieved precision values is that it is “relative” to the impact estimate. Therefore programs with low realization rates are likely to have larger relative precision values because the error bound (in kWh or kW) is being divided by a smaller number. This means two programs with exactly the same reported savings and sampling error in absolute terms, will have very different relative precision values, as shown in Table 4-2.

Table 4-2 Relative Precision Example

Program	Reported kWh	Realization Rate	Error Bound (kWh)	Verified kWh	Relative Precision (90%)
Program #1	4,000,000	0.5	400,000	2,000,000	± 20%
Program #2	4,000,000	1.0	400,000	4,000,000	± 10%

In many cases a program-level savings estimate requires summation of the verified savings estimates from several strata. In order to calculate the relative precision for these program-level savings estimates, the evaluation team used Equation 8 to estimate the error bound for the program as a whole from the stratum-level error bounds.

Equation 8: Combining Error Bounds across Strata

$$Error\ Bound_{Program} = \sqrt{Error\ Bound^2_{Stratum1} + Error\ Bound^2_{Stratum2} + Error\ Bound^2_{Stratum3}}$$

Using this methodology, the evaluation team developed verified savings estimates for the program and an error bound for that estimate. The relative precision of the verified savings for the program is then calculated by dividing the error bound by the verified savings estimate.

4.4 Targeted and Achieved Sampling

Table 4-3 presents the final achieved sample size for Duke's Ohio service territory based on data collection activity (verification and M&V) and the program delivery stream method (Classic versus Custom-to-Go). Impact sample sizes targeted a 90/10 confidence precision based on the expected participation counts for the evaluation period. Samples were selected on an on-going basis across the evaluation period (August 2015 - December 2017) to help ensure proper representation of measure types and program approaches as the program progressed.

Table 4-3 NR Custom Sampling Plan Custom-to-Go vs. Custom Classic - Achieved

Utility	Data Collection Activity	Custom to Go	Classic	Total
Duke Energy Ohio	Share of Participation	42%*	58%*	100%
	Site Visits – On-site Measurement	16	20	36
	Site Visits – On-site Verification	6	11	17
	Total	**22**	**31**	**53**

* Percentages are representative of project counts (58 of 137 enrollment IDs went through Custom-to-Go track). Distribution of program-level savings was 7% Custom-to-Go / 93% Custom Classic.

The evaluation team stratified the participant population by technology category (lighting vs. non-lighting) and relative magnitude of savings (kWh) to ensure that the evaluated sample represented the population make-up of the total program-level savings and in order to achieve higher statistical precision by reducing the variability within the sample. Our stratification approach and achieved sample sizes are summarized in Table 4-4.

Table 4-4 NR Custom Stratified Sampling - Achieved

Strata	Population	Pop Reported Savings (kWh)	Achieved Sample Size
L-Large (>400 MWh)	16	24,502,606	2
L-Small (<400 MWh)	110	11,301,697	36
NL-Large (>1,000 MWh)	17	38,284,556	3
NL-Small (<1,000 MWh)	52	12,831,537	12
Total	**195**	**86,920,395**	**53**

4.5 Data Collection

As outlined in prior sections, the gross impact evaluation process began with a thorough review of project documentation. This information was provided upon formal request. Documents commonly provided by the program team include:

- Smart $aver Incentive Calculation workbooks
- DSMore Summary workbooks
- Custom Incentive Application Forms
- Contractor Proposals
- Detailed project narratives
- Product specifications and invoices
- Customer utility data (billing history)
- Incentive payment request forms
- Email correspondence between members of the program management team and participants
- Other documents commonly provided on lighting project include:
  - Smart $aver Custom Incentive Program Lighting Calculators
  - Specification sheets for retrofit lighting systems
- Other documents commonly provided for non-lighting projects include:
  - Customer submitted energy and demand savings calculations
  - Detailed reports developed by third-party engineering consultants
  - Building energy simulation model output files

After reviewing all program-supplied project documentation the evaluation team engineer assigned to each project then developed a site-specific measurement and verification plan (SSMVP) for each unique premise. These were developed in order to create a standardized, rigorous process for the verification of project claims while on-site. Each SSMVP was specifically tailored to verify the equipment that was installed and measures that were implemented per the provided project documentation. The SSMVP also identified baseline assumptions for verification with on-site personnel in order to validate ex-ante, forecasted savings estimates.

Each SSMVP also identified the specific parameters to be gathered in the field for each measure. These plans followed guidelines set forth in multiple Department of Energy Uniform Methods Project (DOE UMP) protocols including:

- Chapter 2: Commercial and Industrial Lighting Evaluation Protocol
- Chapter 14: Chiller Evaluation Protocol
- Chapter 18: Variable Frequency Drive Evaluation Protocol
- Chapter 19: HVAC Controls (DDC/EMS/BAS) Evaluation Protocol
- Chapter 22: Compressed Air Evaluation Protocol
- Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol

The plans also identify a preferred and one or two alternate analysis approaches (level of rigor) along with the critical data to be gathered for each. Regardless of the method ultimately selected for the savings analysis, field engineers were instructed to gather the data necessary for all methods identified in the SSMVP. Table 4-5 provides a few examples of the data points typically gathered for several of the more commonly-encountered energy conservation measures (ECMs).

Once completed each SSMVP was then submitted to the Duke EM&V Team for review and approval. Upon approval from Duke an on-site inspection was then scheduled with the participant.

4.5.1 On-site Verification Activities

During on-site verification, field engineers would verify that measures were appropriately implemented in accordance with the SSMVP developed for the site. Field engineers would also deploy metering equipment for short-term monitoring of parameters such as lighting hours of use, energy consumption (amps or kW), and loads. They also requested copies of equipment specifications and sequences of operation, as appropriate. Any available historic trend data (when available) was also obtained from existing HVAC control and central plant sequencing control systems.

Table 4-5 Key Data Points Gathered for Commonly Encountered ECMs

Measure Name	Baseline or Retrofit
Interior Lighting Retrofits	Quantity of existing and retrofit fixtures Fixture type of existing and retrofit fixtures Existing fixture controls, if any New fixture controls, if any Typical schedule and hours of operation Space temperature Type of heating and cooling equipment/specifications
HVAC Control/EMS	Determine baseline setpoints and schedules through customer interviews Determine post-retrofit setpoints and schedules through central BAS Obtain any available trend data Verify occupancy and equipment schedules Gather nameplate information from primary heating and cooling systems
Variable Speed Drive on Pump	Determine baseline method of pump control Determine conditions that dictate the speed of the VSD Determine whether loads modulate or are fairly constant If loads modulate, determine load profile (% load bins) Nameplate information from pump Nameplate information from VSD Gather any available trend data Deploy metering equipment capable of measuring true polyphase RMS power Perform spot power measurements (kW) of pump while running under normal operating conditions
VSD Air Compressor	Determine baseline method of control Gather information on baseline air compressor system (kW/CFM, hp, CFM output, system type, etc.) Determine how loads vary daily, weekly, seasonally, annually for VSD compressor Nameplate information from new air compressor Gather any operational parameters displayed on control panels Gather any available trend data from central controls system Determine whether compressor serves central plant with multiple compressors or is stand-alone. If part of multi-compressor plant determine role and sequences of operation (primary, secondary, trim, etc.) Deploy metering equipment capable of measure true polyphase RMS power

4.6 Level of Rigor

A variety of analysis approaches were utilized for the impact evaluation. The approach applied was decided based upon the methods used by the participant, trade ally, or program in generating the ex-ante[5] savings estimates, the availability of information, and the extent of interactive effects. An overview of each analysis approach applied is provided in Sections 4.6.1 through 4.6.3.

4.6.1 Basic Rigor: Simple Engineer Model (SEM) with On-Site Measurement

Consistent with IPMVP Option A (Partially Measured Retrofit Isolation), this approach was used for the majority of lighting, custom process, and compressed air measures. This method uses engineering calculations, along with site measurements of a limited number of important parameters, to verify the savings resulting from specific measures. This was the most prevalent level of rigor applied for this evaluation.

An overview of the key inputs and algorithms used to develop energy and demand savings estimates for lighting measures and compressed air measures is provided in Section 4.6.1.1 and 4.6.1.2.

4.6.1.1 Lighting Measures

Equation 9 and Equation 10 were used to calculate energy and demand savings for all lighting retrofit measures.

Equation 9: Lighting Demand Savings

$$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1000 \times WHF_d$$

Equation 10: Lighting Annual Energy Savings

$$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1000 \times HoursWk \times Weeks \times WHF_e$$

Where:

Qty_{BASE} = *Quantity of baseline fixtures*

$Watts_{BASE}$ = *Watts of baseline fixture (based on the specified existing fixture type) (Watts)*

Qty_{EE} = *Quantity of energy efficient fixtures*

$Watts_{EE}$ = *Watts of energy efficient fixture (based on the specified installed fixture type) (Watts)*

HoursWk = *Weekly hours of equipment operation (hrs/week)*

Weeks = *Weeks per year of equipment operation (weeks/year)*

[5] The term “ex ante” represents the forecasted energy and demand savings rather than the actual results.

WHF_d	=	*Waste heat factor for demand to account for cooling savings from efficient lighting**
WHF_e	=	*Waste heat factor for energy to account for cooling savings from efficient lighting**
1000	=	*Conversion: 1000 Watts per kW*

Fixture Wattages

The pre-existing fixture wattages were quoted from industry standards and commercial literature for the applicable type of fixtures.

The installed light fixture wattages were taken from the manufacturer's cut sheets.

Hours of Use

Nexant verified hours of use assumptions by deploying lighting loggers. The lighting operating hours may exceed the facility's posted hours of business.

4.6.1.2 Compressed Air Measures

Energy use reduction for all compressor projects can be calculated by the difference between the energy consumed in the baseline operation minus the energy consumed in the post-retrofit operation. Generally, information is required for compressor capacity in both the baseline and post-retrofit scenarios. Appropriate adjustments are made to ensure the flow profile is equivalent between pre- and post-retrofit conditions unless demand improvements have been made that result in a change in the flow profile. Compressor power at full load can be calculated using Equation 11 and Equation 12.

Equation 11: Compressor Power at Full Load (No VSD)

$$\text{Full Load } kW_{rated} = \frac{(\text{Compressor hp}) \times LF_{rated} \times (0.746\ kW/hp)}{(\eta_{motor})}$$

Equation 12: Compressor Power at Full Load (w/ VSD)

$$\text{Full Load } kW_{rated} = \frac{(\text{Comp hp}) \times LF_{rated} \times (0.746\ kW/hp)}{(\eta_{motor}) \times (\eta_{VSD})}$$

Where:

Comp hp	=	*compressor horsepower, nominal rating of the prime mover (motor)*
0.746	=	*horsepower to kW conversion factor*
η_{moto}	=	*motor efficiency (%)*
η_{VSD}	=	*variable-speed drive efficiency (%)*
LF_{rated}	=	*load factor of compressor at full load (typically 1.0 to 1.2)*

The above methods for determining the instantaneous demand of an air compressor at a given load is then repeated for many bins of hour-CFM operation. This is commonly referred to as a CFM demand profile. A demand profile is developed to provide accurate estimates of annual energy consumption. A demand profile typically consists of a CFM-bin hour table summarizing hours of usage under all common loading conditions throughout a given year.

The annual CFM profile is used to determine base case and proposed case energy use. For both, compressor electricity demand for each CFM-bin is determined from actual metering data, spot power measurements, historical trend data or CFM-to-kW lookup tables.

The difference in energy consumption between an air compressor operating in idling mode and being physically shut down can be significant depending on the base case and post-retrofit case methods of system control. For example, a rotary screw compressor with inlet valve modulation (w/blowdown) controls will draw 26% of full-load power (kW) when operating in idling mode; whereas a VSD-controlled system (w/stopping) has zero load for the same bin-hours. Table 4-6 shows the average percent power versus percent capacity for rotary screw compressors with various control methods[6].

Table 4-6 Average Percent Power versus Percent Capacity for Rotary Screw Compressors with Various Control Methods

	% Power							
% Capacity	**On/Off Control**	**Load/Unload (1 gal/CFM)**	**Load/Unload (10 gal/CFM)**	**Inlet Valve Modulation (w/o Blowdown)**	**Inlet Valve Modulation (w/Blowdown)**	**Variable Displacement**	**VSD w/Unloading**	**VSD w/Stopping**
0%	0%	27%	27%	71%	26%	25%	12%	0%
10%	10%	32%	35%	74%	40%	34%	20%	12%
20%	20%	63%	42%	76%	54%	44%	28%	24%
30%	30%	74%	52%	79%	62%	52%	36%	33%
40%	40%	81%	60%	82%	82%	61%	45%	41%
50%	50%	87%	68%	86%	86%	63%	53%	53%
60%	60%	92%	76%	88%	88%	69%	60%	60%
70%	70%	95%	83%	92%	92%	77%	71%	71%
80%	80%	98%	89%	94%	94%	85%	80%	80%
90%	90%	100%	96%	97%	97%	91%	89%	89%
100%	100%	100%	100%	100%	100%	100%	100%	100%

[6] Source: Department of Energy Uniform Methods Project: Chapter 22: Compressed Air Evaluation Protocol

The energy consumption for each CFM-bin is determined from the product of the average compressor demand and the number of hours in each bin (Equation 13). The sum of the kWh bin values gives the annual consumption (Equation 14).

Equation 13: Energy Consumption of CFM-bin

$$\Delta kWh_{bin1} = (Base\ kW_{operating\_bin1} - Post\ kW_{operating\_bin1}) \times CFM\text{-}bin\ 1\ Hours$$

$$\Delta kWh_{binN} = (Base\ kW_{operating\_binN} - Post\ kW_{operating\_binN}) \times CFM\text{-}bin\ N\ Hours$$

Where:

$Base\ kW_{operating\_bin1}$ = *baseline demand at part-load associated with CFM-bin 1*

$Post\ kW_{operating\_bin1}$ = *post demand at part-load associated with CFM-bin 1*

$Base\ kW_{operating\_binN}$ = *baseline demand at part-load associated with CFM-bin N*

$Post\ kW_{operating\_binN}$ = *post demand at part-load associated with CFM-bin N*

Equation 14: Total Energy Consumption of All CFM-bins

$$Total\ Energy\ Reduction\ (kWh/yr) = \sum_{o\text{-}n} [\ \Delta kWh_{bin1} + \Delta kWh_{bin2} + \ldots + \Delta kWh_{binN}\ ]$$

Where:

ΔkWh_{bin1} = *energy reduction for CFM-bin 1*

ΔkWh_{binN} = *energy reduction for CFM-bin N*

4.6.2 Basic Rigor: Simple Engineer Model (SEM) with On-Site Verification Only

This approach is very similar to SEM with On-site Measurement, but without direct measurement of key parameters. This approach was generally applied to measures that are not conducive to direct measurement such as outdoor lighting or building envelope improvements. This approach was also used in instances where process equipment could not be de-energized for the purposes of deploying metering equipment. The algorithms and inputs described in Section 4.6.1 are still applicable to this approach.

4.6.3 Enhanced Rigor: Billing Analysis with On-Site Verification Only

Consistent with IPMVP Option C (Whole Building), this approach was used for projects involving multiple HVAC control measures with interactive effects, when final ex ante building simulation models could not be obtained from the trade ally. It was also used for large industrial custom process measures involving equipment that could not be de-energized to accommodate installation of data logging equipment. This approach was only applied on projects where the reported gross energy savings exceeded 10% of annual energy consumption. This approach entailed a pre- and post-retrofit comparison of weather-normalized whole facility energy consumption. This approach adhered to guidelines set forth in the Department of Energy Uniform Methods Project Protocols for HVAC Controls (Chapter 19) and Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol (Chapter 8).

Our general approach consisted of the following:

1. Fit a premise-level degree-day regression model separately for the pre- and post-periods.
2. For each period (pre- and post-) use the coefficients of the fitted model with normal year degree days to calculate weather-normalized annual consumption (NAC) for that period.
3. Calculate the difference between the pre- and post-period NAC for the site.

This approach was used for four of the Custom Incentive Participant projects. Outlined below is the step-by-step process for this analysis:

Step 1. Fit the Regression Model: The degree-day regression for the site and year (pre or post) are modeled as:

Equation 15: Average Consumption per Day

$$E_m = \mu + \beta_H H_m + \beta_C C_m + \varepsilon_m$$

Where:

E_m	=	*Average consumption per day during interval m*
H_m	=	*Specifically, $H_m(T_H)$, average daily heating degree days at the base temperature (T_H) during meter read interval m, based on daily average temperatures on those dates*
C_m	=	*Specifically, $C_m(T_C)$, average daily cooling degree days at the base temperature (T_C) during meter read interval m, based on daily average temperatures on those dates*
μ	=	*Average daily baseload consumption estimated by the regression*
β_H, β_C	=	*Heating and cooling coefficients estimated by the regression*
ε_m	=	*Regression residual*

Step 2. Applying the Model: To calculate NAC for the pre- and post-installation periods for the given site and timeframe, combine the estimated coefficients μ, β_H, and β_C with the annual normal-year or typical meteorological year (TMY) degree days H_0 and C_0 calculated at the site-specific degree-day base, T_H and T_C. The example shown below puts all premises and periods on an annual and normalized basis.

Equation 16: Weather-Normalized Annual Consumption

$$NAC = \mu * 365.25 + \beta_H H_0 + \beta_C C_0$$

Step 3. Calculate the Change in NAC: The difference between pre- and post-program NAC values (ΔNAC) represents the change in consumption under normal weather conditions.

4.6.4 Peak Period Definition

Demand savings were evaluated based on the definition of the peak period provided by Duke Energy, as summarized Table 4-7.

Table 4-7 Definition of Peak Demand Periods

	Summer	Winter
Month	July	January
Hour	3pm – 4pm	7pm – 8pm

4.7 Measurement & Verification Reports

Once a savings analysis was complete all findings from on-site verification and each project-level savings analysis was summarized in a standalone Measurement and Verification Report. Each report contained the full contents of the original SSMVP (Sections 1 through 3) prepared in advance of the on-site inspection as well as a new section (Section 4) summarizing all site visit findings, the chosen approach for quantifying energy savings, the verified energy and demand savings, and commentary on reasons for differences between the reported and verified savings values. Each individual M&V Report was then submitted to the Duke EM&V Team for review, comment, and approval. The 55 individual M&V Reports developed as part of this evaluation were provided under separate cover.

4.8 Impact Evaluation Analysis and Findings

4.8.1 High Level Findings

4.8.1.1 Continue with Current Work

Based upon the results of the gross impact evaluation it is evident that the level of rigor being applied to each project as it goes through the application process of the NR Custom Program is resulting in accurate estimates of energy and demand savings. The practice of subjecting each project to a thorough engineering review by AESC followed by a high-level review by the program team seems to be providing a level of quality control that minimizes calculation errors or instances of over-claimed energy or demand savings. The strata-level realization rates also indicate that an appropriate level of rigor is being applied to every project regardless of its size (magnitude of energy /demand savings) or measure category (lighting vs. non-lighting).

4.8.1.2 Interactive Energy Changes for Lighting Retrofits

How energy-efficiency projects change the energy use of other equipment, not associated directly with the projects themselves, should be a consideration in estimating the energy efficiency program benefits. These interactive energy changes can be challenging to quantify, but should be accounted for whenever possible.

Interactive energy changes come in a number of forms and affect different fuel types. A measure that directly saves electricity may cause another building system to consume less energy. Alternatively, a measure that directly saves electricity could cause another building system to consume more energy. Sometimes, a single project can have both positive and negative interactive effects on other systems. For example, upgrading to energy efficient lighting reduces the electricity that a participant uses on lighting; the associated reduction in waste heat reduces the burden on the cooling system in the summer – but increases the burden on the heating system in the winter.

Lighting projects produce relatively predictable interactive energy changes enabling the development of stipulated factors through building energy simulation modeling. For this evaluation building energy simulation models were developed for 18 facility types using DOE-2 based modeling software and Database of Energy Efficiency Resources (DEER) building prototypes. A single set of models was developed for the DEO service territory using TMY3 weather data from the Cincinnati/Northern Kentucky International Airport (CVG) weather station. Table 4-8 presents the interactive factors developed by the evaluation team for each building type and weather station. The CVG weather station aligns with Duke Energy Ohio's service territory.

Table 4-8 Interactive Factors by Facility Type and Weather Station

Building Type	CVG Interactive Factors (IF)
Assembly	106.3%
Bio Tech Manufacturing	109.6%
Community College	104.8%
Hospital	107.7%
Hotel	110.2%
Light Industrial Manufacturing	102.6%
Motel	119.9%
Nursing Home	126.6%
Office Large	103.2%
Office Small	102.8%
Primary School	101.8%
Restaurant Fast Food	102.6%
Restaurant Sit Down	98.5%
Retail Large	104.0%
Retail Small	102.2%
Secondary School	102.6%
University	109.9%
Warehouse Conditioned	107.0%

Interactive effects were estimated for each facility type by simulating a reduction in annual lighting end use energy consumption of approximately 4%. This value was chosen based upon Nexant's experience with evaluating other custom and prescriptive lighting programs across the country.

Table 4-9 provides an overview of the verified energy savings attributed to interior lighting measures within conditioned spaces and the relative contribution to savings by interactive effects estimated by the evaluation team. Total savings attributable to interactive effects within the evaluated sample is estimated to be approximately 115,431 kWh or 2.5% of total verified energy savings for all lighting projects. Interactive effects account for approximately 6.4% of verified energy savings for projects with space cooling.

Table 4-9 Verified Energy Savings (kWh) and Relative Contribution of Interactive Effect Savings by Facility Type from Evaluated Sample for Facilities with Space Cooling

Building Type	Verified Energy Savings (kWh)	Interactive Effects Savings (kWh)	% Savings Attributable to Interactive Effects
Assembly	358,745	7,034	2.0%
Hospital	1,000	72	7.1%
Light Industrial Manufacturing	679,221	17,110	2.5%
Nursing Home	332,993	69,965	21.0%
Office Large	8,234	257	3.1%
Restaurant Fast Food	39,489	2,116	5.4%
Retail Large	65,302	2,511	3.8%
Retail Small	42,388	919	2.2%
Secondary School	47,534	1,198	2.5%
Warehouse Conditioned	234,344	14,250	6.1%
Total	**1,809,250**	**115,431**	**6.4%**

4.8.1.3 Documentation of Baseline Assumptions on New Construction Lighting Projects

Assumptions used in ex ante energy savings estimates are fairly well-documented, but there are opportunities for improvement on new construction lighting projects as well as some non-lighting projects. Through the course of the evaluation and in correspondence with the Duke EM&V Team it was discovered that the approach to baseline assumptions on new construction lighting projects is not necessarily uniform.

Baseline lighting demand (kW) is either estimated using the area (ft^2) and the maximum allowable lighting power density (Watts/ft^2) for the applicable space type, or an assumed baseline fixture type specified by the participant in the Custom Lighting Worksheet. As a general practice the EM&V Team uses whichever approach results in the most conservative estimate of project-level savings.

The evaluation team agrees with this practice, but it is recommended that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet. This will provide better transparency to the evaluator when assessing project-level savings.

Figure 4-2 provides a hypothetical example of how baseline assumptions on a new construction lighting project could be documented within the incentive calculation spreadsheet utilized by the Duke program team.

Figure 4-2 Example of Documenting Baseline Assumption in Smart $aver Custom Incentive Calculation Workbook

Notes:
FINAL: ECM#1 removed because it was not installed. Project cost adjusted for ECM#4 based on invoice. Corrected standard nighttime hours form 4368 to 4380
Rev2: Incentive amounts updated
NOTE: Elected to use customer-specified baseline fixture types in lieu of space-by-space Lighting Power Density approach as this results in more conservative estimate of savings.

	EI	Technology	Sub-Technology	Monthly Data Provided	Unit of Measure	Applicant estimated annual kWh savings	Perf. Incentive Weight %	ECM Quantity	Before Implementation: Summer Peak kW per Unit	Winter Peak kW per Unit	Customer Peak kW per Unit	Annual hours use
6		Lighting	LED	NO	Per Lamp/Fix	#DIV/0!		0				
6		Lighting	LED	NO	Per Lamp/Fix	46		27	0.120	0.120	0.120	3,796
6		Lighting	LED	NO	Per Lamp/Fix	822		4	0.000	0.291	0.291	4,380
6		Lighting	LED	NO	Per Lamp/Fix	563		50	0.000	0.452	0.452	4,380
6		Lighting	LED	NO	Per Lamp/Fix	987		30	0.452	0.452	0.452	3,796

4.8.2 Gross Impacts

Table 4-10, Table 4-11, and Table 4-12 summarize gross impact results for energy (kWh), Summer demand (kW), and Winter demand (kW). Detailed results for each sampled project are provided in the standalone M&V Reports.

