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Duke Energy Carolinas and Progress

EnergyWise Business
Evaluation Report – Final

November 9, 2018

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1. Evaluation Summary

1.1 Program Summary

The Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) EnergyWise Business (EWB) program is an integrated demand response (DR) and energy efficiency (EE) program that provides small businesses with the opportunity to participate in DR Conservation Period events, earn bill credits, and realize additional energy savings benefits. The program was introduced in 2016 and offers participants either a free programmable, two-way Wi-Fi Thermostat or a Load Control Switch if participants agree to participate in summer Conservation Period events. Participants can select one of three levels of demand response participation—30% cycling, 50% cycling, and 75% cycling—with varying levels of earned bill credits based on the selected cycling strategy. Thermostat participants who have a heat pump with electric resistance heat strips are also offered the option of participating in winter Conservation Period events and can earn additional bill credits per season. Alongside the hardware, participants who install a thermostat also have access to a web-based customer portal via their personal computer, tablet, or mobile phone that allows customers to manage their thermostats remotely, including presets, and advanced control and scheduling options. Duke Energy contracted with Itron (formerly Comverge)[1] to implement this program.

The program targets small businesses with a qualifying central air conditioning system and an average minimum usage of 1,000 kWh per month during the billing months of May through September. By the end of 2017, the program had enrolled a total of 4,561 customers and 8,511 devices. The program called five summer Conservation Period demand response events in 2017 and did not call any winter Conservation Period demand response events.

1.2 Evaluation Objectives

This evaluation of the EWB program includes process and impact assessments and addresses several major research objectives:

- Determine the estimated gross demand response impacts from the program;
- Determine the estimated net energy efficiency impacts from the program;
- Explore how participating customers are interacting with the program, and how satisfied they are; and
- Determine whether any modifications or improvements can be made to program design, program operations, or program equipment/software to reduce customer barriers to enrollment and support increasing enrollment and event participation.

[1] The company Itron acquired Comverge in June 2017. For consistency, this evaluation refers to the implementer as Itron.

1.3 High-Level Findings

Our impact evaluation assessed program performance in terms of program enrollment and participation, as well as summer Conservation Period demand response impacts and energy efficiency savings. The program overachieved device and thermostat installation goals, but did not meet its per device energy or demand impact goals. Overall, the energy efficiency savings impact analysis found realization rates of 204% for DEC and 5% for DEP; the demand response event analysis found realization rates of 72% for DEC and 70% for DEP.

In 2017, EWB program staff, working in coordination with Itron, enrolled a total of 6,793 devices. The majority of these devices were enrolled in the DEC territory (72% of devices). In terms of devices, the majority of new enrollees selected thermostats (91%), and the majority enrolled in the 30% cycling strategy (84% for DEC and 53% for DEP). Notably, the average size of HVAC units controlled by devices installed in 2017 remained relatively unchanged from 2016, at 4.2 tons,[2] but the DEC program saw enrollment shift towards lower cycling strategies in 2017 compared to 2016.

In terms of gross demand response impacts, the EWB program achieved an average of 2,582 kW per event in DEC and an average of 1,421 kW per event in DEP. Opinion Dynamics conducted a gross demand response analysis to estimate event-specific hourly load impacts for installed devices, by jurisdiction, device type, and cycling strategy. We conducted this analysis using device log data supplied by Itron (which provides device run-time data) in combination with program-tracking data, event data, and weather data. Notably, because the data is at the device level and not the facility level, this analysis produces gross impacts. These gross impacts are not adjusted for participant takeback actions caused by increased temperatures due to central air conditioning (CAC) cycling, such as running fans or increased run-time for refrigeration and/or process cooling equipment.[3]

Despite exceeding enrollment goals, per device demand response load impacts were lower than anticipated across jurisdictions (realization rates of 56% for DEC and 55% for DEP) and cycling strategies. As noted above, device enrollment was heavily distributed towards lower cycling strategies. Device operational rates and opt-out rates were consistent with Itron's expectations for program events (91% of eligible units cycled during an event, and 4% to 7% of devices opt-outed on average per event). Table 1-1 provides average per-unit gross demand response load impacts across all cycling strategies by device type and jurisdiction for all operational devices installed before the end of the 2017 cooling season.

[2] In 2016, the evaluation team found that the tonnage values tracked in the program participation database suggested that Duke Energy's planning values were too high. Duke Energy subsequently lowered their tonnage planning value as a result of the evaluation.

[3] Participant spillover will occur due to takeback actions (see above), likely increasing energy consumption before, during or after an event. Notably, because the data used to conduct this analysis is at the device level (thermostat or switch), this analysis produces gross impacts (e.g., not corrected for participant spillover).

Table 1-1. Summary of 2017 EWB *Ex Post* Gross Per-Device and Program Demand Response Impacts

DR Load Impact Estimates	Average Reference Load (kW)	Average Load Impact (kW)	Average % of Load
DEC Device Level			
Thermostat	3.28	0.88	27%
Switch	3.07	0.74	24%
Weighted Average	3.27	0.87	27%
DEP Device Level			
Thermostat	2.76	0.80	29%
Switch	2.77	0.65	24%
Weighted Average	2.76	0.79	29%
Program Level[A]			
DEC	9,724	2,582	27%
DEP	4,973	1,421	29%

[A] Reflects per-device load impact multiplied by the average number of devices eligible to participate on an event day and which were cycled (e.g., participated or opted-out) in an event.

For energy efficiency savings, we conducted a consumption analysis using monthly billing data to develop an average energy savings estimate for thermostats enrolled in 2017. The results of this analysis reflect net savings from participation in the EWB program plus any effect of participation in other Duke Energy programs.[4] To estimate net energy savings, we adjusted the billing analysis results using a cross-participation analysis. The purpose of the cross-participation analysis is to determine energy efficiency savings realized by EWB participants as a result of their participation in other Duke Energy non-residential programs. To do so, we identified measures installed through the Non-Residential Prescriptive and Small Business Energy Saver (SBES) Programs, and their savings, during the post-participation period. Once identified, we adjusted billing analysis results by the difference between cross-participation savings of EWB participants and cross-participation savings of the comparison group used in the consumption analysis.[5] This approach accounts for the fact that the consumption analysis already nets out equal cross-participation savings for the comparison group and participants.

Despite overachieving thermostat installation goals across both jurisdictions, per device energy savings realization rates were lower than goals for both jurisdictions. In addition, cross-participation adjustments substantially reduced the program's energy impacts. Table 1-2 provides a summary of the EWB ex post net energy savings in 2017.

[4] This analysis includes a comparison group in the model to adjust for operational changes that non-participating customers are making. Additional changes made by participating customers (within-participant spillover) are captured in the net savings.

[5] Cross-participation savings reflect pro-rated net ex post impacts based on the date of installation.

Table 1-2. Summary of 2017 EWB *Ex Post* Net Energy Efficiency Savings

Energy Savings Estimates	Unadjusted Energy Savings (kWh)	Cross Participation Adjustment (kWh)	Adjusted Energy Savings (kWh)
Device Level[A]			
DEC	1,060	-549	511
DEP	394	-376	18
Program Level			
DEC	4,759,461	-2,463,014	2,296,448
DEP	677,283	-645,546	31,737

[A] Device-level results reflect all devices enrolled from January 2017-December 2017, including devices that were deactivated.

We identified substantial variation in energy efficiency savings between DEC and DEP: Billing analysis results showed unadjusted energy savings for DEC participants more than 2.5 times those of DEP participants. While the cross-participation analysis found a smaller savings adjustment for DEP participants in absolute terms, it was much higher than for DEC participants as a percentage of unadjusted energy savings. The resulting adjusted energy savings are estimated to be 511 kWh per DEC participant and only 18 kWh per DEP participant.

The evaluation team conducted a series of checks to identify what may be driving lower energy savings in the DEP territory compared to the DEC territory. According to program staff, program design and implementation is relatively consistent across both territories, as are the type of facilities targeted and enrolled in the program. Our analysis found that DEP participants tend to have lower annual average baseline usage and summer average baseline usage than DEC participants, as well as slightly lower average tonnage in terms of the HVAC units being controlled. Other factors, such as customer behavior, e.g., engagement with their thermostat, may play a role. Survey results suggest that DEP customers may change their set points more frequently than DEC customers.