The realization rates for the Non-Lighting – Large stratum were lower than the other three strata primarily due to two large projects that had realization rates below 70%. On one of the projects the low realization rate was ultimately attributed to the customer and program using a top-down approach to estimating project-level savings based upon results from a similar scope of work implemented at a similar manufacturing facility. The evaluation team used a bottom-up approach based upon historic production data and trend data available from the central control system.

The other Non-Lighting – Large project that had a lower realization rate was an HVAC-EMS project where a weather-normalized analysis of pre- and post-retrofit billing data (IPMVP Option C) showed that achieved energy savings were approximately 34% lower than claimed savings.

Table 4-10 Gross Verified Energy Savings (kWh) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	16	2	24,502,606	27,247,510	111.2%	3.8%
L-Small (<400 MWh)	110	36	11,301,697	10,896,832	96.4%	32.7%
NL-Large (>1,000 MWh)	17	3	38,284,556	26,618,948	74.8%	20.4%
NL-Small (<1,000 MWh)	52	12	12,831,537	11,150,566	86.9%	22.1%
Total	**195**	**53**	**86,920,395**	**77,913,856**	**89.6%**	**9.4%**

Table 4-11 Gross Verified Summer Demand Savings (kW) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kWh)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	16	2	3,513	3,883	110.5%	2.8%
L-Small (<400 MWh)	110	36	1,901	1,887	99.2%	39.2%
NL-Large (>1,000 MWh)	17	3	3,800	2,385	62.8%	10.0%
NL-Small (<1,000 MWh)	52	12	1,934	2,058	106.4%	20.8%
Total	**195**	**53**	**11,148**	**10,213**	**91.6%**	**8.8%**

Table 4-12 Gross Verified Winter Demand Savings (kW) by Stratum

Stratum	Population (N)	Sample Count (n)	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	Realization Rate (%)	Relative Precision @ 90% Confidence
L-Large (>400 MWh)	16	2	3,126	3,205	102.5%	13.3%
L-Small (<400 MWh)	110	36	1,664	1,482	89.1%	59.8%
NL-Large (>1,000 MWh)	17	3	3,304	2,143	64.9%	5.4%
NL-Small (<1,000 MWh)	52	12	1,685	1,789	106.2%	18.7%
Total	**195**	**53**	**9,779**	**8,619**	**88.1%**	**12.1%**

Additionally, consistent with Ohio SB310, the higher of the evaluated estimates of energy efficiency impacts or the deemed values are applied prospectively to adjust subsequent impact assumptions until superseded by new EM&V results[7]. The deemed impacts reported for the Smart $aver NR Custom program were found to be greater than the verified savings and therefore the deemed results shall be applied to the rider in the month following the completion of this EM&V report. These results will also be used to estimate future target achievement levels for development of estimated incentives and in future cost-effectiveness evaluations. Table 4-13 below summarizes the program claimed, deemed, and evaluated values.

Table 4-13 DEO Program Impact Summary

	Energy kWh	Summer Demand (kW)	Winter Demand (kW)
Gross Claimed Impacts	86,920,395	**11,148**	**9,779**
Deemed Realization Rate	95.0%	95.0%	95.0%
Deemed Savings	**82,574,375**	**10,591**	**9,290**
Evaluated Realization Rate	89.6%	91.6%	88.1%
Evaluated Savings	**77,913,856**	**10,212**	**8,615**

[7] Per Section 4928.66(B) of the Revised Code from Senate Bill 310, energy efficiency savings and peak demand reduction achieved on and after the effective date of S.B. 310 of the 130th general assembly shall be measured on the higher of an as found or deemed basis, except that, solely at the option of the electric distribution utility, such savings and reduction achieved since 2006 may also be measured using this method.

4.8.2.1 Custom-to-Go vs. Custom Classic

Custom-to-Go realization rates were higher primarily based upon the fact that the majority of savings come from lighting measures. Lighting measures represent 99.5% of total Custom-to-Go project reported energy savings, whereas for Classic Custom projects lighting measures account for only 37% of gross reported energy savings. Figure 4-3 shows the distribution of reported energy savings for classic custom projects broken down by technology category.

Figure 4-3 Distribution of Reported Energy Savings for Classic Custom Projects by Technology Category

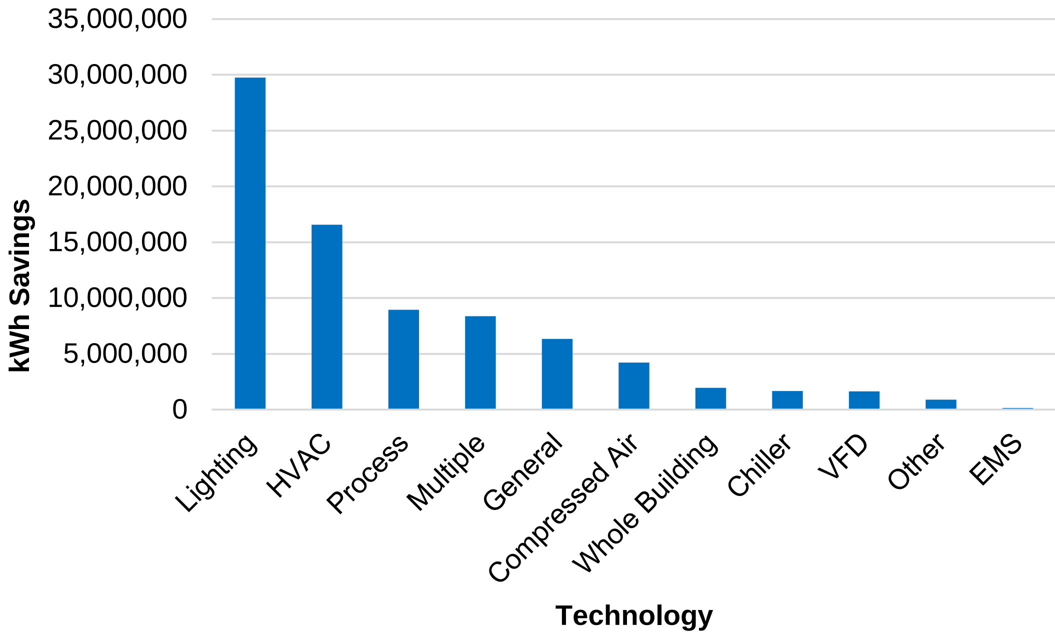


Table 4-14 indicates the reported and verified energy (kWh) savings stratified by technology category (lighting vs. non-lighting) and participation track (Custom Classic vs. Custom-to-Go) for the evaluated sample. Realization rates were generally higher for Custom-to-Go projects since the majority of the energy savings comes from lighting retrofits.

Table 4-14 Comparison of Strata-Level Realization Rates - Classic vs. Custom-to-Go[8]

Track	Measure Category	Sample	Sample Reported (kWh)	Sample Verified (kWh)	Realization Rate (%)
Classic	Lighting	17	3,036,838	3,244,886	106.9%
	Non-lighting	14	7,429,531	5,842,836	78.6%
	Total	**31**	**10,466,369**	**9,087,722**	**86.8%**
Custom-to-Go	Lighting	21	1,490,314	1,400,378	94.0%
	Non-lighting	1	11,247	12,656	112.5%
	Total	**22**	**1,501,560**	**1,413,034**	**94.1%**

4.8.2.2 Baseline Assumptions for Linear Fluorescent T12 Fixture Retrofits

Starting in 2017, the evaluation team agreed to ask participants and trade allies about the continued use of linear fluorescent T12 lamps. The evaluation team sought to understand how claimed energy savings for linear fluorescent to LED retrofit measures would be estimated with a T8 baseline as opposed to a T12 baseline, even if the pre-existing fixture was a T12. Additionally, the research sought to understand how high Color Rendering Index (CRI) T12s are still readily available in the marketplace enabling participants to continue using T12 lighting systems. This research was completed in a cross-cutting manner for NR Custom evaluations for multiple Duke jurisdictions including Ohio, Ohio, North Carolina, and South Carolina.

In an effort to gain direct insights on this issue from participants and trade allies, the evaluation team developed a battery of survey questions for each program participant and incorporated them into the survey instruments developed for this evaluation. The set of survey questions developed for participants was only fielded by those who implemented lighting retrofits involving linear fluorescent T12s, which was very limited (total of four participants across all jurisdictions being evaluated and only one from DEO). The questions asked and a summary of the responses received are summarized below.

Participant Surveys

Sampled participants with projects involving T12 retrofits (4) were asked:

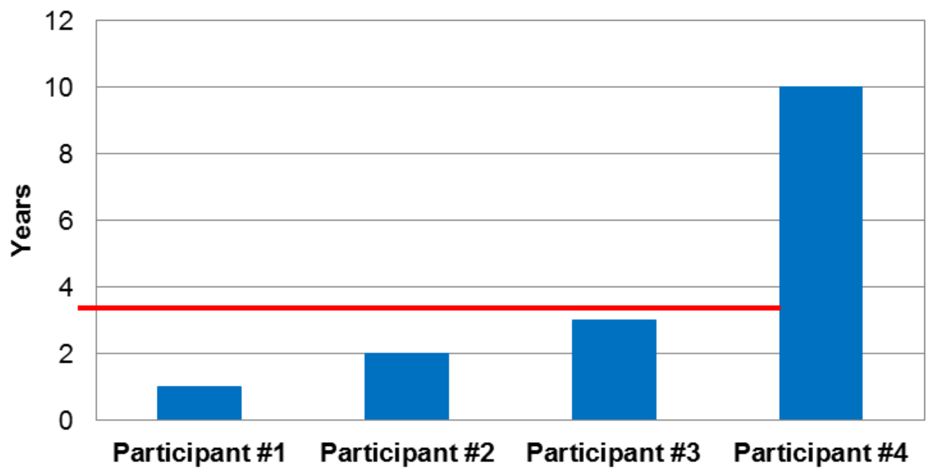
- **Question #1:** *"Would you have continued using linear fluorescent T12 fixtures if you had not received a financial incentive to upgrade to LED?"*
  - Two respondents said *"Yes"*
  - Two respondents said *"No"*
- **Question #2:** *"Were you previously purchasing high Color Rendering Index (CRI) T12 replacement lamps as a means of postponing full fixture replacements?"*

[8] Note that all savings presented in Table 4-13 reflect sampled projects only.

- Two respondents said *"Yes"*
- Two respondents said *"No"*

- **Question #3:** "How long could replacement lamps have allowed you to continue to use T12 fixtures?" (Responses in Figure 4-4)

Figure 4-4 How Long Participant Could Have Continued Using T12 Fixtures

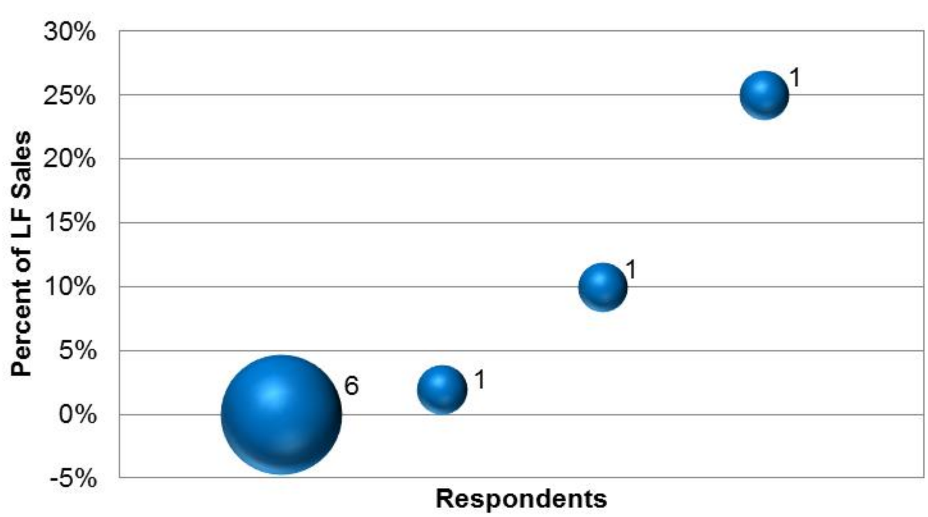


Trade Ally Surveys

Trade allies were asked the following questions regarding historic 2017 sales and forecasted 2018 sales for linear fluorescent T12 lamps and fixtures:

- **Trade Ally Question #1: "**Of your linear fluorescent lighting system sales in 2017, what percent were T12s?" (Responses in Figure 4-5)

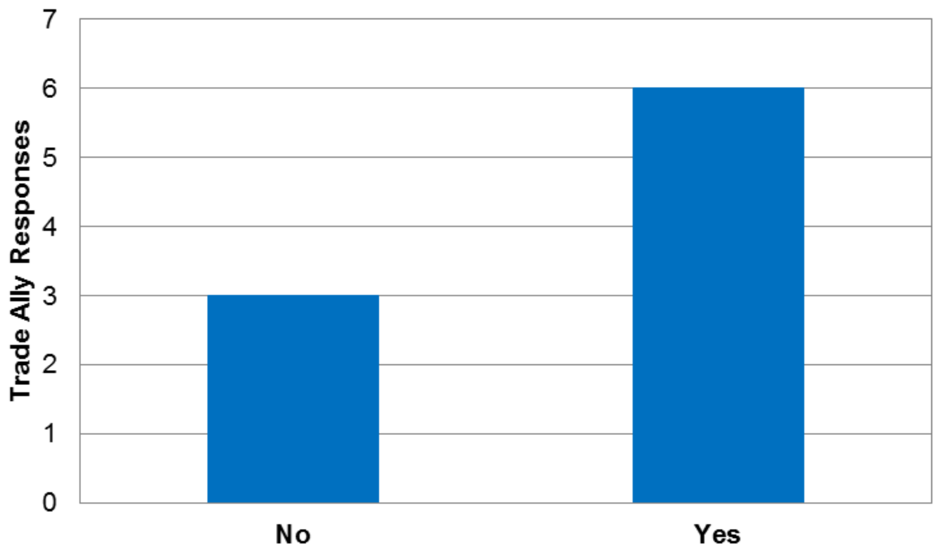
Figure 4-5 Percentage of 2017 Linear Fluorescent Lighting Sales that were T12 According to Surveyed Trade Allies



Trade ally responses to Question #1 suggest that the majority of the market has already shifted away from linear fluorescent T12s. Six of the nine trade allies surveyed reported that 0% of 2017 linear fluorescent sales were of the T12 variety.

- **Trade Ally Question #2:** "Are you still stocking and selling linear fluorescent T12 lighting systems and replacement lamps?" (Responses in Figure 4-6)

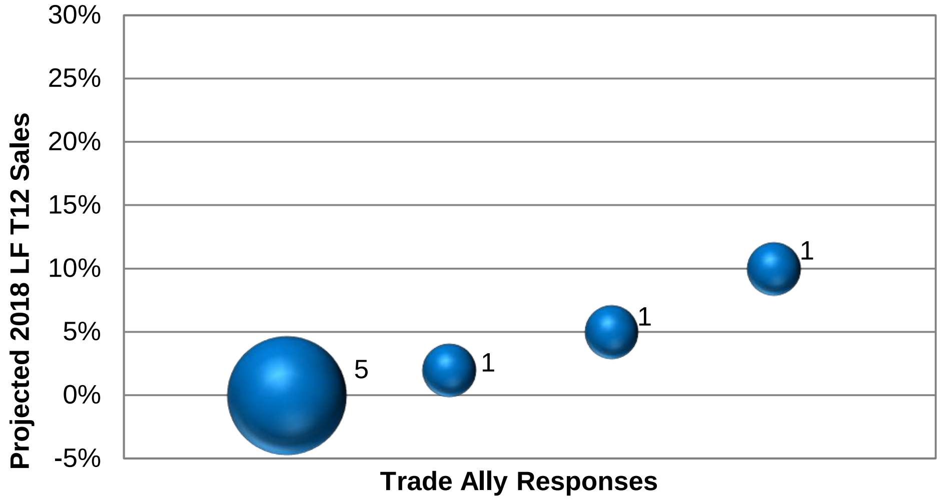
Figure 4-6 Are Trade Allies Still Stocking Linear Fluorescent T12 Replacement Lamps



Responses to Trade Ally Question #2 were also mixed. Six of the surveyed trade allies reported that they are still stocking linear fluorescent T12 lamps; however, only three of the trade allies surveyed reported to have sold T12s in 2017. This indicates that T12 lamps are being stocked, but not sold.

- **Trade Ally Question #3**: "Thinking of your 2018 sales of linear fluorescent lighting system sales, what percent will be T12s?" (Responses in Figure 4-7)

Figure 4-7 Estimated Percentage of 2018 Linear Fluorescent Lamps Sales That Will Be T12



Responses to Trade Ally Question #3 suggest that linear fluorescent T12 sales are expected to decline even further in 2018. Five of the nine trade allies surveyed indicated that 0% of 2018 linear fluorescent sales would be T12s.

In addition to asking participants and trade allies about linear fluorescent T12 lamps and fixtures, the evaluation team also quantified the difference in verified energy savings for all T12 measures sampled. For this analysis the evaluation team calculated the measure level savings using two scenarios. The first approach used a T12 baseline which is consistent with what the program uses in ex-ante energy savings estimates. The second approach used a reduced baseline fixture wattage consistent with a linear fluorescent T8 equivalent. The results of this analysis are summarized in Figure 4-8.

Figure 4-8 Comparison of Verified Energy Savings (kWh) and Realization Rates when Using T12 vs. T8 Baseline for Linear Fluorescent Retrofits

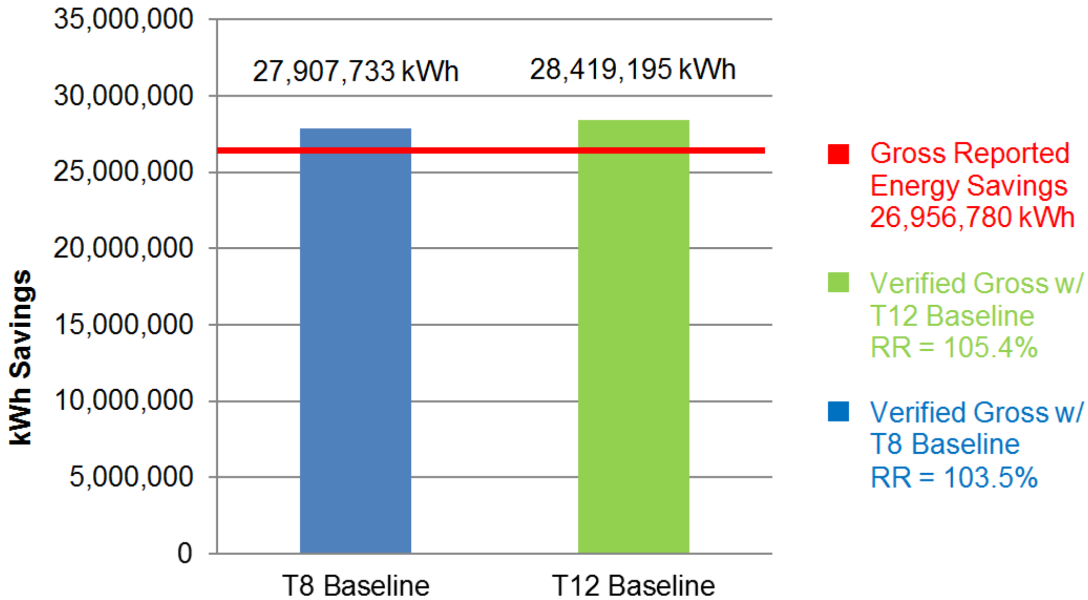


Figure 4-8 indicated that the overall impact on verified energy savings at the program level is very small regardless of whether a T12 or a T8 baseline is used for linear fluorescent fixture retrofits. Verified energy savings would reduce by approximately 511,462 kWh or 1.8%. Due to the relative minimal impact and in keeping with current industry standards, it is recommended that the NR Custom Program adopt a T8 baseline standard.

5 Net-to-Gross

5.1 Methodology

The evaluation team based the net-to-gross evaluation on customer self-report surveys, as described in the Uniform Methods Project, Chapter 23: Estimating Net Savings: Common Practices.[9] The survey was designed based on established methodologies outlined in the Pennsylvania Evaluation Framework.[10]

Net-to-gross analysis for this program involved two calculations: free-ridership and spillover. The results of these calculations are combined to produce the program-level net-to-gross ratio as follows:

Equation 17: Net-to-Gross Equation

$$NTG_p = (1 - FR_p) + SO_p$$

Where:

NTG_p	=	*the program-level net-to-gross ratio*
FR_p	=	*the program-level free-ridership ratio*
SO_p	=	*the program-level spillover ratio.*

The program net verified energy savings are calculated by multiplying the program net-to-gross ratio by the gross verified energy savings resulting from the impact evaluation activities as described in Section 4.

Equation 18: Net Verified Energy Savings

$$kWh_{nv} = kWh_{gv} \times NTG_p$$

The calculations of the program-level free-ridership and spillover ratios are detailed in the following sections.

5.1.1 Free-Ridership

The evaluation calculated free-ridership for each survey respondent based on their answers to a series of questions. These questions collected information on the customers' *intention* prior to interacting with the program and the *influence* of the program on changing those intentions.

Survey respondents were asked how the project would have changed if the incentive were not available. Responses were scored on a scale from 0 to 50 as shown in Table 5-1. If the respondent indicated they would do a smaller or less efficient project, they are prompted to categorize it as a small, moderate, or large reduction in scope.

[9] https://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf, Section 3.2.

[10] http://www.puc.state.pa.us/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework082516.pdf, Appendix B.

Table 5-1 Net-to-Gross Intention Score Methodology

Response	Intention Score
Done nothing	0
Canceled or postponed the project	0
Done a smaller or less efficient project	Small = 37.5 Moderate = 25 Large = 12.5 Don't know = 25
Done exactly the same project	Would have paid = 50 Would not have paid = 25 Don't know = 37.5

To recognize the direct points of influence that the program has on customers' decisions, the survey asked respondents to rate the influence of several program aspects (where 10 is extremely influential and 0 is not at all influential). The highest rating for each customer was scored, again on a scale of 0 to 50. The rationale is that if any aspect of the program is highly influential on a customer's decision, then the program overall was equally influential (see Table 5-2).

Table 5-2 Net-to-Gross Influence Score Methodology

Program Aspect	Max Rating → Influence Score
Incentive provided by Duke Energy	0-1 → 50 2 → 43.75 3 → 37.5 4 → 31.25 5 → 25 6 → 18.75 7 → 12.5 8 → 6.25 9-10 → 0
Interactions with Duke Energy	
Duke Energy marketing materials	
Previous experience with Duke Energy programs	
Contractor or vendor recommendation	

The intention and influence scores are added together to produce each respondent's free-ridership ratio using Equation 19.

Equation 19: Respondent Free-ridership Ratio

$$FR_i = \frac{Intention + Influence}{100}$$

The ratio is multiplied by that respondent's verified gross savings to result in free rider savings, or savings that would have occurred without the program. The program free-ridership ratio is the sum of free rider savings divided by the sum of verified gross savings as shown in Equation 20.

Equation 20: Program Free-ridership Ratio

$$FR_p = \frac{\sum(FR_i \times kWh_{gv})}{\sum kWh_{gv}}$$

5.1.2 Spillover

Spillover is an estimate of savings resulting from the installation of energy efficient projects that were completed without a program incentive but that still were influenced by the program. There are two components to arriving at these program-attributable savings.

First, the survey collects information on the type of energy-efficiency equipment that was installed but for which an incentive was not received. This is used to estimate energy savings through the application of established calculation methodologies, often a technical reference manual.