Table 1-3 provides a summary of participation, per-device impacts and total impacts for energy efficiency and demand response impacts.

Table 1-3. Summary of 2017 EWB *Ex Post* Energy Efficiency and Demand Impacts and Realization Rates

Metric	2017 Ex Ante		2017 Ex Post		Realization Rate	
	DEC	DEP	DEC	DEP	DEC	DEP
Demand Response Impacts						
Participation (devices)	2,310	1,414	2,978	1,800	129%	127%
Per Participant Weighted Average Summer Coincident Savings (kW)	1.56	1.44	0.87	0.79	56%	55%
Total Summer Coincident Demand Savings (kW)	3,605	2,035	2,582	1,421	72%	70%
Energy Efficiency Impacts						
Participation (thermostats)	1,755	1,076	4,490	1,719	256%	160%
Per Participant Average Annual kWh	641	562	511	18	80%	3%
Total Energy Savings (kWh)	1,124,522	605,111	2,296,448	31,737	204%	5%

Source: Ex Ante: Duke-provided goals; Ex Post: 2017 evaluation.

1.4 Evaluation Recommendations

Our recommendations focus on a core set of actionable efforts to increase program impacts while maintaining customer satisfaction, including those related to customer recruitment, education, and retention; program implementation enhancements; device functionality and operations optimization; and data tracking improvements. Notably, we understand that Duke Energy developed this program to provide small business customers an opportunity to participate in demand response, since these customers pay a surcharge but did not have an opportunity to participate in these programs. As a result, recommendations must be considered in light of enhancing program cost-effectiveness as well as equitably serving this historically underserved population.

Recommendation: Customer Recruitment, Education, and Retention

The EWB program staff and their implementation contractors far exceeded enrollment goals in 2017. In fact, recruiters were so successful that the program experienced a backlog in the second half of 2016 where recruited customers had to wait two to three months to have their thermostat or switch installed, instead of the target of four weeks. Building on this success, we recommend that Duke Energy focus on recruiting customers that evaluation results suggest are optimal from a demand response and energy savings impact perspective.

- **Optimize customer recruitment targeting.** Evaluation results from 2016 and 2017 both suggest that the program should seek to recruit customers with specific attributes, such as customers with larger HVAC units and higher monthly usage in summer months. In terms of event participation, several unenrolled participants mentioned that they felt their business segment was not appropriate for event participation. Specifically, unenrolled participants with gyms, massage parlors, and florists report that their business segment do not tolerate large temperature changes. Additionally, a review of event participation data suggests that restaurants tend to have higher opt-out rates than other business types. When examining unenrollment by NAICs code, restaurants are unenrolling at more than double the average rate. We recommend:
  - Continuing to target customers with larger HVAC units and higher average summer consumption.
  - Conducting in-depth upfront vetting customers within specific business types that are less able to accommodate changes in temperature in their facilities to reduce Conservation Period opt-outs, unenrollment, and potentially lower impacts.
- **Enhance customer education for Conservation Period participation.** Our process research found that better participant understanding of program elements is correlated with higher participant satisfaction. Participants report relatively low understanding of cycling levels, and only a quarter of participants could correctly recall their cycling level. In addition, participants who unenrolled from Conservation Periods were less familiar with program elements than on-going participants, which may have contributed to their unenrollment. To minimize participant unenrollment and opt-outs, and increase satisfaction, we recommend:
  - Ensuring canvassers and installers fully explain cycling levels and Conservation Periods, including strategies for minimizing impacts of the events. This could include additional training for canvassers and installers, as well as adjustments to canvassers incentives, as described further below.

- Developing additional leave-behind materials or welcome email blasts for newly-enrolled program participants. These materials should describe what a customer should expect during Conservation Periods. The materials may also provide suggestions for minimizing the impact of Conservation Periods such as pre-cooling facilities or reducing the use of heat-emitting technologies during Conservation Periods.