Second, the survey asks the respondent to rate the influence of the program on their decision to implement the project despite not receiving an incentive. That score is used to prorate the total project savings, recognizing that the program may not have been the only influence in the completion of the project. The result of this calculation is program-attributable spillover, shown in Equation 21:

Equation 21: Program-Attributable Spillover

$$kWh_{aso} = kWh_{gso} \times Influence$$

Where:

kWh_{aso} is the program-attributable spillover savings

kWh_{gso} is the gross spillover savings

Influence is the value based on the respondent's rating of the program influence, as shown in Table 5-3.

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Table 5-3 Participant Spillover Program Influence Values

Reported SmartSaver Program Influence	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0
Don't know / Refused	Sector-level measure average

This number is divided by the total verified gross energy savings for the program to produce a program spillover ratio (Equation 22):

Equation 22: Program Spillover Ratio

$$Program\ SO\ Ratio = \frac{\sum kWh_{aso}}{kWh_{gv}}$$

5.2 Net-to-Gross Analysis and Findings

The evaluation team conducted interviews with 31 customers who completed projects at 49 different locations in Ohio. Customers reported that for most projects (38 of 49 surveyed projects) they would have put off the work, canceled it entirely, or reduced the scope or efficiency of the project. The remaining customers said they planned to do the same project prior to learning about the Smart $aver Custom Program, and most of those customers said they would have paid the cost of the upgrade if the incentive were not available. The full distribution of responses is shown in Table 5-4.

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Table 5-4 What Would You Have Done Had You Not Received an Incentive?

Response	Respondents
Canceled or postponed the project	30
Done a smaller or less efficient project	8 Large reduction (2) Moderate reduction (4) Small reduction (1) Don't know (1)
Done exactly the same project	9 Would have paid (9)
Don't know	2

When asked to rate the influence of the program on their decision to complete the energy-efficiency project, all respondents rated at least one program aspect a 7 or higher on a 0 to 10 scale, where 0 means "not at all influential" and 10 means "extremely influential." The program incentive and contractors' recommendations were the program aspects most commonly given a high rating.

The resulting free-ridership, spillover, and net savings are shown in Table 5-5 below. These results indicate that the program is extremely effective in encouraging customers to complete projects they would not otherwise do.

Table 5-5 Net-to-Gross Evaluation Results

Measurement	Gross Verified Energy Savings (MWh)	Ratio	Net Verified Energy Savings (MWh)
Net of Free-ridership	12,341 (surveyed)	82.8%	10,212
Program-influenced Spillover	77,914	0.1%	73
Net-to-Gross	77,914	82.9%	64,620

6 Process Evaluation

6.1 Summary of Data Collection Activities

Process evaluation activities are designed to support continuous program improvement by identifying successful program elements that can be expanded or built upon, as well as underperforming or inefficient program processes that could be holding back program performance or participation. The data collection activities for the process evaluation of the NR Custom Program included a database review, and interviews with key contacts involved in program operations, participating customers, and contractors who assisted customers with projects.

The evaluation team developed data collection instruments designed to explore the research questions identified in Table 3-1. Table 6-1 summarizes the process evaluation data collection activities for Duke Energy Ohio.

Table 6-1 Summary of Process Evaluation Data Collection Activities

Target Group	Completes
Staff	5 In-depth interviews
Participants	49 Telephone surveys with participant projects (33 unique participant respondents)
Contractors	6 In-depth interviews 17 Telephone surveys

6.1.1 Program Staff Interviews and Database Review

Five interviews were conducted in June 2016 with Duke Energy's NR Custom program staff so that the evaluation team had a good understanding of the program and to get background information on program design and implementation practices. The program staff provided valuable feedback on intended operations, processes of the program's stated (and unstated) goals and objectives, perceived barriers to program up-take, and modifications to any program components based on the previous program cycle as well as the rationale for those modifications. The information the team gathered assisted in the design of the interview guides and surveys for customers and contractors.

In addition to the program staff interviews, the evaluation team reviewed the program tracking database to ensure necessary data and information was being collected to track program progress.

6.1.2 Contractor Interviews and Surveys

Custom programs include a variety of types of contractors and projects that require preapproval. For these programs to be successful, contractors must be able to access and use calculation tools, navigate preapproval processes, and communicate the steps involved to project representatives. Contractors are important market actors, especially in large custom programs, and a good understanding of their experience with program processes, preapprovals, customer decision making, and persistent barriers to additional projects is crucial to the success of custom programs.

Six in-depth interviews were conducted in January and February 2017 to gain an in-depth understanding of contractors' experience with the program. The input from these interviews helped the team design the guide for the telephone survey, which was completed in November 2017. The evaluation team selected implementation contractors associated with customer projects from the tracking database provided by Duke Energy. Discussion topics in the survey included program awareness among customers, program guidelines and processes, interactions with customers, and suggestions for improving the program. Surveys were completed with 19 of 55 program contractors who participated in the program. The average survey length was 21.2 minutes and average number of telephone attempts was 8.6. Table 6-2 outlines the contractor response for the evaluation.

Table 6-2 Contractor Response Rate

Disposition	Contractor Count
Starting Sample	**52**
Does not recall participating	5
Refusal	13
Incompletes (partial surveys)	1
Language barrier	1
Wrong number	3
Not completed	12
Completes	**17**
Response Rate (Complete/Starting Sample)	**32.7%**

6.1.3 Participant Surveys

Collecting survey data from program participants provides data suitable for quantitative analyses on participant characteristics, and key aspects of the program. The evaluation team conducted a telephone survey with program participants, defined as customers who received a rebate through Duke Energy's NR Custom Program between August 2015 and July 2017.[11] Surveys were conducted with program participants in two waves; the first in November 2016 and the second in October 2017. Surveys focused on customers' experience with the program, sources of awareness, decisions to install equipment, barriers to participation, satisfaction with various aspects of the program, and any program improvement suggestions. Surveys were

[11] In order to meet the reporting deadline outlined in the evaluation plan, the participant surveys utilized all sampled received through July 2017. The team does not believe the projects received after this date were systematically different than those included in the participant survey.

completed regarding 42 of 66 projects completed through the program (33 unique respondents). Table 6-3 outlines the participant response rate for the evaluation.

Table 6-3 Participant Response Rate

Disposition	Participants
Starting Sample	**74**
Does not recall participating	1
Refusal	7
Incompletes (partial surveys)	2
Wrong number	1
Not completed	14
Completes	**49**
Response Rate (Complete/Starting Sample)	**66.2%**

Wave 1 calling started November 2, 2016 and ended November 18, 2016

Wave 2 calling started October 5, 2017 and ended October 26, 2017

6.2 Process Evaluation Findings

6.2.1 Program Staff and Database Review

The program staff interviews were extremely useful in helping the evaluation team understand how the program operates, and to design the interview guides and surveys for program participants and contractors. Information from staff interviews has been used throughout the findings section to add context around respondent answers.

An additional part of the evaluation activities included reviewing the program database to ensure the necessary information needed to track the program and conduct evaluation activities existed. Program staff use the tracking database to document customers who participated in the program, the details of the equipment being installed, and the savings associated with the project. Once the application is received, this information is passed to AESC, the vendor responsible for the technical review. AESC verifies the accuracy of the savings calculations and provides Duke Energy with verification in a systematic format. Duke Energy engineers also review the application information to verify savings calculations.

The evaluation team utilized this same database to select samples for impact and process evaluation activities. When using information for evaluation purposes, the information included in the file was accurate and thorough although some areas were not electronically documented. Specifically, some contact information was missing from the file, specifically contact phone numbers and email addresses. Additionally, the quantities of installed equipment (particularly for lighting) and some savings values associated with projects was missing or incorrect.[12] Understanding which customers received a Custom incentive is critical in evaluating progress towards program goals and conducting an independent review of program participants.

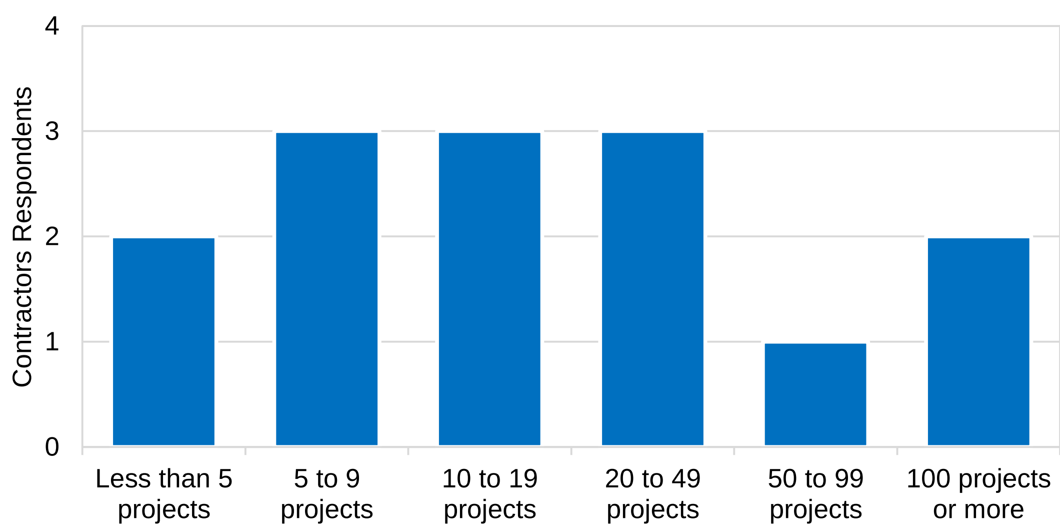
In conducting the process evaluation telephone efforts, some contact information associated with some participants was out of date. Given that evaluation activities went back to 2015, some level of personnel turnover at companies is expected, resulting in having contact information for people who no longer work for listed companies.

6.2.2 Contractors

The evaluation team surveyed 17 contractors who were involved in the installation of participating customer's projects during the evaluation period. The amount of time these contractors have been involved in the program varied with five contractors indicating they have participated in Duke Energy's programs for one to two years, seven contractors indicating they have been involved between three to five years and five have been involved for more than five years. Two contractors could not recall how long they have been participating in Duke's NR Custom program.

Responses regarding the number of projects contractors have completed during their time with the program varied from less than 5 projects to more than 100. Figure 6-1 shows the number of contractors and an estimate of the number of projects they recall completing through the program since they began. As expected, contractors involved in the program longer completed more projects while those only involved in the program a few years completed fewer.

Figure 6-1 Number of Total Completed Projects



When asked about their 2018 project plans, 5 of 17 contractors felt their program participation would be higher compared to their 2017 participation. The most mentioned reason was an

[12] It should be noted that the baseline and post-retrofit quantities are well-documented elsewhere by the program team outside of the participation tracking database. In fact standard policy is to verify installed equipment quantities prior to issuing payment. The pre- and post-retrofit quantity information isn't considered by the program to be critical to include in the participation database.

expected increase in projects (3 respondents), e.g. as a result of increased interest in energy efficiency projects by building owners. Two respondents added that "*the program is good and fits well*" or that "*the business is better*." The other two respondents described financial reasons related to the program and its benefits: "*will add to the bottom line and profitability*," and "*is another sales tool that offers incentives*."

Six contractors felt that their program participation in 2018 would be about the same because they do not anticipate a change in the number of projects (based on their customers interests and needs), especially if there are no major changes in the prescriptive program. Five contractor respondents thought the participation would be lower in 2018 due to potential changes in the program (program not being offered, change in the incentives, or moving equipment currently offered through custom to the prescriptive program), or anticipated reduction in number of projects based on the needs of major clients.

When asked if they were registered with Duke Energy's contractor network and appear on Duke's website, 11 of 17 contractors indicated they were. The remaining six contractor respondents were not sure.

6.2.2.1 Communication

Most contractors reported that communication with Duke Energy program staff was effective (7 very effective and 6 somewhat effective). Almost two-thirds of respondents (10 of 17) indicated they have received trainings and information from Duke Energy about the Smart $aver Custom Incentive program. One of the 10 contractors indicated additional trainings/information could be provided, in this case "*more in-depth process training from start to end*."

6.2.2.2 Customer Interaction

On average, contractor respondents felt about 40 percent of their customers were aware of the Custom program prior to them telling them about it. Most contractors (12 respondents) felt they were at least partially responsible for the awareness. Other sources of awareness mentioned by contractors included other contractors or vendors (4 respondents), Duke Energy website (3 respondents), Duke Energy advertisements (3 respondents), Duke Energy staff (2 respondents). When talking with contractors, 4 of 17 respondents indicated that customers do not have any concerns about the program. The remaining 13 contractors had a variety of customer concerns about participating, as outlined in Table 6-4.

Table 6-4 Contractor Reported Customer Concerns About the Program

Concern	Respondents
If they will get the rebate and how long it will take	5
Unsure if the savings will be achieved	3
Unsure if the incentive will be as high as estimated	3
Uncertainty around the approval	2
Unsure who is getting the incentive	2
Unsure if the program will continue to be funded	2
Unsure if the equipment qualifies	1
Unsure about electricity cost reduction	1
Program not keeping up with the industry	1
Skeptic	1
Respondents	**17**

Source: Question PI5
Don't know responses are excluded.

Thirteen of the 17 contractor respondents indicated that they use the program as a sales tool and that the program is helpful in selling energy efficient equipment (10 very helpful and 3 somewhat helpful)[13].

When asked about the factors that influence the type of equipment nonresidential customers purchase, the most common response from respondents was equipment cost (7 respondents), and payback period (5 respondents), as outlined in Table 6-5.

Table 6-5 Factors on NR Customer's Purchase

Factor	Respondents
Equipment costs	7
Payback or return on investment (ROI)	5
Efficiency and reliability of equipment	3
Warranty, quality, and design of equipment	3
General need	2
Interest in new technology	1
Equipment specifications	1

[13] Response options where very helpful, somewhat helpful, neither helpful nor unhelpful, not very helpful and not at all helpful.

Factor	Respondents
Rebate and incentive availability	1
Desire to reduce energy bills	1
Availability of equipment for emergency replacement	1
Respondents	**15**

Source: Question CI1
Don't know responses are excluded.

Some contractor respondents felt manufacturing, industrial, and commercial (4 respondents) customers were more receptive to high efficiency equipment. Other contractors, however, felt it was not about the sector but rather if the customer owned the building (2 respondents), if they have longer operation hours such as warehouses (2 respondents), if customers are concerned about reducing their costs (3 respondents), or if they are educated and value saving energy (3 respondents).

Based on the contractor respondents, the main reason some customers do not move forward with projects is financing or equipment cost (11 respondents). This was followed by project not meeting payback or ROI criteria (5 respondents), urgency of the project combined with the burden of completing incentive forms (1 respondent), facility operation constraints (1 respondent), and lack of knowledge (1 respondents).

6.2.2.3 Application Process

Most contractor respondents (14 of 17) indicated that they received a request for additional information after submitting their initial application for preapproval. Typical requests were related to providing additional documentation about the equipment or its use (10 respondents), examples include specification sheet, fixture wattage, size of the facility, and confirmation that the equipment is on the Design Lights Consortium (DLC) list. Other requests were regarding calculations or audit information.

When asked if there were any enrollment paperwork or rebate submission processes that could be simplified to encourage customers to complete projects, most contractor respondents did not think so (9 respondents). Of the seven contractor respondents who thought processes could be simplified, responses varied by contractor. Examples of improvement included the following: more existing lighting could be added to prescriptive rebates so they would not have to be custom (e.g. T8 and T12), the ability to use external calculators for smart control systems, streamline the submittal process, and shorten the preapproval process. One contractor was not able to provide detail on what specifically he would change about the process.

Email applications have been used almost exclusively for the past three years. Although starting in 2016, an online application portal was launched. All but two contractors were aware of the online application portal to submit the application online. Of the 15 contractor respondents who were aware of the online application portal, 14 indicated they have used the portal and rated its usefulness high (average 7.64 on a 0 to 10 scale where 0 was 'not at all useful' and 10 was 'very useful'). The one contractor respondent who was aware of the online portal but has not used it, did not indicate any reasons preventing him from using the portal.

6.2.2.4 Calculators

As part of the application process, and to receive incentives through the Smart $aver Custom program, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and Custom-to-go. Classic Custom calculators are Excel-based worksheets available for five different technologies. One Custom-to-go Windows-based calculation tool is also available.

Contractors were asked how they typically estimate savings for projects that were submitted through the program. Ten respondents mentioned using Duke Energy provided tools while eight mentioned they only use their own/other tools (Table 6-6).

Table 6-6 Tools Used by Contractors to Estimate Savings

Calculators Used	Respondents
Own calculators only	5
Custom-to-go, Classic Custom, and own calculators	8
Own calculators and other calculators	1
Custom-to-go and own calculators	2
Custom-to-go and Classic Custom	1
Respondents	**17**

Source: Question PP1

Contractor respondents who used Duke provided calculators were asked to rate their usefulness on a 0 to 10 scale where 0 was ‘not at all useful’ and 10 was ‘very useful.’ Both calculators were rated as being useful with mean scores of 7.8 and 7.3 for Custom-to-go and Classic Custom, respectively.

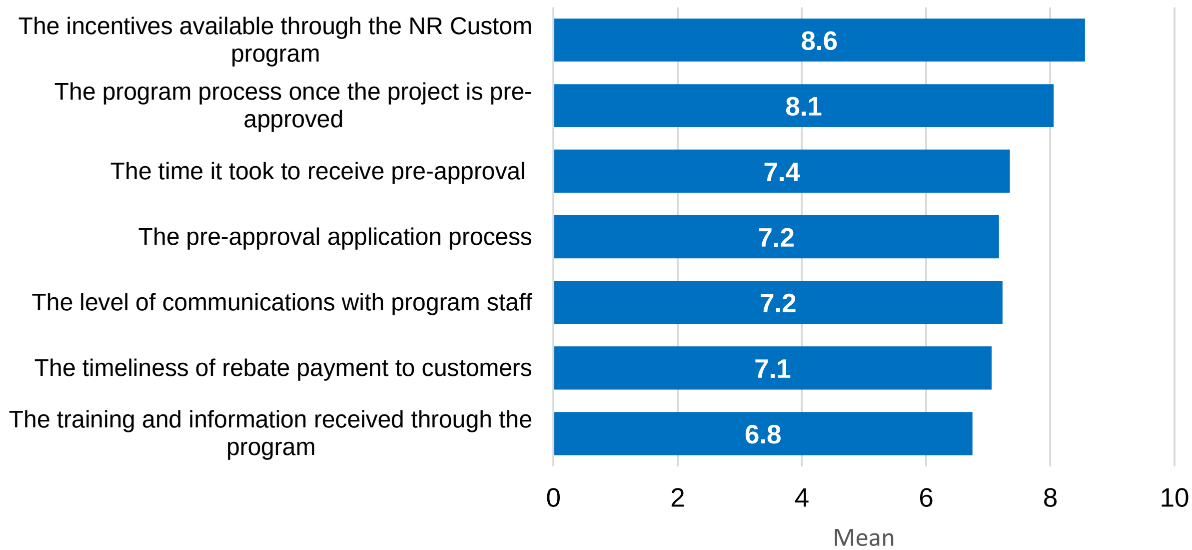
Respondents who did not use the calculators provided by Duke reported not being aware of the calculators (1 respondents) and using their own calculators which they are familiar with or customized to their company (2 respondents) as reasons for not using the Custom-to-go and Classic Custom calculators. Two contractors indicated Duke’s calculators did not fit their specific project or equipment category, and another contractor mentioned that the Duke’s calculators are not complex enough. Two contractors were not able to provide detail on why they have not used Duke calculators.

6.2.2.5 Satisfaction

Overall, contractor respondents were satisfied with the NR Custom program and with Duke Energy. Respondents were asked to rate their satisfaction on a 0 to 10 scale where 0 was ‘not at all satisfied’ and 10 was ‘very satisfied’. On average, contractor respondents rated their satisfaction with the program 7.6 and their satisfaction with Duke Energy 7.2.

Using the same scale, contractors were also asked to rate their satisfaction with different program components. Contractors were generally satisfied with the program with most mean scores over 6.8. The lowest rated item was the training and information received through the program while the highest rated item was the incentives available through the program, as shown in Figure 6-2.

Figure 6-2 Contractor Satisfaction with Program Components



Source: Question SA1
Don't know responses are excluded.

Most contractor respondents felt the program aspect that was most influential in customers' decision to move forward with projects was the incentive (12 of 16 respondents). Additionally, contractor respondents felt the program incentive was the most valuable part of the NR Custom program (10 of 17 respondents).

As far as improvements with the program, four contractor respondents indicated no changes were needed. For the remaining 13 respondents: 6 contractors proposed increased communications, especially related to future changes in rebates (4 respondents), clarity about initial stages, initial M&V requirements, and incentives (2 respondents); 5 contractors indicated shortening the application review or the time it takes to receive the incentives; 1 contractor suggested increasing the incentives; 1 contractor proposed updating the application instructions in relation to smart control systems; and 1 contactor suggested moving more equipment to prescriptive.

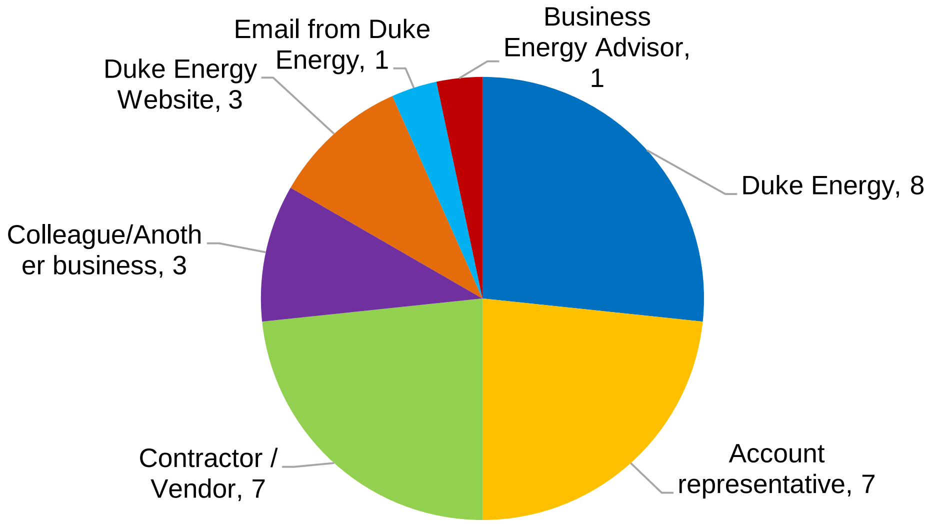
6.2.3 Participants

Surveys were conducted with program participants, or customers who received a rebate through the NR Custom Program. This section provides detailed findings from 31 customer respondents who completed the surveys.

6.2.3.1 Marketing Practices

Prior to 2016, the program largely focused on account managers as the primary source of program promotion. In 2016, traditional marketing channels were used such as direct mail, ads on social media or other websites and emails to a subset of customers by segment. Contractor outreach representatives market the program directly to contractors, which Duke staff indicates accounts for a significant percentage of projects. When asked how they heard about the program, the three primary sources of awareness of the NR Custom Program reported by participant respondents were Duke energy (8 respondents), their contractor or vendor (7 respondents) or their account representative (7 respondents) as the primary, which is consistent with how the program was marketed. Figure 6-3 shows breakdown of the awareness sources customer respondents.

Figure 6-3 Participant Source of Program Awareness



Source: Question Q1
Don't know responses are excluded.

For respondents who heard about the program from their contractor, account representative, or business energy advisor, all respondents indicated they were provided with enough information about the program and no additional follow-up or information was needed. This supports what was reported by the surveyed contractors and the role they play in increasing program awareness. This also shows that contractors, in addition to Duke staff, are well-versed on the program and can answer customer questions.

Program website materials note that the NR Custom incentives "can help you offset up-front costs and improve your bottom line." When respondents were asked what made them decide to apply for the NR Custom program, needing a new equipment was mentioned most. Nine participant respondents mentioned the return on investment, and several others mentioned contractor recommendation and monetary savings. Other reasons are included in Table 6-7.

Table 6-7 Reasons for Participating in Smart $aver Custom Incentive Program

Reason	Respondents
Needed new equipment	15
ROI/payback/cost-benefit	9
Contractor recommendation	7
Monetary savings	5
Energy savings	3
The rebate/incentive	2
Ability to get a better product cheaper	1
Didn't know	1
Respondents	**31**

6.2.3.2 Application Process

According to program staff, the review process takes about four to six weeks. Staff mentioned they would like to improve the turnaround and are currently tracking the timing and looking for ways to improve the internal review process. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process (Table 6-8). When asked about their satisfaction with various aspects of the application process, respondents rated their satisfaction highly, with mean scores 8.2 or higher (using a 0 to 10 scale where 0 is 'very dissatisfied' and 10 is 'very satisfied'). Over half of participant respondents (16 of 26 respondents) indicated their contractor filled out the Smart $aver Custom Incentive program application, 6 respondents indicated someone within their organization filled out the application, and 4 respondents reported someone within their company worked on the application with the contractor.

Table 6-8 Satisfaction with Application Process

Application Aspect	Mean	Respondents
Process to fill out and submit your application	8.33	30
Staff time it took to submit the application	8.21	29
Duke Energy's processing and preapproval of your application	8.36	28

Source: Questions Q8, Q9, Q10
Don't know responses are excluded.

Only two respondents rated their satisfaction low for an aspect of the application process (less than 4) due the complexity of the application: one respondent indicated that the application is hard to fill out when involving the supplier and vendor, the other respondent explained that the application requires "*so much information and justification*."

About half of participant respondents (12 of 25 respondents) indicated they received a request for additional information after submitting their initial application for preapproval. Most respondents could not recall the specifics around the request although some noted that it was additional equipment information (3 respondents), or calculation justifications (3 respondents).

6.2.3.3 Calculators

As mentioned above, as part of the application process and to receive incentives through the program, an appropriate worksheet or calculator must be submitted. In addition to the feedback contractors provided, participant respondents were also asked if they used any of the calculators provided by Duke Energy or if they used their own methods to calculate energy savings. Over one-third of respondents reported using the tools Duke provided while the remaining used their own tool or relied on their contractor to calculate savings (Table 6-9). This is similar to the feedback received from contractors where 11 of the 17 contractors indicated they used Duke tools to calculate savings.

Table 6-9 Calculators Used by Participants

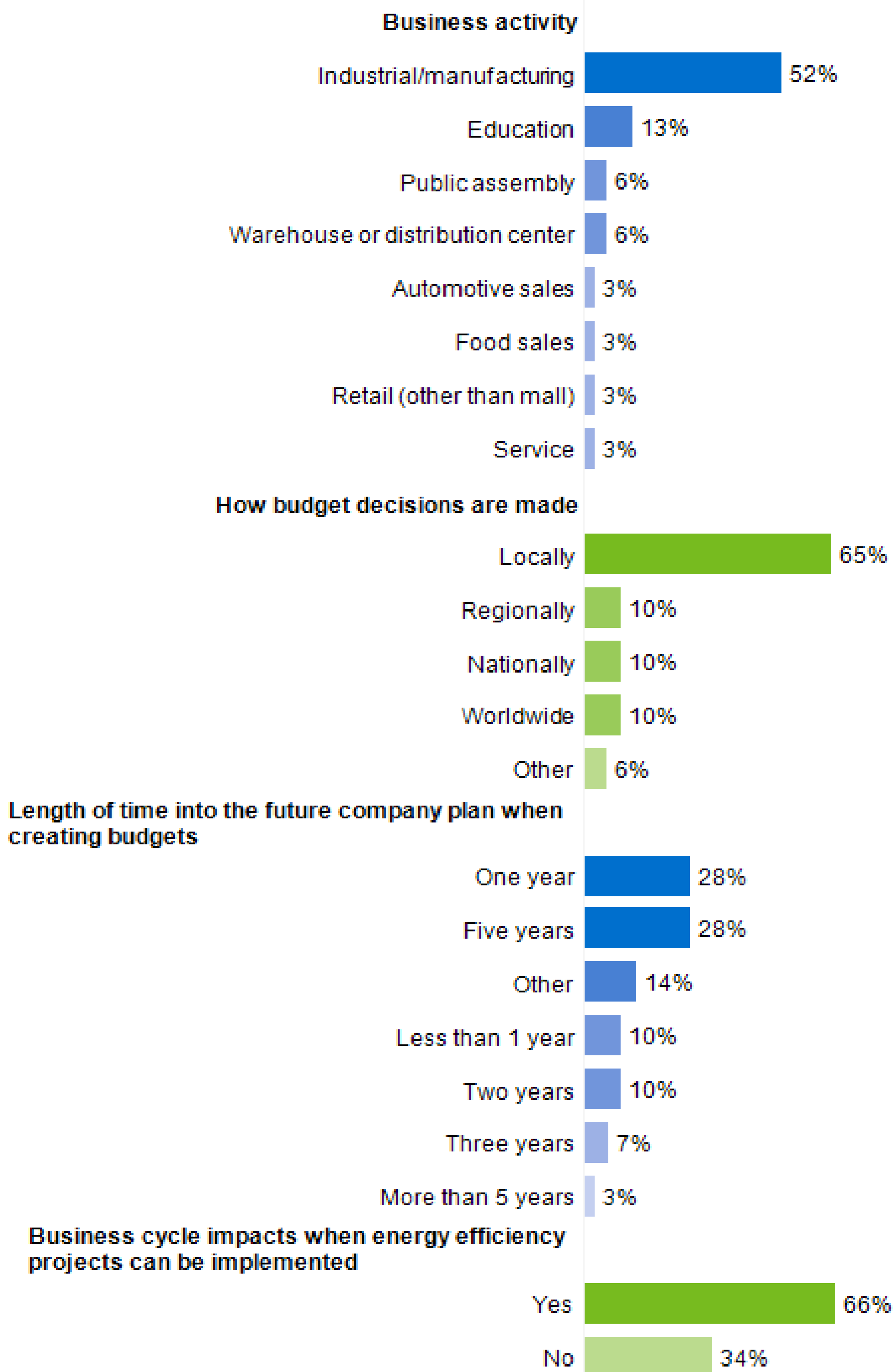
Calculators Used	Respondents	Percent
Own methods only	10	37%
Custom-to-go only	9	33%
Contractor calculated only	7	26%
Custom-to-go and own methods	1	4%
Respondents	**27**	

Source: Question Q12
Don't know responses are excluded.

6.2.3.4 Participating Customer Characteristics

Facility types varied across the 31 participant respondents' locations. The most mentioned type of businesses was Industrial/Manufacturing (16 respondents, 52 percent), followed by Education (4 respondents, 13 percent). The facility types are consistent with how the program was marketed, which initially targeted larger industrial customers. When participants were asked how their companies make budget decisions and whether they were decided locally, regionally, nationally, worldwide or something else, most respondents reported that decisions are made locally (20 respondents, 65 percent). Most respondents tended to plan one year (8 of 29 respondents) or 5 years (8 of 29 respondents) into the future when creating budget and financial plans. Figure 6-4 shows the participant business characteristics.

Figure 6-4 Smart $aver Custom Incentive Program Participant Characteristics



Source: Questions C1, C2, C3, C4
Don't know responses are excluded.

6.2.3.5 Fast Track

Duke piloted and now offers a fast track option in other jurisdictions where customers with a project under a tight timeline can pay a $550 fee to accelerate the review of their project from four to six weeks to about one week. Customers must also commit to participating in a kick off meeting and promptly responding to any requests.

While this option is not currently offered in Ohio[14], customers were asked about their awareness and interest in the offering. Before the survey, only 2 of 31 respondents were aware of the Fast Track offering, one participant found out from their account representative, and the other one from their contractor. This is likely a result of spillover from other territories. Given this option is not available in Ohio, neither respondent have utilized the Fast Track offering.

Figure 6-5 Awareness about the NR Custom Program Fast Track Option

Source: Question FT10
Don't know responses are excluded.

Respondents who have not utilized the fast track option were asked about their interest in the offering. Over half (19 of 30 respondents) indicated they would be willing to pay a fee to have an accelerated review of their application if they had a project under a tight timeline. Those who were not willing to pay the fee indicated reasons such as delaying the project or planning it better to avoid having to pay a fee (2 respondents), or not having projects large enough that would require needing an expedited process (1 respondent). Two participant respondents reported that they cannot afford to pay that money or get approval for it. Other respondents mentioned that the fee "*is a waste of tax payers' money*," or that "*the cost would outweigh the incentive*." One respondent reported that "*they would do the project regardless*."

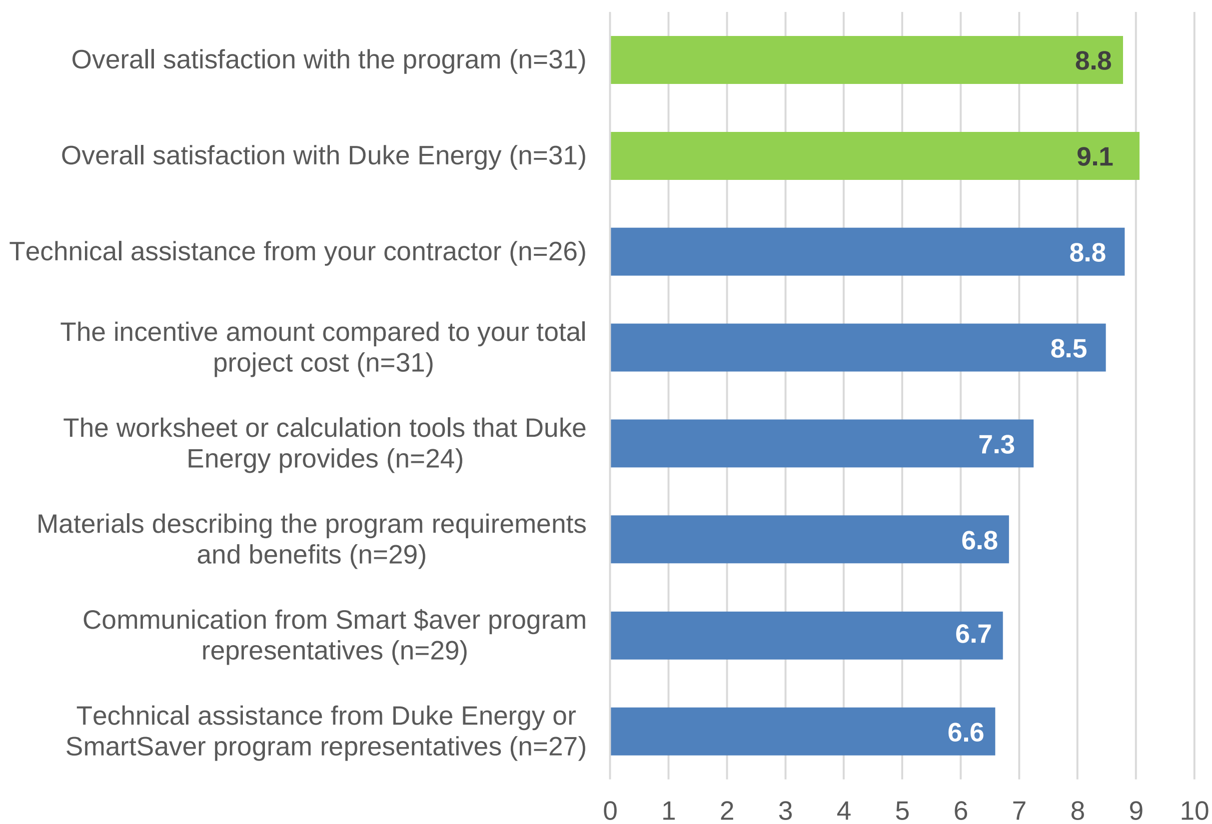
[14] The Fast Track offering was originally planned to launch in Ohio for program year 2018; however, this was put on hold as a result of the Public Utilities Commission of Ohio (PUCO) September 2017 order which limited program funding. Should additional funding become available, the program should consider adding the Fast Track option for customers who need an expedited review of their project.

While the fee may be a barrier, the meetings may not be. Over two-thirds of respondents (22 of 30) would be willing to participate in an entrance meeting and respond to requests about the project specifications in a timely manner. Five respondents indicated they would not be willing to pay the fee nor participate in the necessary meetings. Overall, when asked about the value of the Fast Track option, responses were mixed. The average response was 5.4 (on a 0 to 10 scale with 0 being 'not at all valuable' and 10 being 'very valuable').

6.2.3.6 Program Satisfaction

Overall, program participants were highly satisfied with the NR Custom program. Respondents were asked to rate their overall experience with the program and with Duke Energy on a scale of 0 to 10, where 0 is 'very dissatisfied' and 10 is 'very satisfied.' Respondents rated their overall satisfaction with the program overall highly (8.8 out of 10.0) and rated Duke Energy highly as their service provider (9.1 out of 10.0). Respondents were also asked to rate the value of different program components on a similar 0 to 10 scale. All program aspects were rated an average of 6.6 or higher (see Figure 6-6).

Figure 6-6 Program Participant Satisfaction and Value of Program Aspects

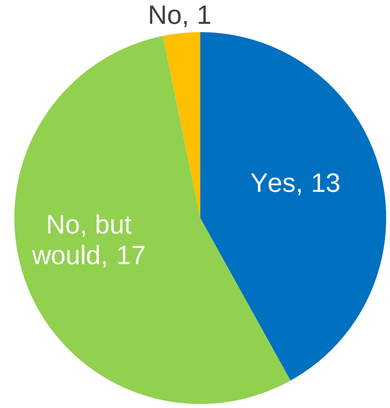


Source: Question SAT5, SAT11, SAT13
Don't know responses are excluded.

As far as the program aspect that is most valuable to their organization, 17 of the 31 participant respondents indicated the incentive compared to their total project cost (which correlates with the contractor responses). This was followed by 6 respondents indicating the technical assistance they received from their contractor, and 6 respondents saying the worksheet or calculation tools that Duke Energy provides.

As another gauge of satisfaction, customers were asked if they have recommended the program to others. As shown in Figure 6-7, participants reported that they had already recommended the program. If provided the opportunity, 17 of the remaining 18 respondents said they would recommend the program. Furthermore, all respondents indicated they would participate in the program again. The one respondent who did not indicate he would recommend the program if given the opportunity provided no indication of dissatisfaction throughout the survey.

Figure 6-7 Have You Recommended the Program to Others?

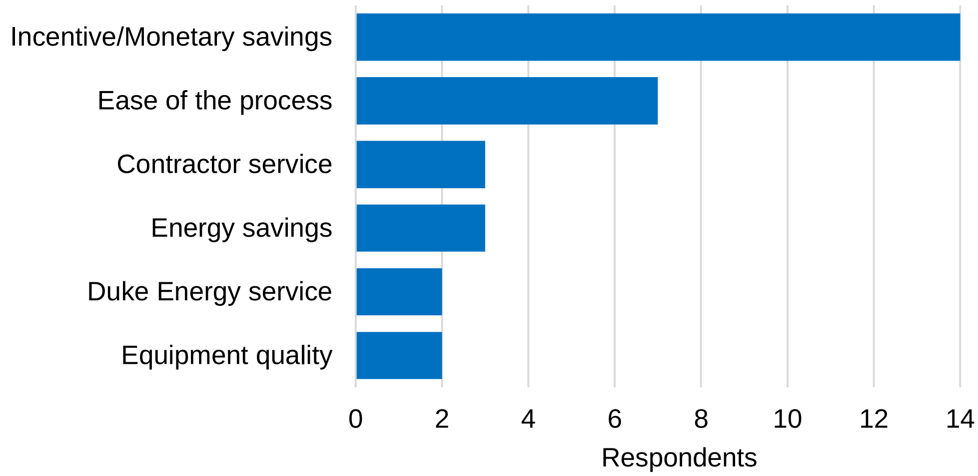


Source: Questions SAT8, SAT9

Respondents reported many reasons for rating the program highly (

Figure 6-8); those include mainly availability of the incentive and money savings (14 respondents), and ease of the process (7 respondents). Three of the 14 respondents indicated that they would have not done the projects without the incentives provided through the program.

Figure 6-8 Reasons for Rating the Program Highly



Source: Question SAT12o
Don't know responses are excluded.

When asked what they would change about the Smart $aver Custom Incentive program, 12 of 30 respondents indicated they would not change anything. Of the remaining 18 respondents, five respondents felt the paperwork was too complex and six respondents asked for improving the initial processing time. Other responses included reducing the amount of paperwork (1 respondent) and removing the preapproval requirement (1 respondent). These suggestions align with opportunities for improvement reported by the contractors.

7 Conclusions and Recommendations

7.1 Impact Evaluation

Conclusion 1: The evaluation team's analysis resulted in an 89.6% realization rate (energy) for the DEO NR Custom Program. The strong realization rate indicates that Duke Energy's internal processes for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts.

Recommendation 1: The evaluation team recommends that Duke continue to operate this program with the current level of rigor. For interior lighting projects, Duke should consider developing and applying deemed interactive factors to quantify the interactive effects between lighting retrofits and their associated HVAC systems.

Conclusion 2: Assumptions used in ex-ante energy savings estimates are well-documented, but there are opportunities for improvement on new construction lighting projects and some non-lighting projects.

Recommendation 2: The evaluation team recommends that any adjustments made to baseline assumptions on new construction projects be well-documented within the incentive calculation spreadsheet developed by the program. This will provide better transparency when deviations from a lighting power density approach are used in ex-ante energy savings estimates.

Conclusion 3: The NR Custom Program still uses T12 baseline fixture wattages in ex-ante energy savings estimates for linear fluorescent to LED tube retrofit measures. This practice is defensible given the availability of high color rendering index (CRI) replacement lamps; however, peer DSM programs no longer credit energy or demand savings beyond a T8 baseline.

Recommendation 3: It is recommended that the Duke NR Custom Program consider using a T8 equivalent when developing ex-ante energy and demand savings estimates for T12 to LED tube retrofit measures.

7.2 Process Evaluation

Conclusion 1: The program is operating as intended and has resulted in high satisfaction across participant and contractor respondents. The most common source of program awareness from customers was through their contractor, which is consistent with how the program marketed.

Recommendation 1: Continue to engage contractors in the program and keep them informed of the program to increase awareness among customers and encourage the installation of program-qualifying equipment.

Conclusion 2: The Fast Track option is available to customers with projects under a tight timeline. While few respondents have utilized the offering, the option exists for those who need it. Those who have not utilized the option indicated the associated fee may be a barrier;

although these customers indicated they were likely to reschedule the project to avoid paying the fee. While not all customers are willing to pay the fee, some are -- and may utilize the offering -- should they need an expedited review.

Recommendation 2: Continue to offer the Fast Track option to expedite the review process and encourage program participation for customers who need a quick turnaround on their project approval.

Conclusion 3: As part of the application process, an appropriate worksheet or calculator must be submitted. Duke Energy provides access to two types of calculators: Classic Custom and Custom-to-go. About half of both contractor and participant respondents indicated they have used Duke's tools to calculate savings. Contractors who used Duke's provided tools rated their usefulness high.

Recommendation 3: Continue to keep the Custom-to-Go and Classic Custom calculators updated and available to customers and contractors who need a tool to estimate savings.

Conclusion 4: Interviews with program staff indicated the pre-approval review process could take as much as six weeks for review. While Duke staff felt the review process could be improved, program participants were generally satisfied with the review process. Contractor respondents were slightly less satisfied than participant respondents in the pre-approval process although they still provided high satisfaction scores. While no respondents reported being dissatisfied with the application process, it is something to watch to make sure the length of time to review applications is not taking too long.

Recommendation 4: Monitor the time it takes to review applications to ensure the time does not exceed six weeks.

Appendix A Summary Form

Duke Energy Ohio Smart $aver NR Custom Program

Completed EMV Fact Sheet

Description of Program

Duke Energy's Non-Residential Smart $aver® Custom Incentive Program (NR Custom) offers financial assistance to qualifying commercial, industrial and institutional customers in the Duke Energy Ohio (DEO) service territory to enhance their ability to adopt and install cost-effective electrical energy efficiency projects. The Program targets energy saving projects involving more complicated or alternative technologies, or those measures not covered by the non-residential Smart $aver Prescriptive Program. The intent of the program is to encourage the implementation of energy efficiency projects that would not otherwise be completed without the company's technical or financial assistance. The program requires pre-approval prior to the project implementation.

Summary		Strata	Verified Net Savings (kWh)
Region(s)	*Ohio*	*Lighting*	*31,636,000*
Evaluation Period	*Aug 1, 2015 – Dec 31, 2017*		
Annual kWh Net Savings	*64,619,880*	*Non-lighting*	*32,983,880*
Coincident kW Net Impact - Summer	*8,470*		
Coincident kW Net Impact - Winter	*7,149*		
Net-to-Gross Ratio	*82.9%*		
Process Evaluation	*Yes*		
Previous Evaluation(s)	*N/A*		

Evaluation Methodology

Impact Evaluation Activities

- *53 On-site Measurement & Verification*

Impact Evaluation Findings

- *Energy Realization Rate: 89.6%*
- *Summer Demand Realization Rate: 91.6%*
- *Winter Demand Realization Rate: 88.1%*
- *Net-to-gross: 82.9%*

Process Evaluation Activities

- *Program Staff; 5 interviews with program staff*
- *Trade Allies; 6 in-depth interviews with high volume contractors, telephone surveys with representative sample of 17 trade allies*
- *Participants; 49 telephone surveys*

Process Evaluation Findings

- *Primary source of program awareness is Duke Energy followed by contractors*
- *Satisfaction with program is high among participants and trade allies*
- *Contractor assistance was most valuable program component as rated by participants*
- *Program-provided calculators are being used by participants and contractors*
- *Contractors value the program and use incentives to encourage customers to purchase high efficiency equipment*

Appendix B Survey Instruments

Duke Energy Nonresidential Custom Program
Participant Survey

Sample Variables

CONTACT NAME Primary customer contact name

MEASURE Summary of project measure implemented
1 lighting
2 process
3 compressed air
4 HVAC

MEASURETYPE Type of measure sampled

LIGHTFLAG Customers who will get asked the T12 lighting questions

LIGHTINGTYPE Specific lighting type rebated through the program
QTY Number of measures installed

YEAR The year the measure was completed and paid

MAIL_ADDR, MAIL_CITY, MAIL_ST, MAIL_ZIP The address of the site where the measure was installed

INCENTIVE The amount of the incentive paid for the measure

CONTRACTOR Flag that customer worked with external contractor

1 Worked with contractor
0 Implemented within company

FASTTRACK Flag that customer went through the Custom Fast Track application process

1 Fast track customer
0 Standard process customer

STRATUM
1 Indiana
2 Kentucky
3 Ohio

TOTAL_KWH

PROGRESS

Introduction and Screening

INT01 Hello, my name is [NAME], and I am calling on behalf of Duke Energy. May I speak with [CONTACT NAME]?

01 Yes
02 No

MULTCHK [ASK IF MULTFLAG=1] [INTERVIEWER: Is this the first case of a multiple?

01 Yes, first case
02 No, subsequent case [SKIP TO Q1]

PREAMBLE I'm calling from Tetra Tech, an independent research firm. We were hired by Duke Energy to talk with some of their customers about their participation in the SmartSaver Custom Incentive Program.

Our records indicate that you participated in Duke Energy's SmartSaver Custom Incentive Program that included a [MEASURE] project in [YEAR] at [PREMISE_ADDR]. Are you able to answer questions about your company's participation in this program?

01	Yes, I'm able to answer	SKIP TO SCREEN1
02	Yes, but information isn't quite right (specify)	SKIP TO SCREEN1
03	No, I'm not able to answer	
04	We have not participated	[THANK AND TERMINATE 82]
99	Refusal	[THANK AND TERMINATE 91]

OTHER_R Is it possible that someone else in your organization would be more familiar with the program or the project that was completed?

01	Yes	
02	No	[THANK AND TERMINATE 81]
99	Refusal	[THANK AND TERMINATE 91]

AVAILABLE_R May I please speak with that person?

01	Yes	
02	No (When would be a good time to call back?)	
03	We have not participated	[THANK AND TERMINATE 82]
99	Refusal	[THANK AND TERMINATE 91]

SCREEN1 Were you involved in the decision to complete the [MEASURE] project?

01 Yes
02 No [SKIP TO OTHER_R]

PREAMBLE2 Great, thank you. I'd like to assure you that I'm not selling anything, I would just like to ask your opinion about this program. Your responses will be kept confidential and your name will not be revealed to anyone. For quality and training purposes, this call will be recorded.