- **Encourage customer retention strategies.** The only drop-out prevention strategy noted by participants who unenrolled from the program was the loss of the Conservation Period bill credit. Most interviewed participants who dropped out of the Conservation Periods did so due to discomfort during events. In some cases, the discomfort was exacerbated by issues with their facilities' HVAC systems and building envelopes. We recommend Duke Energy staff:

  - Consider having the program call center employ additional drop-out prevention strategies, such as providing tips for mitigating discomfort during events or helping them understand how to opt out of events.[6] We suggest informing customers about how to opt-out since opting out of some events will yield higher impacts overall than if the customer is to drop out entirely. In addition, the call center might refer customers mentioning issues with their building's HVAC system or building envelope to other Duke Energy programs. While this may not stop a customer from dropping out of the program, it would provide Duke Energy with increased energy savings through the relevant energy efficiency programs.

- **Encourage adoption of, or conversion to, higher cycling strategies.** Enrollment in the lower cycling strategies, especially the 30% strategy, is higher than expected, leading to lower than anticipated per participant impacts.

  - Test options to support converting existing customers to higher cycling strategies. We understand that Duke is already in the process of an analytics project to help identify customers that could use higher cycling strategies. These analytics could help Itron during the installation to assess if customers could increase their cycling strategy, without jeopardizing comfort. An additional option would be to promote higher cycling strategies on the customer portal; especially for customers with higher reference loads. Customers can currently change strategies after they enroll, but according to the program manager, most customers who change after enrollment change to a lower cycling strategy. It should be noted that more aggressive cycling strategy enrollment goals should be balanced with customers' comfort, as we found that higher cycling strategies are tied to more noticeable reductions in comfort, higher opt-out rates, and reduced likelihood of participating in the future.

Recommendation: Program Implementation Enhancements

The program uses a series of marketing channels, including door-to-door marketing ("canvassing"), phone recruitment, email and direct mail, website, and digital marketing. Door-to-door marketing was a successful

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[6] Based on information from the program team, assisting customers in changing cycling levels is a retention strategy already employed by the call center.

strategy in 2017, and program enrollment increased considerably after Duke Energy engaged Threshold Marketing canvassers.

Duke Energy pays Threshold Energy a set fee for every account enrolled in the program. This fee does not vary based on the size or number of HVAC devices that a customer has, or the cycling level chosen. Perhaps as a result, the Threshold program managers describe focusing their efforts on customers where they can likely engage with an on-site decision maker (e.g., "mom and pop" businesses), and described how it was easier and more lucrative for canvassers to enroll customers with fewer HVAC units, since customers with more complex systems required more time to enroll for the same commission. Although engaging willing participants benefits marketing cost-effectiveness and increases participation, these enrollment strategies may not capture the most optimal savings opportunities from an impacts perspective. We recommend:

- **Aligning enrollment incentives with factors known to produce higher impacts to maximize cost-effectiveness.** Threshold's enrollment incentives were not aligned with Duke Energy's goals as they are paid per account regardless of characteristics that affect potential kW and kWh savings (e.g., cycling strategy, number of devices enrolled, baseline usage, or HVAC size). We recommend revisiting how Threshold is compensated by developing a tiered incentive strategy that provides greater compensation for customers with greater savings potential or interest in higher cycling levels. At the same time, customer comfort matters: higher cycling strategies are tied to more noticeable reductions in comfort, higher opt-out rates, and reduced likelihood of participating in the future. Accordingly, any tiered incentive strategy will need to balance recruitment into aggressive cycling strategies with continued support for customer comfort.

- **Considering adjustments to education or incentives to ensure installers offer participants with heat pumps winter Conservation Period participation.** Only half of participants with heat pumps recall installers offering participation in winter Conservation Periods. To increase the number of winter participants, the evaluation team recommends increasing installer education on the benefits of winter participation and on the program goals related to winter participation. The program may also consider adjusting installer incentives for enrolling winter participants.