Program Awareness and Marketing

Q1 [IF MULTCHK=2 SKIP TO MEASCHK] How did you first hear about the SmartSaver Custom Incentive Program? (Select one)

01 Account representative
02 Business Energy Advisor
03 Contractor or Vendor [CONTRACTOR = 1]
04 Email from Duke Energy
05 Mail from Duke Energy
06 Colleague/Another business
07 Conference/Trade Show/Expo
08 Duke Energy website
09 Other (specify)
88 Don't know

Q2 [ASK IF Q1 = 1, 2 or 3] Did the [response from Q1] provide you with enough information about the program?

01 Yes SKIP TO Q4
02 No

Q3 [ASK IF Q1 = 1, 2 or 3] What additional information would you have liked [response from Q1] to provide?

[RECORD VERBATIM]

Q4 [ASK IF Q1<>3] Did you work with a contractor or vendor to implement the [MEASURE] project or did you work with internal staff at your company?

01 Worked with a contractor / vendor [CONTRACTOR = 1]
02 Internal staff at company [CONTRACTOR = 0]
03 Both the contractor and internal staff [CONTRACTOR = 1]
88 Don't know [CONTRACTOR = 0]

Q5 Before your [MEASURE] project in [YEAR], had you participated in the SmartSaver Program before?

01 Yes
02 No
88 Don't know

Q6 What made you decide to apply to the SmartSaver program?

[RECORD VERBATIM]

Q7 [IF CONTRACTOR=1] Did someone at your company fill out your application for the SmartSaver Custom Incentives program or did your contractor or vendor?

01 Someone at my company
02 Contractor / Vendor
03 Both someone at our company and the contractor
88 Don't know

Q8 Using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how satisfied are you with the process to fill out and submit your application?

___ [RECORD RESPONSE]
77 Does not apply
88 Don't know
99 Refused

Q9 Using the same scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how satisfied are you with the staff time it took to submit the application and necessary paperwork?

___ [RECORD RESPONSE]
77 Does not apply
88 Don't know
99 Refused

Q10 Using the same scale [OPTIONAL: "of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied"], how satisfied are you with Duke Energy's processing and preapproval of your application?

___ [RECORD RESPONSE]
88 Don't know
99 Refused

Q11 [IF Q8<=3 OR Q9<=3 OR Q10<=3] What could the program have done differently to make the application process easier?

[RECORD VERBATIM]

Q12 Did you use the Custom-to-Go calculators provided by Duke Energy, or did you calculate energy savings using your own methods? (Select all that apply)

01 Custom-to-Go
02 Own methods
03 Other (specify)
04 Contractor/vendor calculated
88 Don't know

Q12a [ASK IF Q12 = 4] How did the contractor / vendor calculate the energy savings? (Select all that apply)

01 Custom-to-Go calculators provided by Duke Energy
02 Own methods
03 Other (specify)
88 Don't know

Q13 After submitting your initial application for preapproval, did you receive any requests for additional information while Duke Energy was processing your application?

01 Yes (What additional information was requested?)
02 No
88 Don't know

Q14 Was your project under pressure to be completed in a short amount of time?

01 Yes
02 No

Equipment Questions

E1 Was the [MEASURE] part of a newly constructed building or major renovation of an existing facility?

01 Yes [SKIP TO MeasChk]
02 No
88 Don't know
99 Refused

E2 Did the [MEASURE] you purchased replace an existing [MeasureType]?

01 Yes
02 No [SKIP TO MeasChk]
88 Don't know [SKIP TO MeasChk]
99 Refused [SKIP TO MeasChk]

E3 About how old was your existing [MEASURE]?

____ Years
888 Don't know

E4 What condition was your existing [MEASURE] unit when you decided to purchase a new one? (Read list)

01 Operating with no performance issues
02 Operating but in need of repair
03 No longer operating (broken, did not work)
88 Don't know
99 Refused

Net-to-Gross

MeasCHK [ASK IF MULTCHK = 2 ELSE SKIP TO FR1]
[INTERVIEWER QUESTION: Is this case's MEASURE variable the same as a previous case's MEASURE variable?]

1 Yes; Duplicate measure
2 No, New measure [SKIP TO Q4_MULT]

DecisionCHK [ASK IF MeasCHK=1]
Now, thinking about the [MEASURE] project at [PREMISE_ADDR], was the decision making process the same or different from the previous [MEASURE] project we discussed?

1 Same decision making process [SKIP TO INT99]
2 Different decision making process

Q4_MULT [ASK IF MULTCHK=02] Did you work with a contractor or vendor to implement the [MEASURE] project or did you work with internal staff at your company?

01	Worked with a contractor / vendor	[CONTRACTOR = 1]
02	Internal staff at company	[CONTRACTOR = 0]
03	Both the contractor and internal staff	[CONTRACTOR = 1]
88	Don't know	[CONTRACTOR = 0]

FR1 Which of the following is most likely what would have happened if you had not received the incentive from Duke Energy? (Read list)

01 Canceled or postponed the project at least one year
02 Reduced the size, scope, or efficiency of the project
03 Done exactly the same project
04 Done nothing
88 [DO NOT READ] Don't know

FR2 [ASK IF FR1=2] By how much would you have reduced the size, scope, or efficiency of the project? Would you say a small amount, a moderate amount or a large amount?

01 Small amount
02 Moderate amount
03 Large amount
88 Don't know

FR3 [ASK IF FR1=3] Would your business have paid the additional [INCENTIVE AMOUNT] to complete the project on your own?

01 Yes
02 No
88 Don't know

FR4 On a scale of 0 to 10, with 0 being "not at all influential" and 10 being "extremely influential", how would you rate the influence of the following factors on your decision to complete the [MEASURE] project? [RANDOMIZE ORDER]

FR4A The incentive provided by Duke Energy
FR4B The interaction with Duke Energy SmartSaver program representatives
FR4C SmartSaver marketing materials
FR4D [IF Q5=1] Previous experience with the SmartSaver program
FR4E [IF CONTRACTOR=1] Your contractor's or vendor's recommendation

___ Record influence [0-10]
77 Not applicable
88 Don't know
99 Refused

FR5 [ASK IF CONTRACTOR=1] Was there anything your contractor or vendor said to make you choose the equipment that you ended up installing?

01 Yes [SPECIFY: What did they say?]
02 No
88 Don't know

T12 Questions

[Ask if LightFlag = 1, Else skip to SP1]

TL1 Would you have continued using linear fluorescent T12 fixtures if you had not received a financial incentive to upgrade to [LightingType]?

01 Yes
02 No
88 Don't know

TL2 [If TL1 = 1] How long could replacement lamps have allowed you to continue to use T12 fixtures?

___ Months
___ Years

Tl3 Were you previously purchasing high Color Rendering Index (CRI) T12 replacement lamps as a means of postponing full fixture replacements?

01 Yes
02 No
88 Don't know

Spillover

[IF MULTCHK=02 SKIP TO INT99]

SP1 Since your participation in the SmartSaver program, did you complete any additional energy efficiency projects at this facility or another facility served by Duke Energy that did not receive incentives through a Duke Energy program?

01	Yes	
02	No	SKIP TO SAT1
88	Don't know	SKIP TO SAT1
99	Refused	SKIP TO SAT1

SP2 What energy efficient products, equipment, or improvements did you install or implement? (Select all that apply)

01 Lighting
02 Heating / Cooling
03 Hot Water
04 Appliances / Office
05 Insulation
06 Motor / Variable Frequency drives (VFDs)
07 Compressed Air
08 Refrigeration
09 Other1 [SPECIFY]
10 Other2 [SPECIFY]
88 Don't know SKIP TO SAT1

[ASK SP3-SP4 FOR EACH MENTIONED IN SP2]
SP3 Can you describe the [SP2] equipment? For example: What was the brand or model? Efficiency rating? Dimensions? or Capacity?

[RECORD VERBATIM]

SP4 How many [SP2] units did you install?

____ [RECORD RESPONSE]

SP5 On a scale of 0 to 10, with 0 meaning "not at all influential" and 10 meaning "extremely influential", how influential was your participation in the SmartSaver program on your decision to complete the additional energy efficiency project(s)?

___ [RECORD RESPONSE]

Customer Satisfaction

SAT1 What would you change about the SmartSaver Custom Incentive Program, if anything? (DO NOT READ, Select all that apply)

01 Would not change anything
02 Remove pre-approval requirement
03 Improve initial processing time
04 Increase rebate amount
05 Other (specify)
88 Don't know

SAT2 [ASK IF SAT1=3] What would you consider to be a reasonable amount of time for processing the initial application?

___ [RECORD VERBATIM]

SAT3 [ASK IF SAT1=4] What percent of the project's cost do you think would be reasonable for the SmartSaver program to pay?

___ [RECORD PERCENT]
888 Don't know
999 Refused

SAT4 Was the incentive you received close to the amount you originally calculated when completing your application?

01 Yes
02 No
88 Don't know

Fast Track Feedback

FT1 [IF FastTrack=1 ELSE SKIP TO SAT5] Our records indicate that your project was reviewed under the SmartSaver program's Custom Fast Track option, where you paid for an accelerated review of your project's application. Is this correct?
[IF NEEDED: "There is typically a several hundred dollars fee for the accelerated review."]

01	Yes	
02	No	[FastTrack = 0] SKIP TO SAT5
88	Don't know	SKIP TO SAT5

FT2 How did you hear about the Smart $aver Custom FastTrack option?

01 Account representative
02 Business Energy Advisor
03 Contractor
04 Other (specify)
88 Don't know

FT3 Why did you choose the Custom Fast Track option?

[RECORD VERBATIM]

FT4 Did you have any difficulty responding to the Custom Fast Track questions or requests?

01 Yes
02 No
03 No follow-up questions were asked
88 Don't know

FT5 [ASK IF FT4=1] What was challenging about responding to the SmartSaver program's requests?

[RECORD VERBATIM]

FT6a Were you involved in the kickoff phone call to discuss the scope of the project or to answer any questions Duke Energy had about your project or the building?

01	Yes	
02	No	SKIP TO FT8
88	Don't know	SKIP TO FT8

FT6b Were you notified in advance of the kickoff phone call what would be discussed or any information you would need available?

01 Yes
02 No
88 Don't know

FT7 [ASK IF FT6b=1] What was discussed during the kickoff call?

[RECORD VERBATIM]

FT8 Did your participation in the Fast Track option allow you to complete your project on schedule?

01 Yes
02 No
88 Don't know

FT9 [ASK IF FT8 = 2] What drove the delay in your project being completed as planned?

[RECORD VERBATIM]

FT9a Will you use the Fast Track option again if you have a project under a tight timeline?

01 Yes
02 No [SPECIFY: Why not?]
88 Don't know

SAT5 Using a scale of 0 to 10, where 0 is "not at all valuable" and 10 is "very valuable", how valuable are the following SmartSaver program components to your organization? [RANDOMIZE LIST]

FOR SAT5A through SAT5G

__ Record value [1-10]
NA Not applicable
DK Don't know
RE Refused

SAT5A Materials describing the program requirements and benefits
SAT5B Communication from SmartSaver program representatives
SAT5C Technical assistance from Duke Energy or SmartSaver program representatives
SAT5D [IF CONTRACTOR=1] Technical assistance from your contractor or vendor
SAT5E The incentive amount compared to your total project cost
SAT5F The worksheet or calculation tools that Duke Energy provides
SAT5G [IF FastTrack=1] The Custom Fast Track application option

[ASK IF MULTIPLE SAT5 COMPONENTS RATED EQUALLY VALUABLE]
[SKIP IF ONE SINGLE COMPONENT IS RATED HIGHEST]
[SKIP IF ALL SAT5 COMPONENTS ARE EQUAL TO ZERO]
SAT7 Which of the following SmartSaver program components is most valuable to your organization? [READ LIST, SELECT ONE] [RANDOMIZE CHOICES]

01 Materials describing the program requirements and benefits
02 Communication from SmartSaver program representatives
03 Technical assistance from Duke Energy or SmartSaver program representatives
04 Technical assistance from your contractor or vendor
05 The incentive amount compared to your total project cost
06 The worksheet or calculation tools that Duke Energy provides
07 The Custom Fast Track application option
88 [DO NOT READ] Don't know
99 [DO NOT READ] Refused

SAT8 Have you recommended the SmartSaver Custom Incentive Program to anyone?

01 Yes SKIP TO SAT10
02 No
88 Don't know

SAT9 If provided the opportunity, would you recommend the SmartSaver Custom Incentive Program to anyone?

01 Yes
02 No
88 Don't know

SAT10 Would you consider participating in the SmartSaver Custom Incentive Program again in the future?

01	Yes	
02	No	[SPECIFY: Why not?]
88	Don't know	[SPECIFY: Please explain.]

SAT11 Considering all aspects of the program, using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how would you rate your overall satisfaction with the SmartSaver Custom Incentive program?

___ [RECORD RESPONSE]
88 Don't know
99 Refused

SAT12 Why do you say that?

[RECORD VERBATIM]

SAT13 Using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how would you rate your overall satisfaction with Duke Energy?

___ [RECORD RESPONSE]

SAT14 [ASK IF SAT13<=3] Why do you say that?

[RECORD VERBATIM]

FT10 [ASK IF FastTrack = 0 ELSE SKIP TO C1] Duke Energy offers a fast track option where customers can pay a fee to accelerate the review of a project from 4 to 6 weeks to about one week. Before today, were you aware this is now offered?

01	Yes	
02	No	SKIP TO FT13
88	Don't know	SKIP TO FT13

FT11 How did you become aware of the offering?

01 Account representative
02 Business Energy Advisor
03 Contractor / Vendor
04 Other (specify)
88 Don't know

FT12 Why did you choose not to participate in the offering?

[RECORD VERBATIM]

FT13 If you have a project under a tight timeline, would you be willing to pay several hundred dollars for an accelerated review of your SmartSaver application?

01 Yes
02 No [SPECIFY: Why not?]
88 Don't know

FT14 Would you be willing to participate in a meeting or teleconference and respond to requests about the project specifications in a timely manner?

01 Yes
02 No
88 Don't know

FT15 Using a scale of 0 to 10, where 0 is "not at all valuable" and 10 is "very valuable", how valuable would the fast track application option be for future projects?

___ [RECORD RESPONSE]
88 Don't know
99 Refused

Customer Characteristics

C1 What is the main business activity at [PREMISE_ADDR]?

01 Office/Professional
02 Warehouse or distribution center
03 Food sales
04 Food service
05 Retail (other than mall)
06 Mercantile (enclosed or strip malls)
07 Education
08 Religious worship
09 Public assembly
10 Health care
11 Lodging
12 Public order and safety
13 Industrial/manufacturing [SPECIFY]
14 Agricultural [SPECIFY]
15 Vacant (majority of floor space is unused)
16 Other [SPECIFY]
88 Don't know

C2 Are your company's budget decisions made locally, regionally, nationally, worldwide, or something else?

01 Locally
02 Regionally
03 Nationally
04 Worldwide
05 Other (specify)
88 Don't know

C3 When creating budgets and financial plans, how far into the future does your company plan?

00 Less than 1 year
01 One year
02 Two years
03 Three years
04 Four years
05 Five years
06 More than 5 years
07 Other (specify)
88 Don't know

C4 Does your business' production schedule or business cycle affect when you can implement energy efficiency projects?

[PROBE: A business cycle refers to time periods when your business' activities might be significantly different. For example, a school might have to wait until summer to implement projects, while a manufacturing facility might wait until production is lower."]

01 Yes (Please describe that schedule or cycle)
02 No
03 Don't know

C7 Would you like someone from Duke Energy to contact you directly to provide more information or answer any questions you might have about their energy efficiency programs?

[PROBE: We will not share your responses to this survey, only pass along your contact information]

01 Yes
02 No [SKIP TO C9]

C8_phone To confirm, what's the best number to reach you at?

[RECORD VERBATIM]

C8_name And who should they get in touch with? [Can you spell your name?]

[RECORD VERBATIM]

C9 [IF MULTFLAG=1 SHOW: "[INTERVIEWER, If R has more surveys to complete read: Now I'd like to ask you a smaller selection of questions about another location we have on record for your firm." OTHERWISE READ: "Those are all the questions I have. I'd like to thank you for your help with this survey."]
Do you have any comments you would like to share with Duke Energy?

01 Yes [SPECIFY]
02 No

INT99 That completes the survey, thank you very much for your time.

Duke Energy Midwest SmartSaver Custom Incentive Program
Participating Trade Ally Survey

Sample Variables

CONTACT Primary customer contact name

Company Customer company name

Territory Territory state

Introduction and Screening

INT01 Hello, my name is <NAME> and I am calling on behalf of Duke Energy. May I speak with <CONTACT_NAME, or> the person most familiar with your company's participation in <PROGRAM>?

01 Yes
02 No

PREAMBLE I'm calling from Tetra Tech, an independent research firm. We were hired by Duke Energy to talk with contractors such as yourself about their participation in the SmartSaver Custom Incentive program.

[If needed: We are working with Duke Energy to evaluate their SmartSaver Custom Incentive program. As part of this evaluation, we are speaking to contractors such as yourself. We will be asking about your experience with the program in the past and improvements you would suggest for the future.]

I'd like to assure you that I'm not selling anything, I would just like to ask your opinion about this program. Your responses will be kept confidential and your name will not be revealed to anyone. For quality and training purposes, this call will be recorded.

01 Continue

I1 Are you familiar with the Duke Energy SmartSaver Custom Incentive Program?

01 Yes, I'm able to answer [SKIP TO C_QAL]
02 Yes, but information isn't quite right (specify) [SKIP TO C_QAL]
03 No, I'm not able to answer
04 We have not participated [THANK AND TERMINATE]
99 Refused [THANK AND TERMINATE]

OTHER_R Is it possible that someone else in your organization would be more familiar with the program or the project that was completed?

01	Yes	[SKIP TO AVAILABLE_R]
02	No	[THANK AND TERMINATE]
88	Don't' know	[THANK AND TERMINATE]
99	Refused	[THANK AND TERMINATE]

AVAILABLE_R May I please speak with that person?

01	Yes	[SKIP TO INT01]
02	Yes, but R is not currently available	
03	No, we have not participated	[THANK AND TERMINATE]
88	Don't know	[THANK AND TERMINATE]
99	Refused	[THANK AND TERMINATE]

Trade Ally Background

TA1 I want to begin by asking you a few background questions about you and your company.

What is your role at <company>? (Select one)

01 Owner, partner
02 President, vice president
03 Sales
04 Incentive manager
05 Engineer
06 Other (specify)
88 Don't know
99 Refused

TA2 What equipment and services does your company provide to your customers? (Select all that apply)

01 Application completion assistance
02 Architectural and engineering firm
03 Building shell (insulation, window film, windows, doors, etc.)
04 Cool roof
05 Food service
06 HVAC (heating, ventilation, air conditioning, chillers)
07 Information technology
08 Lighting
09 Motors, pumps or drives
10 Performance
11 Plumbing
12 Process (air compressors, injection molding, etc.)
13 Other (specify)
88 Don't know
99 Refused

TA3 In what states do you provide these services? (Select all that apply)

01 Ohio
02 Indiana
03 Kentucky
04 Others (specify)
88 Don't know
99 Refused

TA4 How long has <company> been participating in the Duke Energy SmartSaver Custom Incentive program?

01 Less than 1 year
02 1 to 2 years
03 3 to 5 years
04 More than 5 years
88 Don't know
99 Refused

TA5 About how many projects would you say you have completed through the SmartSaver program since then?

01 Less than 5 projects
02 5 to 9 projects
03 10 to 19 projects
04 20 to 49 projects
05 50 to 99 projects
06 100 projects or more
88 Don’t know
99 Refused

TA6 Thinking about the number of projects you did through the program in the last 12 months, do you think the number of 2018 projects will be higher, lower or about the same?

01 Higher
02 Lower
03 About the same
88 Don’t know
99 Refused

TA7 Why do you think your 2018 projects will be <TA6 response>?

[RECORD VERBATIM]

TA8 Are you registered with Duke Energy’s trade ally network and appear on their website?

[if needed, you would have had to complete a code of conduct and agreement form to appear on Duke Energy’s website.]

01 Yes
02 No, [SPECIFY: Why not?]
88 Don’t know
99 Refusal

Program Interaction

PI1 Did you receive any training or information from Duke Energy as part of the Custom program?

01 Yes
02 No [SKIP TO PI3]
88 Don’t know [SKIP TO PI3]
99 Refusal [SKIP TO PI3]

PI2 Is there any additional training or information Duke Energy could provide?

01 Yes – [SPECIFY: What additional training or information would you like?]
02 No
88 Don’t know
99 Refused

PI3 What percent of your customers know about the Custom program prior to you telling them about it?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

PI4 Based on your own interactions with customers, how do customers become aware of the SmartSaver Custom program? (Do not read; Select all that apply)

01 Direct contact from <company>
02 Contractor marketing materials such as direct mail, ad, etc.
03 Another contractor
04 Duke Energy bill insert
05 Duke Energy website
06 Duke Energy employee, account representative, customer service representative
07 Colleague, family or friends
08 Program brochure
09 Other (specify)
88 Don’t know
99 Refused

PI5 What types of concerns do customers have about the program, if any? (Select all that apply)

01 No concerns
02 Unsure if the equipment qualifies
03 Unsure if the savings will be achieved
04 Unsure if the incentive will be as high as estimated
05 Uncertainty around the preapproval
06 Other (specify)
88 Don’t know
99 Refused

PI6 Do you use the program as a sales tool?

01 Yes
02 No SKIP TO AT1
88 Don’t know SKIP TO AT1
99 Refusal SKIP TO AT1

PI7 How helpful is the Duke Energy program in selling energy efficient equipment? Do you think it is. . .? [READ LIST]

01 Very helpful
02 Somewhat helpful
03 Neither helpful nor unhelpful
04 Not very helpful
05 Not at all helpful
88 [DO NOT READ] Don't know
99 [DO NOT READ] Refused

Attribution

AT1 Approximately how many projects did you complete through the SmartSaver Custom Incentive program in the past 12 months?

__ [RECORD # OF PROJECTS 0-50]
888 Don't know
999 Refused

AT2 In what percent of your sales situations did you recommend high-efficiency equipment *before* you learned about the SmartSaver Custom Incentive program?

___ [RECORD 0-100%]
888 Don't know
999 Refused

AT3 And in what percent of your sales situations do you recommend high-efficiency equipment now that you have worked with the SmartSaver Custom Incentive program?

___ [RECORD 0-100%]
888 Don't know
999 Refused

AT4 Using a scale from 0 to 10 where 0 is "not at all important" and 10 is "very important", how important was the SmartSaver Custom Incentive program in influencing your decision to recommend high-efficiency equipment to your customers?

__ [RECORD 0-10]
88 Don't know
99 Refused

AT5 And using a scale from 0 to 10 where 0 is “not at all likely” and 10 is “very likely”, how likely is it that you would have recommended the high efficiency equipment to your customers if the SmartSaver Custom Incentive Program had not been available?

__ [RECORD 0-10]
88 Don't know
99 Refused

AT6 And in what percent of your sales situations did the customer choose to go with higher efficiency equipment based on the availability of a Duke Energy rebate?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

AT7 What percent of the projects in the last 12 months where you sold or installed high-efficiency equipment were eligible but DID NOT receive an incentive through a Duke Energy energy-efficiency program?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

AT8 [if AT7 > 0] Did you request an incentive for any of those projects?

01	Yes	
02	No	[SKIP TO AT10]
88	Don’t know	[SKIP TO AT11]
99	Refused	[SKIP TO AT11]

AT9 [if AT8 = 1] If you requested an incentive but did not receive one, why was that?

[RECORD VERBATIM RESPONSE]

AT10 [if AT8 = 2] Why did you or your customers not request an incentive for these energy efficiency projects?

[RECORD VERBATIM RESPONSE]

AT11 What percent of your sales in the last 12 months were for each of the following five categories?

a. planned replacement of working equipment?
b. equipment for new facilities?
c. new equipment for existing facilities?
d. failed or emergency equipment replacement?
e. other?

AT11_OTR [if AT11E>0 and AT11E<>888] You mentioned that [from AT11E] percent of your sales were because of some other reason. What were these reasons?

01 Other (Specify)

AT12 [if AT11a > 0 and AT11<>888] Would you say the working equipment you replaced was typically in good, fair, or poor condition?

01 Good
02 Fair
03 Poor
04 Other (specify)
88 Don’t know
99 Refused

T12 Lamp Questions

[if TA2 = 8, ask this section, else skip to SA1_INT]

TL1 Next I have a few questions about lighting systems.
Of your linear fluorescent lighting system sales in 2017, what percent were T12s?

___ [RECORD 0-100%]
888 Don’t know
999 Refused

TL2 Are you still stocking and selling linear fluorescent T12 lighting systems and replacement lamps?

01 Yes
02 Yes [SPECIFY: Capture any additional contractors comments in TL2 (e.g., yes, but…]
03 No
04 No [SPECIFY: Capture any additional contractors comments in TL2 (e.g., no, but…]
88 Don't know
99 Refused

TL3 [if TL2 = 1 or 2] Thinking of your 2018 sales of linear fluorescent lighting system sales, what percent will be T12s?

___ [RECORD 0-100%]
888 Don't know
999 Refused

Satisfaction

SA1_INT Next I'm going to read a list of aspects related to your experience with the SmartSaver Custom Incentive Program. Using a scale where 0 is "not at all satisfied" and 10 is "very satisfied," how satisfied are you with the following program aspects…

[RANDOMIZE A THROUGH G]

For SA1A THROUGH SA1G
__ [RECORD 0-10]
88 Don't know
99 Refused

a. The time it took to receive pre-approval
b. The pre-approval application process
c. The program process once the project is pre-approved
d. The incentives available through the SmartSaver Custom program
e. The timeliness of rebate payment to customers
f. The training and information received through the program
g. The level of communications with program staff

SA2 Using this same scale (0 being "not at all satisfied" and 10 being "very satisfied"), how satisfied are you with the SmartSaver Custom Incentive program overall?

__ [RECORD 0-10]
88 Don't know
99 Refused

SA3 And how satisfied are you with Duke Energy (if needed: using the same scale where 0 is "not at all satisfied" and 10 is "very satisfied")?

__ [RECORD 0-10]
88 Don't know
99 Refused

SA4 Would you say your communication with Duke Energy program staff was very effective, somewhat effective, neither effective nor ineffective, not too effective, or not at all effective?

01 Very effective
02 Somewhat effective
03 Neither effective nor ineffective
04 Not too effective
05 Not at all effective
88 Don't know
99 Refused

Customer Interaction

CI1 Now I'd like to ask a few questions about your customers.
Based on your experiences, what factors most influence the type of equipment nonresidential customers purchase? (Do not read; Select all that apply)

01 Equipment cost
02 Rebate and incentive availability
03 Contractor recommendation
04 Desire to reduce energy bills
05 Availability of equipment for emergency replacement
06 Equipment specifications
07 Other (specify)
88 Don't know
99 Refused

CI2 Are some nonresidential customers more receptive than others to high efficiency equipment?

01 Yes [PROBE: "What types of customers are more receptive? What types are less receptive?"]
02 No
88 Don't know
99 Refused

CI3 Why do some projects drop out or why do some customers not move forward with projects?

[RECORD VERBATIM RESPONSE]

Program Participation

***Added option of (specify) to choice 03 on 11/08/2017
PP1 How do you typically estimate savings for projects submitted through the SmartSaver Custom program? (Read list; Select all that apply)

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

01 Using Duke's custom-to-go calculator
02 Using Duke's classic custom calculator
03 Using your own calculators (specify)
04 Other (specify)
88 Don't know
99 Refused

PP2 [if PP1 = 1] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the custom-to-go calculator in estimating energy savings?

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

__ [RECORD 0-10]

PP3 [if PP1 = 2] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the classic custom calculator in estimating energy savings?

[note: the "classic custom calculator" is an Excel sheet (workbook) and the "custom-to-go calculator" is an actual non-Excel based calculator.]

__ [RECORD 0-10]

PP4 [PP1<>1 OR PP1 <>2, if do not use Duke's custom-to-go or classic custom calculator] Why haven't you used Duke's <fill from PP1: custom-to-go and/or classic custom> calculators?

[RECORD VERBATIM]

PP5 After submitting an application, have you ever received requests for more information?

01	Yes	
02	No	SKIP TO PP7
88	Don't know	SKIP TO PP7
99	Refused	SKIP TO PP7

PP6 [if PP5 = 1] What was the request for?

[RECORD VERBATIM RESPONSE]

PP7 Are there any enrollment paperwork or rebate submission processes that could be simplified to encourage customers to complete projects?

01	Yes	What process could be simplified?
02	No	
88	Don't know	
99	Refused	

PP8 Were you aware there was an online application portal to submit the application online?

01 Yes
02 No
88 Don't know
99 Refused

PP9 [If PP8 = 1] Have you used the online portal?

01 Yes
02 No
88 Don't know
99 Refused

PP10 [if PP9 = 1] Using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful", how useful is the online portal?

__ [RECORD 0-10]

PP11 [if PP9 =02,88,99] Is there anything preventing you from using this portal?

01 Yes What is preventing you from using the portal?
02 No
88 Don't know
99 Refused

PP12 What program aspect is most influential in customers' decision to move forward with the project?

01 The incentive
02 The energy savings
03 The engineering support provided by Duke
04 Other (specify)
88 Don't know
99 Refused

PP13 From your perspective, what is the most valuable part of the SmartSaver Custom Incentive program? (DO NOT READ)

01 The incentive
02 The energy savings
03 The engineering support provided by Duke
04 Other (specify)
88 Don't know
99 Refused

PP14 From your perspective, what part of the SmartSaver Custom Incentive program could be improved?

[RECORD VERBATIM RESPONSE]
77 Nothing

Wrap up

WU1 Do you have any other feedback that you would like to share with Duke Energy about this program?

01 Yes [record comments]
02 No
88 Don't know
99 Refused

INT99 Those are all the questions I have. Thank you for your time.

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APPENDIX J - RESIDENTIAL ASSESSMENTS EVALUATION

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Duke Energy Ohio

Residential Energy Assessments Program Evaluation Report – Final

October 16, 2018

Opinion Dynamics

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1. Evaluation Summary

1.1 Program Summary

The Duke Energy Ohio (DEO) Residential Energy Assessments (REA) program is a home assessment program that provides customers with a customized energy report that includes recommendations to help lower energy bills. Customers also receive an Energy Efficiency Starter Kit that contains two LEDs, a low-flow shower head, two faucet aerators (one kitchen faucet aerator and one bathroom faucet aerator), a 17-foot roll of weather stripping, and six outlet seals, which the energy specialist (or auditor) who performs the assessment installs free of charge. Up to six additional LEDs may also be installed based on the auditor’s assessment findings. Auditors also encourage behavioral changes related to energy use and recommend higher-cost energy-saving investments to customers, such as a new HVAC system or energy-efficient appliances.

The REA program targets owner-occupied, single-family residences[1] and relies primarily on direct mail marketing. Opinion Dynamics conducted an evaluation of the REA program for the period of May 1, 2016 to April 30, 2017.

1.2 Evaluation Objectives

The overall objectives of the evaluation were to:

- Estimate energy savings using monthly billing data
- Verify the accuracy of deemed per-unit savings estimates and develop in-service rates (ISRs)
- Estimate energy, summer demand, and winter demand savings at the measure level using an engineering analysis
- Assess the likelihood that participants would have installed program measures had the energy efficiency kit not been provided (i.e., free-ridership [FR])
- Document spillover (SO) associated with program participation
- Identify the most successful components of the program’s implementation
- Identify the barriers to participation and provide recommendations to address these barriers

To achieve these objectives, Opinion Dynamics completed several data collection and analytic activities, including an interview with the program manager, a review of program materials, a participant telephone survey, an analysis of the survey results, an analysis of program-tracking data, a billing analysis, a deemed savings review, and an engineering analysis. Through the primary data collection efforts, the evaluation team developed estimates of measure-level ISRs and measure- and program-level net-to-gross ratios (NTGRs).

[1] The participant count is based on the *vendor_update_ts* date variable in the program-tracking data. This represents the date at which the customer was input into the database, not the date of the assessment.

1.3 High-Level Findings

Table 1-1 presents the participant- and program-level net savings from the billing analysis for the evaluation period (May 1, 2016 through April 30, 2017). These results include the savings from the measures included in the distributed energy efficiency kits, as well as from additional LEDs provided to program participants. The results also include savings from behavioral changes that participants made based on the recommendations received during the assessment, as well as participant SO attributable to the program.

Table 1-1. Net Impact Savings from Billing Analysis

Net Participant Savings			Net Program Savings		
Energy (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Energy (MWh)	Summer Peak Demand (MW)	Winter Peak Demand (MW)
1,059	0.0958	0.0945	2,384	0.2158	0.2127

Using information collected during the participant survey, we estimated ISRs ranging from 30% for weather stripping to 87% for LEDs. Table 1-2 presents the ISR estimates and relative precision values for the measures included in the energy efficiency kits. We designed our sample to achieve a relative precision of 10% with 90% confidence; however, for most measures, we were unable to achieve this target due to low rates of installation among the surveyed participants.

Table 1-2. ISR Results and Relative Precision

	Kit Average	By Measure				
		LEDs	Faucet Aerators	Low-Flow Shower Head	Outlet Seals	Weather Stripping
Sample size (n)	149	137	143	149	102	92
Estimated ISR	49%	87%	40%	39%	45%	30%
Relative precision (at 90% confidence)	7.7%	4.9%	14.4%	17.1%	17.9%	25.7%

Table 1-3 presents per-participant gross impact results, based on an engineering review of the measures included in the energy efficiency kit and application of the ISRs. The table presents estimated gross savings for the kit only and for the kit plus additional LEDs, based on the average number provided per participant for the evaluation period.[2]

[2] Participants were eligible to receive up to six additional LEDs per home. Note that we found instances in the program-tracking data where more than six additional LEDs were provided.

Table 1-3. Gross Impact Results Per Home from Engineering Review (Inclusive of ISR)

Measure		May 2016–April 2017			
		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Percent of Total kWh Savings
Energy Efficiency Kit	LEDs (2 9W bulbs)	55.4	0.0044	0.0038	19%
	Low-Flow Shower Head (1)	52.9	0.0018	0.0036	19%
	Bathroom faucet aerator (1)	6.6	0.0006	0.0011	2%
	Kitchen faucet aerator (1)	39.8	0.0017	0.0035	14%
	Outlet Seals (package of 6)	4.3	0.0004	0.0018	2%
	Weather Stripping (per roll)	18.7	0.0086	0.0042	7%
Total Kit Only		**177.8**	**0.0174**	**0.0180**	**62%**
Additional LEDs (average of 3.4 bulbs)		107.8	0.0085	0.0075	38%
Total Per-Home Estimate		**285.6**	**0.0259**	**0.0255**	**100%**

The gross impact results from the engineering analysis per household is far lower than those that we found using a billing analysis. It is common to see a lower estimate from an engineering analysis, as it does not incorporate behavioral changes that customers make due to their interaction with a program.

Based on responses to questions in the participant survey, which focused on each measure from the Energy Efficiency Starter Kit, NTGRs (defined as 1 – FR + SO) were calculated for each interviewed customer (see Table 1-4). FR survey questions asked customers about each measure included in the Energy Efficiency Starter Kit that they installed, while SO questions asked about measures installed outside of the program for which no incentives were received but that were likely a consequence of participation in the REA program. The evaluation team estimated FR at the measure level and SO at the program level.

Table 1-4. Net-to-Gross Ratio Results

Component	FR	SO	NTGR
Energy Efficiency Kit*	27.4%	8.3%	80.9%
LEDs**	52.4%		55.8%
Low-flow shower head	18.2%		90.1%
Faucet aerators***	11.9%		96.4%
Outlet seals	16.8%		91.5%
Weather stripping	20.5%		87.8%

* FR for the Energy Efficiency Kit is the weighted average of the measure-level FR values.
**FR for LEDs applies to LEDs in the kit as well as additional ones supplied.
***FR questions for faucet aerators did not differentiate between kitchen and bathroom aerators.

Table 1-5 below compares the deemed ex ante and ex post per household and program-level net energy and demand savings and presents the savings claimable under SB 310 (final column). As can be seen in the table, DEO will claim 1,059 kWh per household and 2,384 MWh for the program during the evaluation period. Total program savings are calculated as the per-household savings multiplied by the number of participating households in the evaluation period.

Table 1-5. Comparison of Deemed Ex Ante and Ex Post Net Savings

Energy and Demand Savings	Net Deemed (Planning) Savings	Net Ex Post Savings	Claimable Savings under SB 310
Energy Savings			
Total Per-Household Savings (kWh)	890.1	1,058.5	1,058.5
Additional LEDs (kWh) (average of 3.4 bulbs per household)	*96.1*	*59.7*	*96.1*
Energy Efficiency Kit, excluding Additional Bulbs (kWh)	*794.0*	*998.9*	*962.4*
Total Program Savings (MWh)	**2,004.5**	**2,383.7**	**2,383.7**
Summer Coincident Demand Savings			
Total Per-Household Savings (kW)	0.1095	0.0958	0.0958
Additional LEDs (kW) (average of 3.4 bulbs per household)	*0.0094*	*0.0047*	*0.0094*
Energy Efficiency Kit, excluding Additional Bulbs (kW)	*0.1001*	*0.0912*	*0.0865*
Total Program Savings (kW)	**246.5**	**215.8**	**215.8**
Winter Coincident Demand Savings			
Total Per-Household Savings (kW)	0.1130	0.0945	0.0945
Additional LEDs (kW) (average of 3.4 bulbs per household)	*0.0177*	*0.0041*	*0.0177*
Energy Efficiency Kit, excluding Additional Bulbs (kW)	*0.0953*	*0.0903*	*0.0768*
Total Program Savings (kW)	**254.5**	**212.7**	**212.7**

The values included in the DS More inputs table are based on the net savings values claimable under SB 310 and are provided in Table 1-6.

Table 1-6. DS More Inputs

DS More Inputs	Energy Savings (kWh)	Summer Peak Savings (kW)	Winter Peak Savings (kW)
Net energy efficiency kit savings per participant (excluding additional LEDs)	962.4	0.0865	0.0768
Net savings per additional LED bulb*	28.3	0.0028	0.0052

*Net savings per additional LED = ex ante gross savings per additional LED (as provided by Duke Energy) * NTGR for LEDs (55.8%)

1.4 Evaluation Recommendations

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

- **Auditors should install all measures in distributed energy efficiency kits. If unable to install all measures, auditors should track the barriers that prevent them from doing so.** If the program could improve measure installation, it is likely that measure ISRs and program savings would improve, particularly because we found high persistence rates (PRs) for all measures. We understand that there may be safety concerns related to the installation of outlet seals, which may lead auditors to leave these measures uninstalled, but our understanding is that Duke Energy has an expectation that all measures will be installed during home assessments. It should be noted that in subsequent conversations, the evaluation team learned from Duke Energy that in the spring of 2017, after the close of this evaluation period, additional training of implementation staff occurred to address this issue and to instruct installers to document why measures were not installed.

Specifically, to address faucet aerators that do not fit, we recommend providing adaptors to participants to increase the installation rate of this measure.

- **Provide education on the benefits of early light bulb replacement.** Participants report “not needing them” as the most common reason for not installing the LEDs provided in the kit, suggesting that participants are waiting for their current bulbs to burn out. While more emphasis on installing all measures during the audit (see recommendation above) will help with ISRs, providing additional education on the savings potential of LEDs might lead to additional spillover savings by encouraging participants to more quickly replace inefficient bulbs in the future as well.

- **Channeling efforts by auditors that direct participants of the REA program to other Duke Energy programs could be improved.** While our data preparation for the billing analysis showed that a majority of REA participants have participated in other Duke Energy programs prior to participation, our survey findings showed that only a small portion of customers recalled hearing about other Duke Energy programs through the REA program. If Duke Energy is interested in using the REA program to channel customers to their other offerings, program staff may want to direct auditors to leave behind applicable materials to market its other programs. Additionally, we recommend that auditors familiarize themselves with Duke Energy’s other programs and make recommendations to program participants based on the programs that are most suitable.

  According to Duke Energy, the program refreshed the technology and audit report in March 2017 to provide a more user-friendly report to the customer, outlining audit recommendations as well as cross-program recommendations. Additionally, the implementer now has the ability to report back to Duke Energy all recommendations, including cross-promotional referrals. Finally, in addition to including FindItDuke referrals in the audit report, advisors can now generate (where relevant) and email referrals to the customer during the assessment.

- **Ensure that auditors provide all applicable recommendations to customers during assessment visits.** Based on a review of program-tracking data and responses to the participant survey, the evaluation team found that several recommendations were provided to fewer than 20% of customers, with the exceptions being sealing air leaks, installing insulation, removing an extra refrigerator, and replacing old heat pumps. It is unclear whether auditors provided recommendations but did not account for them in their program tracking or whether they did not provide the recommendations to customers because they were not applicable or for some other reason.

  The energy savings from the program could be improved if auditors provided customers with more recommendations on which they could act, since they may not be knowledgeable about the amount of energy that they could save by making changes, such as replacing furnace filters and adjusting thermostat settings. As noted above, Duke Energy has provided additional training to implementation staff to address providing recommendations to program participants that can help them save energy in their homes and has improved the content of the audit reports.

2. Program Description

The Duke Energy Ohio (DEO) Residential Energy Assessments (REA) program is a home assessment program that provides customers with a customized energy report with recommendations to help lower energy bills. The program targets residents of owner-occupied, single-family households who have been in their homes for at least four months and uses direct mailing as its main source of marketing and outreach.

2.1 Program Design

The REA program has two main components. The first is the home energy assessment, branded to customers as the “Home Energy House Call.” During the assessment, energy specialists (auditors) enter participants’ homes to inspect and assess energy-centric equipment in the home, including their heating and cooling equipment and the state of duct and home insulation. Auditors also look for places where customers could either make an improvement to equipment (e.g., replacing an outdated heat pump, removing older secondary appliances) or adjust the way that they use current equipment (e.g., adjusting the settings for their furnace fan, using window shades in the summer). These recommendations are meant to steer customers toward home improvements that will help them save more energy.

The second component is a free kit of low-cost, energy-efficient measures. The Energy Efficiency Starter Kit consists of two 9W LEDs, two faucet aerators (one kitchen aerator and one bathroom aerator), a low-flow shower head, outlet seals (a package of four outlet and two switch seals), and a 17-foot roll of closed cell foam weather stripping. Customers can also receive up to six additional LEDs, regardless of bulbs received from other Duke Energy programs.

In its program-tracking databases, DEO tracks the date that customers were input into the database, the recommendations made by the auditor during the assessment, and the number of additional light bulbs given to the customer.

2.2 Program Implementation

During the evaluation period, DEO contracted with Franklin Energy to implement the REA program. The program was implemented using a multichannel marketing approach, including bill inserts and direct mail letters, as well as a paid search on Google. The successful marketing of the program led to a backlog of participants, causing DEO to scale back its marketing during the evaluation period.

2.3 Program Performance

The program period under evaluation is May 1, 2016 through April 30, 2017. Over this period, the program served 2,252 unique participants. Based on our impact evaluation, the program saved participants, on average, 1,059 kWh per household per year. Coincident demand savings per household were 0.096 kW in summer and 0.095 kW in winter.

3. Key Research Objectives

This evaluation included a gross impact evaluation, a net-to-gross (NTG) analysis, and a process evaluation. The overall objectives of the REA program evaluation were to:

- Estimate energy savings using monthly billing data
- Verify the accuracy of deemed per-unit savings estimates and develop in-service rates (ISRs)
- Estimate energy, summer demand, and winter demand savings at the measure level using an engineering analysis
- Assess the likelihood that participants would have installed program measures had the energy efficiency kit not been provided (i.e., free-ridership [FR])
- Document spillover (SO) associated with program participation
- Identify the most successful components of the program's implementation
- Identify the barriers to participation and provide recommendations to address these barriers

4. Overview of Evaluation Activities

4.1 Program Staff Interview

Opinion Dynamics conducted an in-depth interview with the current REA program manager in March 2017. The purpose of the interview was to gauge the current environment of, and expectations for, the REA program, including the program's goals, successes, and challenges over the evaluation period. During the interview, we discussed the multichannel approach to marketing the program and additional training provided to program implementation staff to educate customers about energy efficiency, as well as the receptiveness of DEO customers to participating in this offering.

4.2 Program Materials Review

Opinion Dynamics reviewed program materials, including implementation plans, marketing and outreach materials, training materials, and the program-tracking database. We found program materials relating to the assessment, recommendations, and marketing to be complete and of high quality.

4.3 Participant Survey

Opinion Dynamics implemented a computer-assisted telephone interviewing (CATI) survey in June and July 2017. The survey gathered data to verify participation in the program; develop measure-level estimates of installation, persistence, and ISRs; estimate the program net-to-gross ratio (NTGR); and support our process evaluation.

The survey sample design and sample size were based on customers who participated during the evaluation period. Of the 2,252 participants in the database, we drew a random sample of 1,001 valid telephone numbers. We used this sample to complete 150 participant telephone interviews.

The average length of the interviews was approximately 21 minutes; the response rate was 19%.

4.4 Billing Analysis

Opinion Dynamics conducted a billing analysis to determine the net savings attributable to the REA program for the 2016-2017 evaluation period. The evaluation team used a linear fixed effects regression (LFER) model to estimate the overall net ex post program savings. The fixed effect in our model is the customer, which allows us to control for all household factors that do not vary over time. The billing analysis used customers who participated from May 2016 through April 2017 as the treatment group and those who participated from May 2017 through December 2017 as the comparison group. A summary of the billing analysis approach is provided in Section 5.1.1; a detailed description of the billing analysis methodology is presented in Appendix F of the accompanying appendices.

4.5 Deemed Savings Review and Engineering Analysis

Opinion Dynamics conducted a review of Duke Energy's deemed savings values and assumptions for each of the measures included in the Energy Efficiency Starter Kit. The deemed savings review had two main objectives:

1. Develop updated measure-level savings algorithms and input assumptions that are consistent with standard industry practice and comparable with applicable technical reference manuals (TRMs)
2. Develop a ratio between energy and demand savings that can be applied to the billing analysis energy savings to determine net demand savings

To conduct our deemed savings review, we prioritized the use of the Ohio TRM (OH TRM) and Indiana TRM (IN TRM V2.2)[3] and other secondary resources and developed per-unit savings estimates for each kit measure. For each of the reviewed measures, we identified recommendations and suggested approaches for quantifying savings for this evaluation.

Our evaluation also relied on telephone survey data to confirm measure installation and persistence, which were combined with engineering estimates for each measure to develop per-unit gross energy and demand savings by measure type. Program-level energy savings are estimated through a billing analysis. Appendix E provides more detail on the methods used in the deemed savings review and engineering analysis.

[3] Ohio Technical Reference Manual. August 6, 2010; Indiana Technical Reference Manual Version 2.2. July 28, 2015.

5. Impact Evaluation

5.1 Methodology

5.1.1 Billing Analysis

Opinion Dynamics conducted a billing analysis to determine the net savings of the REA program. Our billing analysis used participants from May 2016 through April 2017 as the treatment group and participants from May 2017 through December 2017 as the comparison group. This type of comparison group is referred to as a "future participant comparison group," because comparison group participants participated in the future, relative to the evaluation period. A comparison group allows us to establish a counterfactual, i.e., the baseline energy that participants in the treatment group would have used in the absence of the program. In addition, because the comparison group represents energy use in absence of the program, results from the billing analysis are net results, and application of a NTGR to billing analysis results is unnecessary.

Our method requires pre- and post-installation electricity usage data for the treatment group. To be included in the treatment group, we need both pre- and post-installation usage data for at least nine months before and after participation. For the control group, the model includes electricity usage data only from before their participation. The analysis includes all customers who participated during the evaluation period.

Table 5-1 summarizes information about the treatment and comparison groups included in the analyses.

Table 5-1. Accounts Included in Final Billing Analysis Model

Metric	Treatment Group	Comparison Group
Months of participation	May 2016–April 2017	May 2017–December 2017
# customers included in the analysis	538	250
Usage data included	At least 9 months of pre- and post-participation data	At least 9 months of pre-participation data

The number of treatment customers included in the analysis is approximately 24% of those who participated during the evaluation period, and 20% of those who participated between May and December of 2017. The main reason customers were dropped from the analysis was due to participation in other Duke Energy programs (approximately 56% in the treatment group and 69% in the comparison group). The evaluation team recognizes that this is a large number of customers to exclude from the analysis but took this necessary step to limit the risk of the effects of other programs being confounded with the treatment effect of the REA program. It should be noted that while these customers were not included in the billing analysis model, average modeled savings are still applied to them, i.e., the program receives credit for their savings.