Recommendation: Device Functionality and Operations Optimization

Our demand response impact analysis identified average percent load impacts that were routinely under the cycling strategy amount. This is consistent with expectations for a duty cycle strategy, as the average run-time of units during non-events is rarely 100%. We also found that energy efficiency savings were lower than anticipated, which may be driven by customer engagement with their set points. We recommend:

- **Incorporating an adaptive cycling strategy for Conservation Period events.** Adaptive cycling replaces the baseline run-time of 100% with an actual run-time percentage during a non-event hot day. For example, in simple 30% duty cycling where the baseline is 100%, event period run-time is limited to 70% (100%-30%). Adaptive cycling, which uses a previous measurement of run-time during hot days for the particular device (e.g., 90%) would limit event period run-time to 63% e.g., 90%* (100%-30%)). This helps to achieve percent run-time reductions closer to the cycling strategy, and it helps customers who may have under- or over- sized units. We understand that Duke Energy will be implementing this approach to cycling for the 2018 Conservation Period events.

- **Implementing strategies to optimize energy efficiency settings for thermostats.** Notably, Duke Energy implemented an "auto-EE" functionality to their customer portal in 2018. This feature assesses the building's thermodynamics and auto-adjusts the set points when the facility is closed to generate additional energy savings compared to customer setpoints. These changes could potentially increase the overall energy savings from the thermostats in future program years. We also recommend assessing set points for thermostats to understand programming behavior of installers and customers. Educational materials that help customers optimize their own comfort, while also yielding bill savings, may help customers achieve higher energy savings associated with their devices.

Recommendation: Data Tracking

- **Enhance data tracking across Duke Energy program participation databases, customer billing data, and AMI data, as well as with Itron device log data.** Throughout this evaluation, we encountered a number of data issues that limited our ability to execute the planned analyses and increased evaluation cost and time frames. For example, the original evaluation plan sought to assess net demand impacts using AMI data. However, the DEP AMI data had substantial data availability issues as well as quality issues in terms of anomalous load shapes, necessitating incorporating device log data for the impact analysis. In particular, the load shapes within the available AMI data (based on graphical review) were not consistent with expected AC load shapes, and the amount of AMI data was insufficient to fully represent the population of participants. We offer the following set of recommended data tracking enhancements:

  - Develop an identical set of unique identifiers across datasets and include Account ID and Source Account ID and Source Service Point ID in every dataset. If an identical set of unique identifiers is unavailable due to the data existing in different systems, consider developing a crosswalk that links Source Service Point ID and Service Point ID. Currently, Duke Energy program data tracks participation at the Account level, while the vendor tracks participation at the Source Service Point Level. In addition, for DEP consumption data, provide an identifier that links Meter Number to Source Service Point ID and Account Number. This can support effective identification of the meter associated with a device installation.

  - Track changes in cycling strategies across time rather than replacing the strategies with the latest enrollment status. This will allow us to correctly classify participants by cycling level for each event, even if their cycling level or status changed. For example, a participant who participated with a 30% cycling strategy in July events but then changed their cycling strategy in September would be tracked as at the latest cycling strategy. Since the tracking data currently does not reflect the original cycling strategy and when it changed, we cannot accurately analyze the impacts of a past event.

  - Differentiate between unenrollment date and deactivation/removal date in the program-tracking data. Currently, the Duke Energy program-tracking data records two dates for each measure, start date (start_dt) and end date (end_dt). The start date corresponds to the installation date in Itron's data, while and the end date can correspond to either the unenrollment date or the removal date in Itron's data. The distinction between the two end dates in the Itron data is important because unenrolled devices can still achieve energy savings while removed devices achieve neither energy nor demand response savings.

2. Program Description

2.1 Program Design

The DEC and DEP EWB program is an integrated demand response (DR) and energy efficiency (EE) program that provides small businesses with the opportunity to participate in Conservation Period events, earn bill credits, and realize additional EE benefits. The program was introduced in 2016 and offers participants either a free programmable two-way Wi-Fi Thermostat or a Load Control Switch if participants agree to participate in summer Conservation Period events. Alongside the hardware, participants who install a thermostat also have access to a web-based customer portal via their personal computer, tablet, or mobile phone that allows customers to manage their thermostats remotely, including presets, advanced control and scheduling options. Participants can select one of three levels of DR participation—30% cycling, 50% cycling, and 75% cycling—with varying levels of earned bill credits based on the selected cycling strategy. Thermostat participants who have a heat pump with electric resistance heat strips are also offered the option of participating in winter Conservation Period events and can earn additional bill credits per season.