The billing analysis employed a LFER model, which accounts for time-invariant factors, such as square footage, appliance stock, habitual behaviors, household size, and other factors that do not vary over time. The model accounts for differences in weather and pre-program energy use between participants. We also added dummy variables for each calendar month, i.e., binomial terms with "1" signifying that the bill occurred in that month of year and "0" otherwise. The monthly variables help control for seasonal trends in energy use and allow for a more accurate estimate of baseline usage absent the program. The model includes interaction terms between weather and the post-participation period for the treatment group, to account for differences in weather patterns across years.

A more detailed discussion of the billing analysis methodology, including data-cleaning steps, the comparison group assessment, and the final model, is provided in Appendix F of the accompanying appendices.

5.1.2 Engineering Analysis

As part of our impact evaluation, Opinion Dynamics conducted an engineering analysis for each measure contained in the REA Energy Efficiency Starter Kit. The purposes of the engineering estimates were to:

1. Provide a ratio of kW coincident demand to kWh energy savings, which is then applied to the billing analysis energy savings to estimate demand savings
2. Provide insight into the individual measure contributions to the overall kit savings

We used the IN TRM V2.2 and other references and assumptions to conduct our engineering analysis. The engineering analysis takes into consideration the measure ISRs to ensure only savings for installed measures are counted.[4] Additional details and information on the engineering analysis are provided in Appendix E of the accompanying appendices.

It should be noted that the billing analysis determines actual energy (kWh) impacts for the program; the engineering analysis only supplements the billing analysis for the two reasons mentioned above.

Installation Verification and Persistence

As part of the participant survey, we verified measure installation and persistence to obtain measure-level ISRs. Our engineering estimates use these values in calculations for annual per-customer savings (Figure 5-1). Specifically, we asked sampled participants to confirm the quantity of installed kit measures and, when necessary, to provide the corrected quantity. We then divided the number of measures verified by the respondent by the quantity that they received in the kit. This verified installation rate (IR) is the first component of the total ISR. Where applicable, we also asked participants to confirm whether program measures remained installed in their homes to create a persistence rate (PR). We then created a measure-specific total ISR by multiplying the two components.

[4] We reviewed several TRMs, including regional TRMs (e.g., Mid-Atlantic) as part of our engineering review. Many of these TRMs reference consistent methodologies for savings calculations, and we ultimately followed the IN TRM V2.2 methods to remain consistent with other Duke Energy evaluations, but made DEO-specific updates as applicable based on weather and survey data.

Figure 5-1. Installation Rate Components

A) Reported
- Total quantity of measures in the program-tracking data

B) Installed
- Total quantity of the distributed measures that customers confirmed were installed

C) In Service
- Total quantity of measures that customers confirmed as still installed

Installation rate (IR): B ÷ A
Persistence rate (PR): C ÷ B
First-year in-service rate (ISR): IR * PR (or C ÷ A)

5.2 Results

5.2.1 Billing Analysis Results

This section provides billing analysis results and savings estimates for the DEO REA program evaluation period. Appendix F contains a detailed methodology for data cleaning and analysis, as well as complete results of the models. Table 5-2 shows the results of the billing model for REA program participants. The variable "Post" represents the unadjusted treatment effect, i.e., the change in average daily consumption (ADC) attributable to participation in the REA.

Table 5-2. Results of Billing Analysis Models

Variable	Coefficient
Post (REA program participation)	−5.1650*
Heating Degree-Days (HDD)	0.2223**
Cooling Degree-Days (CDD)	0.0276**
Post-participation period CDD	0.0173
Post-participation period HDD	0.0036
Constant	27.9608**
R-squared	0.6412
Additional Terms	**Included**
Monthly effects included	YES
Post-participation period interacted with months included	YES

* $p<0.1$; ** $p<0.01$.

Due to post-participation period interaction terms in the model, it is necessary to recalculate the coefficient of the treatment effect (Post) by combining the average value with the coefficient for each interaction term. The coefficient seen in the regression represents the reduction of daily consumption during the post-participation period, separate of any effect of the included interaction terms. Making these adjustments (detailed in

Appendix F), Opinion Dynamics found that REA program participants included in the model realized 2.9 kWh of daily energy savings, on average.

Table 5-3 shows the per-home and program-level savings for the program. Overall, customers who participated in the REA program saved 1,059 kWh per year. During the evaluation period, the program realized 2,384 MWh of energy savings.

Table 5-3. Annual Savings from Billing Analysis

Annual Savings	
May 2016–April 2017 participants	2,252
Per-home daily savings (kWh)	2.9
Per-home annual savings (kWh)	1,059
Program savings (MWh)	**2,384**

5.2.2 Engineering Analysis Results

This section provides the results of the engineering analysis, including ex post deemed savings values, survey-based ISRs, and application of measure quantities to determine per-participant gross energy and demand savings. Table 5-4 shows the ex post deemed savings values from the deemed savings review completed by the evaluation team (see Appendix E). Note that these values do not yet include ISR.

Table 5-4. Ex Post Deemed Savings for Energy Efficiency Starter Kit Measures

Measure	Ex Post Deemed Savings Per Unit (kWh)	Ex Post Deemed Savings Per Kit (kWh)*
LED	32.0	63. 9
Low-flow shower head	136.5	136.5
Bathroom faucet aerator	16.2	16.2
Kitchen faucet aerator	98.4	98.4
Outlet seals	1.6	9.7
Weather stripping	3.7	63.2
Energy Efficiency Kit	N/A	387.9

* Energy efficiency kit contains two LEDs, six outlet seals and 17 feet of stripping; the per unit value for weather stripping is for 1 foot.

Table 5-5 provides the IR, PR, and ISR by measure. Except for LEDs, the evaluation found relatively low ISRs for measures included in the kit. Many participants reported that auditors often do not install all kit measures during the assessments, resulting in low IRs. However, PRs are high, suggesting that once installed, most measures stay in place.

Table 5-5. Measure-Level IRs, PRs, and ISRs

Measure	IR	PR	ISR
LED	88.1%	98.4%	86.7%
Low-flow shower head	40.1%	96.6%	38.7%
Bathroom faucet aerator	42.3%	95.7%	39.5%
Kitchen faucet aerator			

Measure	IR	PR	ISR
Outlet seal	44.7%	100.0%	44.7%
Weather stripping	29.6%	100.0%	29.6%
Additional LEDs*	100.0%	98.4%	98.4%

*The IR of additional LEDs is assumed to be 100%. The PR is based on survey responses about LEDs provided in the kit.

To calculate per-participant engineering gross impacts, we multiplied the deemed savings values by measure-level ISRs and the average distributed quantity of each measure included in the kit. Table 5-6 shows the resulting estimated energy and demand savings for each measure included in the kit. In addition to the kit measures, the program reported distributing 7,721 extra LEDs to customers through the assessments, an average of 3.4 per household. The estimated energy savings for these additional LEDs is also included in Table 5-6. The lighting portion of the kit and the additional LEDs accounted for approximately 51% of the energy savings for each household. These estimates of energy savings include the ISRs presented in Table 5-5 above.

Table 5-6. Engineering Analysis Gross Impact Results

Measure		May 2016–April 2017			
		Energy Savings (kWh)	Summer Peak Demand (kW)	Winter Peak Demand (kW)	Percent of Total kWh Savings
Energy Efficiency Kit	LEDs (2 9W bulbs)	55.4	0.0044	0.0038	19%
	Low-Flow Shower Head (1)	52.9	0.0018	0.0036	19%
	Bathroom faucet aerator (1)	6.6	0.0006	0.0011	2%
	Kitchen faucet aerator (1)	39.8	0.0017	0.0035	14%
	Outlet Seals (package of 6)	4.3	0.0004	0.0018	2%
	Weather Stripping (per roll)	18.7	0.0086	0.0042	7%
Total Kit Only		**177.8**	**0.0174**	**0.0180**	**62%**
Additional LEDs (average of 3.4 bulbs)		107.8	0.0085	0.0075	38%
Total Per-Home Estimate		**285.6**	**0.0259**	**0.0255**	**100%**

Using the estimated savings from Table 5-6, we can calculate an overall kW per kWh savings ratio from the engineering analysis. Table 5-7 displays two different ratios: one for the kit only and one for the kit plus additional LEDs.

Table 5-7. Engineering Demand-to-Energy Ratios

	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)
Kit only	177.8	0.017	0.018	0.0000978	0.0001014
Kit + additional LEDs	285.6	0.026	0.025	0.0000905	0.0000892

5.2.3 Comparison between Billing Analysis and Engineering Results

We estimated that the program realized per-participant energy savings of 1,059 kWh during the evaluation period. Savings from our engineering analysis (286 kWh per participant) are smaller in comparison to the billing analysis results. Differences in the estimated savings from these analyses are expected due to differences in methodology and the fact that the engineering analysis addresses only a subset of program savings (i.e., the Energy Efficiency Starter Kit and the additional LEDs that can be included). In contrast, the billing analysis provides a comprehensive estimate of program impacts. In addition to the components addressed by the engineering analysis, the billing analysis includes reduced energy consumption associated with improvements made due to assessment recommendations and behavioral changes. In addition, the billing analysis captures other unobserved factors that might have resulted in additional energy savings among participants.

6. Net-to-Gross Analysis

6.1 Methodology

Our participant survey included a NTG module to determine both program and measure-level NTGRs. 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 tracked savings that are attributable to the program. For this evaluation, the NTGR consists of FR and participant SO components.

6.1.1 Free-Ridership

Free-riders are program participants who would have paid for an assessment or installed energy efficiency products on their own, without the program. FR scores represent the percentage of savings that would have been achieved in the absence of the program. We categorized participants who reported that they would not have installed a measure without the program as 0% free-riders and participants who would have installed the measure without the program as 100% free-riders. Partial scores were assigned to customers who had plans to install the measure, but the program had at least some influence over that decision, particularly in terms of timing (i.e., the program accelerated the installation) or quantity (i.e., the program led to the installation of additional measures). We asked questions for each program measure, to enable us to develop measure-level FR estimates. The survey questions measured the following areas of program influence:

- **Influence on installation**: We asked participants about the likelihood that they would have purchased and installed each kit measure if they had not received it with the assessment.
- **Influence on timing**: We asked participants when they would have installed the measure on their own, whether that would have been around the same time, within six months, within a year, or longer.
- **Influence on quantity**: We asked participants whether they would have purchased the same quantity, more, or fewer on their own.

As part of the FR survey module, we included follow-up questions to check participant responses for consistency. We checked survey data for item non-response, and calculated the FR rate per the algorithms presented in Appendix C of the accompanying appendices.

6.1.2 Spillover

SO represents energy savings from additional actions (expressed as a percentage of total program savings) that were the result of program participation, but that did not receive program financial support. While SO can result from a variety of measures, it is not possible to ask about all possible SO measures on a survey due to the need to limit its length. Thus, Opinion Dynamics chose to focus on actions that participants would reasonably take following their program participation and would do so without additional program support.

The participant survey included a series of questions to assess overall SO among program participants. To qualify for program-induced SO, we asked two main questions:

- Did the participant make any additional improvements (or change his or her behavior) to reduce household energy consumption since participation in the program for which he or she received no rebate or incentive?

- *If the respondent indicates making additional improvements (or changing behaviors):* How would the participant rate (on a scale from 0 to 10, with 0 indicating no influence and 10 indicating complete influence) how much influence the experience with the program had on the decision to make these improvements?

We asked participants to rate the degree to which the program influenced their action and to provide a rationale for their rating. We attributed SO for all respondents who gave a program influence score of 7 or higher. These respondents were asked a series of follow-up questions to assess the efficiency of measures.

To estimate the SO rate, we estimated savings for each SO measure using engineering algorithms and assumptions. We determined the program-level SO rate by dividing the sum of measure-level SO savings by the evaluated gross savings achieved by the sample of participants who received SO questions (Equation 6-1).

Equation 6-1. Spillover Rate

$$\boldsymbol{Spillover\ Rate = \frac{Spillover\ Savings}{Evaluated\ Gross\ Savings\ in\ the\ Respondent\ Sample}}$$

6.1.3 Net-to-Gross Ratios

To calculate measure-level NTGRs, we combined the FR and SO rates using Equation 6-2:

Equation 6-2. Net-to-Gross Ratio

$$\boldsymbol{NTGR_{measure} = 1 - FR_{measure} + SO_{program}}$$

6.2 Net-to-Gross Results

This section presents our estimates of FR and participant SO, and the resulting NTGRs. Both FR and SO components of the NTGR were derived from self-reported information from telephone interviews with program participants. The final NTGR is the percentage of gross program savings that can be attributed to the program.

Table 6-1 shows FR estimates at the measure level and the SO estimate at the program level. Appendix A of this report contains the participant survey instrument, which includes the questions used in our algorithms. Appendix C provides an overview of the FR algorithm. We estimate program FR to equal 27.4% and program SO to equal 8.3%. The resulting NTGR for the REA program for the evaluation period is 80.9%. When applied to engineering gross estimates, the estimated SO rate of 8.3% represents an average of about 24 kWh per household.

Table 6-1. Measure-Level NTGRs

Component	FR	SO	NTGR
Energy Efficiency Kit*	27.4%	8.3%	80.9%
LEDs**	52.4%		55.8%
Low-flow shower head	18.2%		90.1%
Faucet aerators***	11.9%		96.4%
Outlet seals	16.8%		91.5%
Weather stripping	20.5%		87.8%

*FR for the Energy Efficiency Kit is the weighted average of the measure-level FR values.
**FR for LEDs applies to LEDs in the kit as well as additional ones supplied.
***FR questions for faucet aerators did not differentiate between kitchen and bathroom aerators.

6.2.1 Measure-Level Free-Ridership

Based on responses to FR questions in our participant survey, which focused on each measure from the Energy Efficiency Starter Kit, FR scores were calculated for customers who installed the measure. Table 6-2 shows the FR estimate for each measure as well as the relative precision, which was calculated around 1 - FR.

Table 6-2. Net-to-Gross Results and Relative Precision

	LEDs	Faucet Aerators	Low-Flow Shower Head	Outlet Seals	Weather Stripping
Sample size (n=)	103	124	131	93	79
FR estimate	52.4%	11.9%	18.2%	16.8%	20.5%
1 - FR	47.6%	88.1%	81.8%	83.2%	79.5%
Relative precision around 1 – FR (at 90% confidence)	10.6%	4.2%	5.0%	5.6%	6.5%

6.2.2 Spillover Savings

From our participant survey, we collected information on participants who were influenced by the program and installed additional energy-savings measures in their homes and for which they received no incentive or rebate. In all, 41 unique participants qualified for SO out of the survey sample of 150. More detail on measures that contributed to participant SO savings is shown in Table 6-3. We estimated a SO rate of 8.3% by taking the total measure-level SO estimates from survey respondents in Table 6-3 (i.e., 3,537 kWh) and dividing it by the total engineering savings from survey respondents (42,840 kWh).[5]

Table 6-3. Engineering Spillover Summary

Measure Type	Quantity of Measure Type	Total Energy Savings (kWh)	Total Coincident Demand Savings (kW)	Source of Savings
LEDs	80	2,556	0.376	Duke REA Kit deemed savings value
Clothes Washer	3	274	0.035	Il TRM V6.0
Clothes Dryer	2	185	0.025	Il TRM V6.0
Dishwasher	2	154	0.054	In TRM V2.2
Faucet Aerators	2	139	0.021	Duke REA Kit deemed savings value
Refrigerator	2	100	0.015	Il TRM V6.0
Hot Water Pipe Wrap	1	82	0.009	Il TRM V6.0
Attic Insulation	3,749	30	0.027	Il TRM V6.0
Wall insulation	400	15	0.013	Il TRM V6.0
Total	**4,241**	**3,537**	**0.576**	

[5] Total engineering savings of participants is calculated by multiplying the average engineering savings per home (i.e., 285.6 kWh) by the total number of survey respondents (i.e., 150). Note that numbers are rounded.

6.2.3 SB 310 Claimable Savings and DS More Inputs

In the state of Ohio, electric distribution utilities (EDUs), including DEO, are required to achieve a cumulative annual energy savings of more than 22% by 2027 per Ohio Senate Bill (SB) 310. SB 310 also introduced new mechanisms that adjust how EDUs may estimate their energy savings achieved through demand side management programs. Specifically, SB 310 requires the Ohio Public Utilities Commission (PUCO) to permit EDUs to account for energy-efficiency savings estimated on an "as-found" or a deemed basis. That is, an EDU may claim savings based on the baseline operating conditions found at the location where the energy-efficiency measure was installed, or the EDU may claim a deemed savings estimate.

To support compliance with SB 310, Table 6-4 below compares net deemed (ex ante) and net ex post per household and program-level energy and demand savings and presents the savings claimable under SB 310 (final column). In 2017, Duke Energy developed revised deemed values that it could claim under SB310 for the energy efficiency kit and additional LEDs that households could receive in addition to those provided in the kit. Duke Energy provided these revised values to the Evaluation Team for analysis of SB 310 impacts.

Per SB 310, DEO will claim 1,059 kWh of energy savings and 0.1130 kW and 0.1095 kW of peak summer and winter demand savings, respectively, per household for the 2016-2017 program years. These values are the higher of the Duke Energy provided deemed values and the impact evaluation-based ex post savings values.

Table 6-4. Savings Claimable under Senate Bill 310 (SB 310)

Energy and Demand Savings	Net Deemed (Planning) Savings	Net Ex Post Savings	Claimable Savings under SB 310
Energy Savings			
Total Per-Household Savings (kWh)	890.1	1,058.5	1,058.5
Additional LEDs (kWh) (average of 3.4 bulbs per household)	*96.1*	*59.7*	*96.1*
Energy Efficiency Kit, excluding Additional Bulbs (kWh)	*794.0*	*998.9*	*962.4*
Total Program Savings (MWh)	**2,004.5**	**2,383.7**	**2,383.7**
Summer Coincident Demand Savings			
Total Per-Household Savings (kW)	0.1095	0.0958	0.0958
Additional LEDs (kW) (average of 3.4 bulbs per household)	*0.0094*	*0.0047*	*0.0094*
Energy Efficiency Kit, excluding Additional Bulbs (kW)	*0.1001*	*0.0912*	*0.0865*
Total Program Savings (kW)	**246.5**	**215.8**	**215.8**
Winter Coincident Demand Savings			
Total Per-Household Savings (kW)	0.1130	0.0945	0.0945
Additional LEDs (kW) (average of 3.4 bulbs per household)	*0.0177*	*0.0041*	*0.0177*
Energy Efficiency Kit, excluding Additional Bulbs (kW)	*0.0953*	*0.0903*	*0.0768*
Total Program Savings (kW)	**254.5**	**212.7**	**212.7**

*Total Program Savings = total number of households (2,252) * total per-household savings.

The evaluation team also developed gross and net energy and demand savings values to serve as inputs to the DS More tables used by Duke Energy for planning purposes (see Table 6-5). These inputs reflect the following:

- Duke Energy requires separate per-participant savings values for the energy efficiency kit and additional LED bulbs.
- For DEO, DS More planning values reflect savings claimable under SB 310, i.e., the higher of ex ante and ex post values.
- Since the kit savings were developed based on a billing analysis, which yielded a net estimate, the same savings estimate is used for both gross and net savings.

Table 6-5. Summary of Energy and Demand Savings for DS More Table

DS More Inputs	Energy Savings (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Gross savings per additional LED bulb*	50.65	0.0049	0.0093
Net savings per LED additional bulb**	28.27	0.0028	0.0052
Gross/Net kit savings per participant (excluding additional LEDs)***	962.4	0.0865	0.0768

*Gross ex ante planning values provided by Duke Energy.
**Calculated as gross savings * LED NTGR (55.8%)
***Savings for *Energy Efficiency Kit, excluding Additional Bulbs* from Table 6-4 above.

7. Process Evaluation

7.1 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:

- What are the most successful components of the program? What improvements can be made to the program's design and implementation?
- Are customers satisfied with the participation process and program measures?
- Do participants find the assessment recommendations useful and actionable?
- Are eligible customers channeled into other Duke Energy programs?
- What kind of behavioral changes do participants make following the assessment?

7.2 Methodology

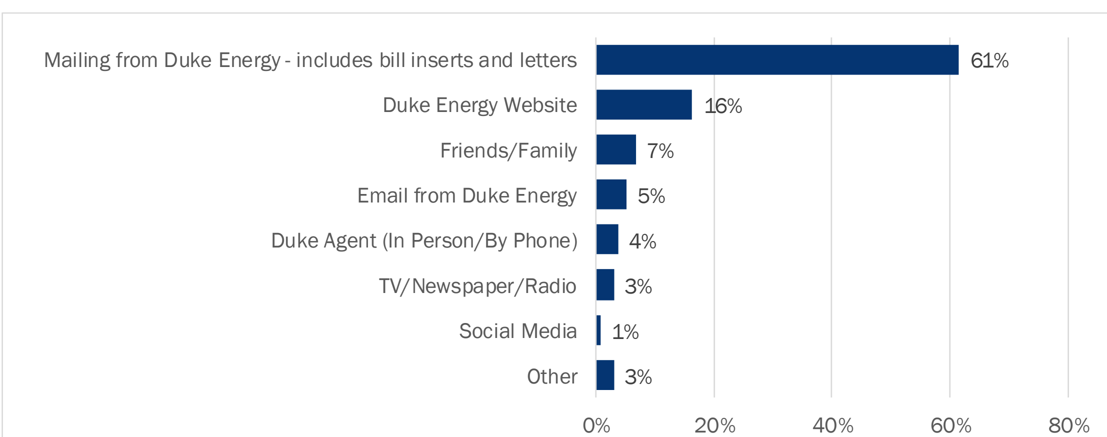
Our process evaluation relied primarily on our interview with program staff, our review of program materials and program-tracking data, and our analysis of the participant survey. The full survey document can be found in Appendix A of the accompanying appendices.

7.3 Key Findings

7.3.1 Marketing and Channeling

Duke Energy has relied heavily on a direct mail marketing strategy to generate interest in the REA program. As shown in Figure 7-1, the majority of respondents (61%) reported first hearing about the program via a direct mailing from Duke Energy (e.g., a bill insert or a letter). Given the length of time between the customer learning about the program and taking the survey, we do not distinguish between the types of mailed items. Customers may simply remember receiving "something" in the mail.

Figure 7-1. Sources of Program Awareness



REA auditors are instructed to inform program participants about other suitable Duke Energy programs for which they might be eligible. However, only about a quarter of REA participants (27%) recalled learning about other Duke Energy programs during their assessment. Of these participants, the largest share reported hearing about the residential Smart $aver program (30%), followed by the Power Manager program (28%). A third of the respondents who said that they recalled hearing about other programs could not recall the names of those programs (see Table 7-1).