Duke Energy designed the program primarily for its demand response benefits. Specifically, the utility wants to provide small business customers with an opportunity to participate in a DR program, since these customers had previously been paying a DR rider without having an opportunity to participate in a program. The energy efficiency savings from the program are an added benefit that is secondary to the demand response savings. The program targets small businesses with a qualifying central air conditioning system and a minimum usage of 1,000 kWh per month during the billing months of May through September.

The program was first implemented by Itron in the DEC and DEP territories in 2016. While Itron is the primary implementer in charge of installing thermostats and calling Conservation Period events, Duke Energy has contracted with two other firms--Lime Energy and Threshold Marketing--to help recruit participants.

The program uses a series of marketing channels, including door-to-door marketing, phone recruitment, email and direct mail, website, and digital marketing. Of these, the most successful channel has been door-to-door recruitment. The program initially engaged Lime Energy to recruit participants as part of their larger contract to implement Duke Energy's Small Business Energy Saver (SBES) program. Specifically, Lime Energy tried to identify potential participants from the pool of SBES program participants. Then, in June 2016, the program engaged Threshold Marketing to help with recruiting efforts. Threshold Marketing canvassers go door-to-door using lists of eligible customers to recruit participants. Representatives from both Lime Energy and Threshold Marketing confirm the eligibility of interested customers, enroll them in the program, and schedule a time for the thermostat or switch installation. As part of this process, canvassers help customers choose their cycling level. When customers learn about the program through a channel other than a canvasser, such as the website or email, these customers enroll online or via phone.

After a customer has enrolled in the program, Itron installers install the thermostat and/or switch during a scheduled installation appointment. Itron installers program the thermostat(s) based on the customer's requested schedule, ensure the thermostat is connected to the customer's Wi-Fi network, set up the customer's program web portal account, and train the customer in how to use the thermostat and portal.[7]

Summer events are called on weekdays between May and September when average temperature criteria are met and a high system peak is projected. The events are used to help Duke Energy manage system peak. According to the filings, the control period under the Summer Control option may be up to four hours each day an event is called. Interruption of cooling equipment for cycling purposes is limited to a total of no greater than 40 hours during any one summer season. Winter events can be called between November and March. For customers selecting the Winter Control option, Duke Energy can, at its discretion, interrupt service to the resistance heating elements associated with each electric heat pump unit for up to four hours each day an event is called. Resistance heating element interruptions are also limited to a total of no greater than 40 hours during any one winter season. Duke Energy decides when to call an event and Itron is responsible for implementing the event. Each time an event is scheduled, participants are notified via email. Participants who received a thermostat are also notified through a light on the thermostat and through the web portal. During the event, the devices display a message that an event is in progress. Participants can opt out of events at any time before or during the event.

Customers receive a bill credit for each enrolled HVAC unit with an installed device in each year that they participate in Conservation Period events. The summer DR credits are tied to cycling level, with credits of $50 for 30% cycling, $85 for 50% cycling, and $135 for 75% cycling. In addition, participating customers receive $25 each year they participate in winter Conservation Period events. Customers can opt out of up to two events each year and still receive their bill credit.[8]

2.2 Program Implementation

Based on program staff interviews and program data review, the evaluation team found that the 2017 program implementation was being executed smoothly. Program participation exceeded targets and the program successfully called multiple events during the summer Conservation Period, however, no winter Conservation Period events were called. Duke Energy was happy with the various vendors implementing the program and the vendors described being well-supported by Duke Energy. To illustrate program success, one of the main challenges mentioned was that Itron could not hire fast enough to support demand for the device installation after Threshold Marketing was enlisted and program enrollment increased quickly. The program staff described internal process improvements that helped address some of the early challenges identified during the program's rollout in 2016.[9] The remainder of this section outlines the highlights the most interesting elements of how the program has been implemented.