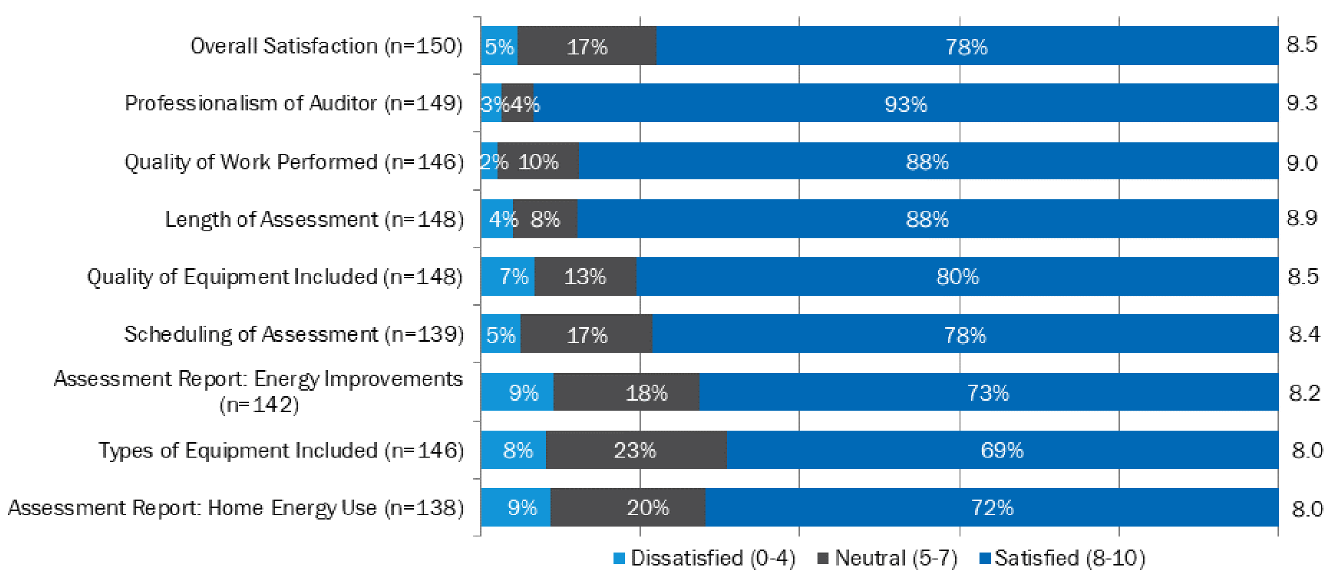
Table 7-1. Channeling to Other Duke Energy Programs

Which programs did you recall hearing about? (multiple responses accepted) (n=40)	
Smart $aver	30%
Power Manager	28%
Other	10%
Don't know	33%

7.3.2 Satisfaction

Overall, program satisfaction was high across various aspects of the program. Seventy-eight percent of customers said that they were "satisfied" with the program overall (see Figure 7-2). The areas of highest satisfaction relate to the professionalism of the auditor (9.3 out of 10) and to the quality and speed of the auditor's work (mean ratings of 9.0 and 8.9, out of 10, respectively). The ratings related to how the assessment report improved the participant's understanding of where energy improvements can be made in the home and of their home energy use, along with the types of equipment included in the kits, were the lowest rated components of the program. Overall, however, all program aspects had a mean satisfaction rating of 8 or above out of 10 and low levels of dissatisfaction (a rating of 4 or less). The mean satisfaction rating of the program overall was 8.5 out of 10.

Figure 7-2. Program Satisfaction



Equal proportions of participants have noticed savings on their Duke Energy bill (38%) as have *not* noticed savings on their Duke Energy bill since participating in the program (also 38%), while the remaining participants were not sure (24%). Participants who reported noticing bill savings or said that they were not sure about bill savings had higher satisfaction ratings for the program overall compared to those who reported not noticing savings (with mean scores of 9.2 and 8.9 vs. 7.7 out of 10, respectively). It is possible that the satisfaction with the program is related to whether participants noticed bill savings.

7.3.3 Program Value

Understanding customers' motivations for participating can help in developing effective program marketing strategies. Opinion Dynamics asked participants for their reason(s) for participating in the program (Table 7-2). A majority (51%) mentioned saving money on energy bills as a reason for their participation; reducing energy consumption was also cited frequently (33% of participants). Only a small share of participants (9%) cited "it was free" as a reason for participation.

Table 7-2. Reasons for Participating

Why did you choose to participate? (n=150) (multiple responses accepted)	
Save money on energy/electric/gas bill	51%
Reduce energy consumption	33%
It was free	9%
Make your home more comfortable	8%
Learn more about home energy use and the program	7%
New house or selling current house	5%
Other	6%
Don't know	4%

Note: Because multiple responses are accepted, total will not sum to 100%.

To assess participants' perception of the value of the REA offerings, the survey asked how much money they would be willing to pay for the energy assessment and for the kit. Participants reported valuing the assessment lower than its stated value. Customers who would be willing to pay for the assessment (39% of respondents) valued it at an average of $48.67, which is less than a third of the stated value ($180) on Duke Energy's website. Customers who would be willing to pay for the kit (44% of respondents) valued it at an average of $28.74, which approximates the stated value of $30.00 on the website.[6] The average willingness-to-pay for both is $77.41. The majority of participants found the LEDs most valuable among the kit items (74%); fewer participants found shower heads (17%) and faucet aerators (16%) to be the most valuable measures.

7.3.4 Experience with Measures and Program Improvement Suggestions

Respondents who installed some or all of the measures in the energy efficiency kit were asked whether they, the auditor, or both installed each measure (i.e., for those measures where more than one unit was provided). LEDs were installed equally by auditors and customers. The majority of the installations of water measures were performed by the auditor, whereas the outlet seals and weather stripping were predominately installed by the customers. In subsequent conversations with Duke Energy staff, the evaluation team learned about

[6] Note that these averages were calculated separately, excluding respondents who valued the item at $0 (22%) or who did not know (25%).

additional implementation staff training on measure installation, occurring after the evaluation period, to address this issue. Table 7-3 shows full details of measure installations.

Table 7-3. Measure Installations

Measure	IRs	Auditor Installed	Customer Installed	Both Installed
LEDs (n=127)	88%	46%	46%	8%
Faucet aerators (n=82)	42%	62%	32%	4%
Shower head (n=59)	40%	58%	42%	N/A
Outlet seals (n=47)	45%	15%	83%	<1%
Weather stripping (n=30)	30%	20%	77%	3%

Additionally, respondents whose energy efficiency kit measures were not still installed were asked to provide reasons for not installing them. Common reasons varied across the measure types. For LEDs, the majority reported that they were waiting for their current bulbs to burn out to install their new ones (67%), suggesting that they may benefit from additional education about the energy savings benefits of replacing existing bulbs with LEDs. For faucet aerators, the most common response was the measure not fitting (26%) while for shower heads, the customers did not like the measure (33%) or already had an efficient shower head (24%). Most respondents who had not installed all of their weather stripping reported not seeing a need (43%), whereas for outlet seals respondents had not had the time to install them yet (30%). Table 7-4 shows full details of the responses by measure.

Table 7-4. Common Reasons for Not Installing Measures

Common reasons for not installing	LEDs (n=24)	Faucet Aerators (n=105)	Shower Head (n=87)	Outlet Seals (n=57)	Weather Stripping (n=67)
Haven't needed the equipment yet	67%	19%	0%	0%	0%
Did not see a need	4%	8%	2%	16%	43%
Did not like the measure	13%	5%	33%	0%	0%
Haven't had time	8%	5%	10%	30%	16%
Did not fit	4%	26%	13%	5%	0%
Already have the measure	4%	14%	24%	9%	6%
Unable to install/needed assistance	0%	1%	0%	9%	12%
Did not receive enough/only received one*	0%	4%	0%	0%	1%
Not enough water pressure	N/A	0%	5%	N/A	N/A
Don't know	0%	7%	2%	25%	18%

Note: The n values represent the number of respondents who said that they had installed only some or none of the measure.
*This response was given by participants who, for example, had more showers, outlet seals, and faucet aerators than could be accommodated by the measures in the kit. In the case of weather stripping, there was not enough to weather strip around all windows and doors in the home.

The evaluation team also inquired about what additional measures participants would have liked to receive. The majority of participants reported that the kit equipment was sufficient (67%) or that they did not know what other equipment they would have liked in the kit (7%). Another 14% reported that they would have liked to receive more of the measures currently offered in the kit. The list of additional measures that participants reported that they would have liked to receive in addition to those in the kit are listed in Table 7-5. The top suggestions were to offer different types of LEDs and to offer insulation, while some of the "other" responses included premium testing (e.g., thermal readings and draft checks).

Table 7-5. Additional Measures

What equipment would you have liked to receive? (n=21)	
Other types of LEDs	29%
Insulation	19%
Smart thermostats/smart plugs	14%
Variety of outlet seals	14%
Hot water measures	10%
Other	19%

Participants were also asked to rate their interest in receiving a "Home Energy Score," which uses a 1–10 scale to rate the efficiency of the home's energy usage; 78% said that they were at least somewhat interested in receiving their score.

Consistent with the high satisfaction levels, the majority of respondents (55%) did not have any recommendations to improve the program, while others did not know what could be done to improve it (9%). Of the 37% who did provide suggestions for improvement, the most common were to include additional measures in the energy efficiency kit, to increase communication and follow-up regarding their assessment, and to increase the quantity of the current measures—all mentioned by fewer than 10% of respondents (see Table 7-6).

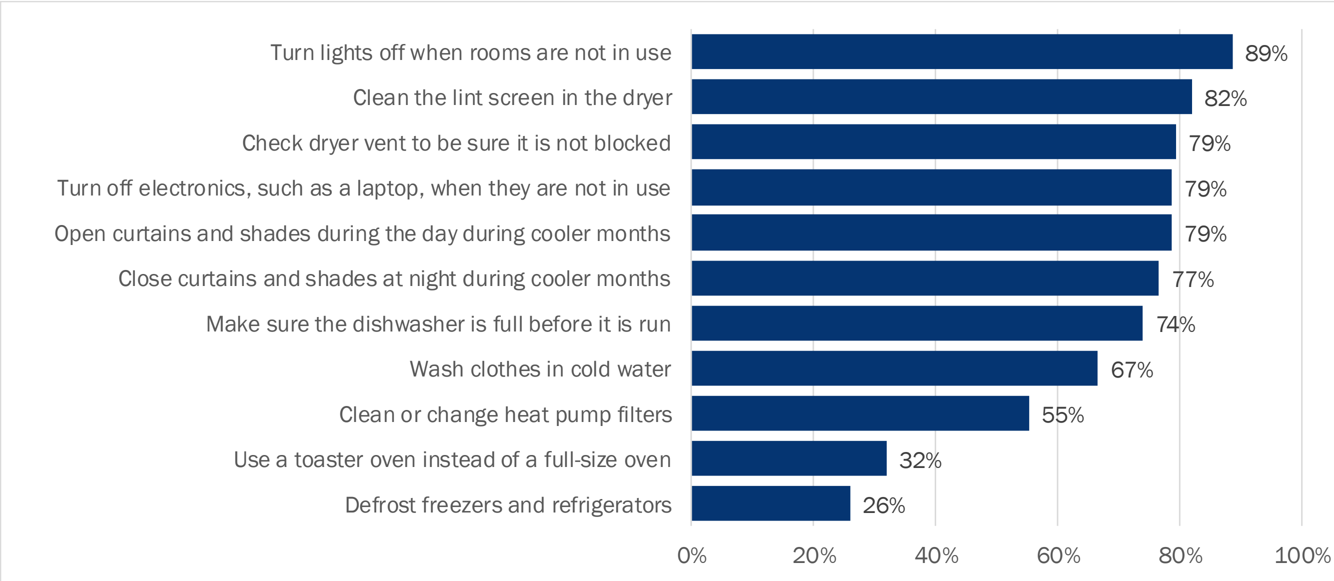
Table 7-6. Suggested Program Improvements

What, if anything, could be done to improve the program? (n=150)	
Nothing	55%
Expand the kit to include more measures	9%
Improve measure quality/increase amount of measures in kits	6%
Have auditor do a more thorough assessment/install all the measures	5%
Increase follow-up and communication before/after assessment	3%
Improve clarity of the report	3%
Offer advanced home assessment features (e.g., thermal imaging, draft checks)	3%
Provide a list of qualified contractors	2%
Increase allowance for additional bulbs	1%
Other	3%
Don't know	9%

7.3.5 Education

As part of the Energy Efficiency Starter Kit, customers received a "Department of Energy, Energy Savers Booklet." This educational material outlines how energy is used, and wasted, in the home. The booklet provides insights about the effects that insulation, lighting, appliances, and other items can have on energy use in the home. Included in the booklet is a list of energy-saving tips. Most respondents remember receiving the booklet (81%), and 76% of those participants reported taking the time to read it. All participants were asked about any behavioral changes that they have made since participating and, overall, these measures have had high uptake (see Figure 7-3). The only exceptions are two recommendations related to kitchen appliances.

Figure 7-3. Behavioral Changes



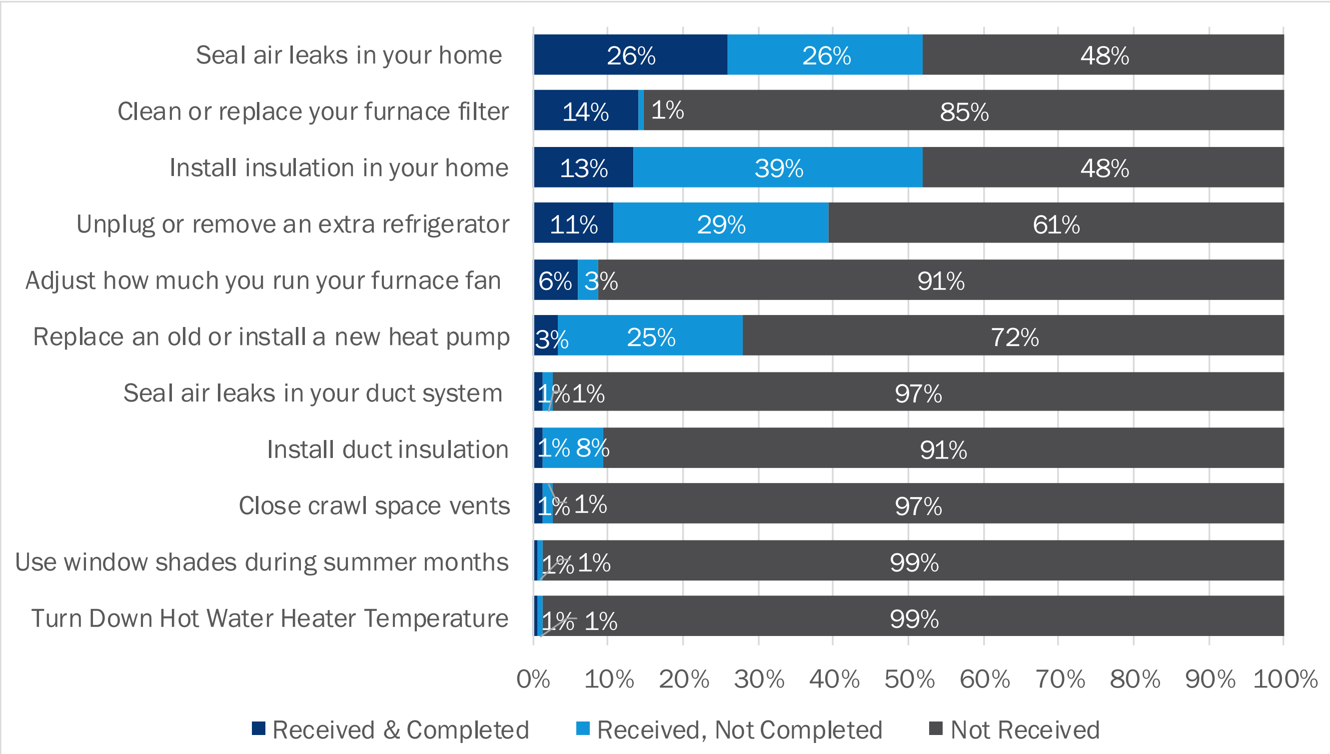
7.3.6 Assessment Recommendations

The program-tracking data includes information about specific recommendations on energy efficiency actions provided to DEO REA program participants during the assessment. The telephone survey then asked participants to confirm that they had received the tracked recommendations, which ones they had completed, and whether they planned to implement any of those recommendations not yet completed. Note that to reduced survey response burden similar recommendations were grouped into categories for the survey. For example, “seal leaky fireplace”, “seal leaky windows”, and “seal leaky doors” were all grouped into the category “seal air leaks” in the survey instrument.

The proportion of participants who received and acted on the given recommendations is shown by the dark blue bars in Figure 7-4. The lighter blue bars represent recommendations that were received but not carried out by participants. The grey bars show recommendations not received. Figure 7-4 shows that several of the recommendations were given to participants less than 20% of the time (as shown by the sum of the percentages of the dark blue and lighter blue bars), with the exceptions being sealing air leaks, installing insulation, unplugging or removing an additional refrigerator, and replace old heat pump. It is not clear why auditors did not provide recommendations more often, such as those related to cleaning or replacing furnace filters, sealing home ducts, installing duct insulation, closing crawl space vents, and turning down the water heater temperature, though one possible explanation is that they did not think that they were applicable.

According to Duke Energy, the program implementer has since received additional training to ensure that all appropriate audit recommendations are provided. In addition, the program refreshed its audit reports in March 2017 to make sure to cover applicable audit recommendations. Among respondents who had not completed one or more of their received recommendations, the majority said that they were currently planning to complete some or all of the remaining recommendations (46%), while the rest either had no plans to complete them (43%) or said that they did not know (11%).

Figure 7-4. Received and Completed Recommendations



8. Conclusions and Recommendations

Below we present the key findings from our evaluation, and, where applicable, accompanying recommendations.

Finding: Overall, Opinion Dynamics found that the DEO REA program performed well. Participants were highly satisfied with the program, and net savings were in line with results from most prior evaluations. We found that most participants first heard about the program through Duke Energy mailings, which is consistent with Duke's marketing efforts.

Finding: Like the REA program that operates in other Duke Energy jurisdictions, not all measures from the Energy Efficiency Starter Kit were installed by auditors. Almost half of the kit measures were not installed by the auditor during the home assessment (weighted average of 52% were installed). However, measures that save more energy, such as LEDs, faucet aerators, and low-flow shower heads, were installed more frequently than outlet seals and weather stripping. Of the 70% who did not have their faucet aerators installed, one-quarter said it was because they did not fit and of the 16% of customers who did not have their free LEDs installed, about two-thirds said they were waiting for their old bulbs to burn out first.

> **Recommendation: Auditors should install all measures in distributed energy efficiency kits. If unable to install all measures, auditors should track the barriers that prevent them from doing so.** If the program could improve measure installation, it is likely that measure ISRs and program savings would improve, particularly because we found high PRs for all measures. We understand that there may be safety concerns related to the installation of outlet seals, which may lead auditors to leave these measures uninstalled, but our understanding is that Duke Energy has an expectation that all measures will be installed during home assessments. It should be noted that in subsequent conversations, the evaluation team learned from Duke Energy that in the spring of 2017, after the close of this evaluation period, additional training of implementation staff occurred to address this issue and to instruct installers to document why measures were not installed.
>
> Specifically, to address faucet aerators that do not fit, we recommend providing adaptors to participants to increase the installation rate of this measure.
>
> **Recommendation: Provide education on the benefits of early light bulb replacement.** Participants report "not needing them" as the most common reason for not installing the LEDs provided in the kit, suggesting that participants are waiting for their current bulbs to burn out. While more emphasis on installing all measures during the audit (see recommendation above) will help with ISRs, providing additional education on the savings potential of LEDs might lead to additional spillover savings by encouraging participants to more quickly replace inefficient bulbs in the future as well.

Finding: While our data preparation for the billing analysis showed that a majority of REA participants have participated in other Duke Energy programs, our survey findings show that only a small portion of customers recalled hearing about other Duke Energy programs through the REA program.

> **Recommendation: Channeling efforts by auditors that direct participants of the REA program to other Duke Energy programs could be improved.** While our data preparation for the billing analysis showed that a majority of REA participants have participated in other Duke Energy programs prior to participation, our survey findings show showed that only a small portion of customers recalled hearing about other Duke Energy programs through the REA program. If Duke Energy is interested in using the REA program to channel customers to their other offerings, program staff may want to direct auditors to leave behind applicable materials to market its other programs. Additionally, we recommend that

auditors familiarize themselves with Duke Energy's other programs and make recommendations to program participants based on the programs that are most suitable.

According to Duke Energy, the program refreshed the technology and audit report in March 2017 to provide a more user-friendly report to the customer, outlining audit recommendations as well as cross-program recommendations. Additionally, the implementer now has the ability to report back to Duke Energy all recommendations, including cross-promotional referrals. Finally, in addition to including FindItDuke referrals in the audit report, advisors can now generate (where relevant) and email referrals to the customer during the assessment.

Finding: Based on a review of the program-tracking data, some energy saving recommendations were provided less than 20% of the time to customers. During assessment visits, auditors are expected to provide participants with all applicable recommendations to improve energy efficiency in their homes. It is unclear if recommendations were not provided because they were not applicable or for some other reason. According to Duke Energy, the program implementer has since received additional training to ensure that all appropriate audit recommendations are provided. In addition, the program refreshed its audit reports in March 2017 to make sure to cover applicable audit recommendations.

Recommendation: The energy savings from the program could be improved if auditors provided customers with more recommendations on which they could act. They may not be knowledgeable about the amount of energy that they could save by making changes, such as replacing furnace filters and adjusting thermostat settings. As noted above, Duke Energy has provided additional training to implementation staff to address providing recommendations to program participants that can help them save energy in their homes.

9. DSMore Inputs

For planning purposes, Duke Energy requires separate per-participant savings values for the energy efficiency kit and the additional bulbs distributed to participants. To provide these estimates, the evaluation team took the following steps:

1. We estimated **net savings per additional LED** by multiplying gross savings per additional LED by the LED NTG ratio of 55.8 %.
2. We estimated **net savings of the kit exclusive of additional LEDs** by subtracting net savings for the average number of additional LEDs (3.4 bulbs) from per household savings based on the billing analysis.

Developing these separate inputs ensures that savings from the additional bulbs are not double-counted for planning purposes, as their savings are already included in the billing analysis estimate.

Table 9-1presents the development of the DSMore inputs.

Table 9-1. Development of DSMore Inputs

Data for Development of DSMore Inputs	Energy Savings (kWh)	Summer Coincident Demand (kW)	Winter Coincident Demand (kW)
Gross savings per additional LED bulb: Engineering analysis	50.65	0.0049	0.0093
LED NTG ratio = 55.8%			
Net savings per LED additional bulb: Engineering analysis	28.27	0.0028	0.0052
Program savings per participant: Billing analysis	1058.50	0.0958	0.0945
Net Savings for additional LED Bulbs	96.10	0.0094	0.0177
Net kit savings per participant (excluding additional LEDs)	962.40	0.0865	0.0768

The DSMore Inputs are included in the embedded Microsoft Excel file.

DEO Residential
Assessments_DSMor

10. Summary Form

Residential Energy Assessments

Completed EM&V Fact Sheet

The REA program provides, free of cost, a home energy assessment, which includes a kit of low-cost energy efficiency measures. A report of recommended upgrades and behavioral changes is given to the customer at the end of the assessment.

Residential customers in DEO service territory who have owned their single-family home for at least four months are eligible for the program. Homes must have an electric water heater, electric heat, or central air conditioning.

Date	October 16, 2018
Region(s)	Duke Energy Ohio
Evaluation Period	May 2016–April 2017
Claimed Savings Per SB 310	
Annual kWh Savings	2,383,742 kWh
Annual kWh Savings (per participant)	1,059 kWh
Coincident kW Impact	254.5 kW (Summer) 246.5 kW (Winter)
Ex Post Savings	
Annual kWh	2,383,742 kWh
Per Participant Net kWh	1,059 kWh
Per Participant Coincident Net kW	215.8 kW (Summer) 212.7 kW (Winter)
Measure Life	Not Evaluated
Net-to-Gross Ratio	81%
Process Evaluation	Yes
Previous Evaluation(s)	Yes, 2014 evaluation

Evaluation Methodology

The evaluation team verified measure-level deemed savings estimates using an engineering analysis of savings assumptions and calculations. The evaluation team also leveraged a participant survey to verify IRs and ISRs for each measure and to estimate measure- and program-level NTGRs. The evaluation team conducted a billing analysis to estimate energy savings and used a combination of billing analysis and engineering analysis results to estimate coincident demand savings.

Impact Evaluation Details

- The evaluation team based assumptions and inputs, for deemed savings and gross impacts on the OH TRM as well as other relevant TRMs (e.g., the IN TRM V2.2). The engineering analysis applied deemed savings values to measures distributed and in service (e.g., via an Energy Efficiency Starter Kit and additional LEDs).
- To comply with SB 310, claimed net savings are based on the larger of the ex ante and ex post savings.
- Results from the billing analysis reflect savings associated with measures installed, assessment recommendations, SO, and potential behavioral changes from energy efficiency knowledge gained through participation in the REA program.

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APPENDIX K - FREE LED & ONLINE SAVINGS STORE EVALUATION

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Duke Energy Ohio

Free LED & Online Savings Store Program
Final Evaluation Report

September 11, 2018

Opinion Dynamics

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