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[7] These activities apply to thermostats only; they do not apply to switches.

[8] Bill credits are paid after customers enroll, so customers that opt out of more than two events are forfeiting the credit on the following year's bill cycle.

[9] These were primarily technical issues related to optimizing program implementation, such as processes for ensuring all of a participant's accounts were enrolled, associating multiple accounts with a single participant log-in, allowing canvassers to enroll participants directly, etc. The program team was able to identify and implement changes to address these challenges early in the program rollout.

Program enrollment increased considerably after Duke Energy engaged Threshold Marketing to help recruit potential participants. While Lime Energy canvassers had competing priorities with completing lighting and refrigeration measures through Duke Energy's SBES program while discussing EWB with customers, Threshold Marketing canvassers were focused solely on promoting EWB. At the end of 2017, Duke Energy reported that approximately 16% of customers approached by a canvasser agreed to participate in the program. Because of Threshold Marketing's success in recruiting customers, the program experienced a backlog in the second half of 2016, where customers had been recruited and had to wait two to three months to have their thermostat or switch installed, instead of the target of four weeks. In response, the program stopped other forms of marketing and Itron hired more installers to handle the influx of new participants.

Although participation has exceeded expectations, participant characteristics differ from what was expected (see Section 5.1, Participation Analysis). For example, Threshold Marketing has found that thermostats have been more popular than expected. As a result, canvassers typically use the benefits of the smart thermostats to sell the program, before describing the Conservation Period events and bill credits. According to the program manager, this has been a positive development, since the thermostats provide Duke Energy with energy savings in addition to the DR impacts, and because the thermostats cost less than the switches. Participants are also installing more devices per business than assumed (an average of 1.8 devices compared to 1.3[10]). At the same time, however, customers are choosing lower cycling levels and the HVAC equipment on which devices are installed is smaller than anticipated. While the higher number of devices per participant has decreased the marketing cost per device enrolled, the combined effect of lower cycling levels and smaller equipment likely reduces savings and therefore increases the program's cost per kW.

Duke Energy pays Threshold Marketing a fixed fee for every account enrolled in the program. This fee does not vary based on the size or number of HVAC devices or control equipment that a customer has, nor the cycling level chosen. Perhaps as a result, the Threshold Marketing program managers describe focusing their efforts on customers where they are most likely to engage decision makers. As a result, revising the incentive structure to provide tiered incentives based on cycling strategy may support enrollment of higher potential customers.

Once a customer has enrolled in the program, Itron installers arrive during the scheduled time window to install the device. At this point, about 20% of enrolled customers "turn down" the program, or do not go through with the program installation. At the time the evaluation team talked to program staff, there was no reliable data on how many of these customers went on to reschedule a different time to have their thermostat or switch installed versus how many declined to participate in the program. However, Itron was planning on collecting this data in the future to be able to better track customer turn downs. Their understanding was that the most common reasons that customers turned down the program (without rescheduling) were that there were issues with Wi-Fi networks or HVAC equipment not working that precluded the customer from participating. While some customers with HVAC equipment issues install the switch instead, many will fix their HVAC systems, so they can participate. Itron took multiple steps to decrease the turn down rate. Itron also made efforts to make their installations more efficient, to help address the backlog of customers waiting for their installation caused by the increase in enrollment after Threshold Marketing started canvassing. First, installers started bringing Wi-Fi signal detectors and starting installation with the furthest away thermostat, to identify Wi-Fi network issues quickly. Second, installers started bringing Wi-Fi extenders to help address Wi-Fi coverage issues. The

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[10] From Duke Energy Stage 2 – Evaluation Screening for: Small Business Demand Response PowerPoint, slide 27.

Itron program managers thought that the canvassers were doing everything that they could to screen out customers that have incompatible equipment and did not think there was a problem with canvassers not fully vetting customers' eligibility.

There are no differences in how the program is implemented in the DEC and DEP service territories. However, since each canvasser and installer focuses on a geographic region, different staff implement the program in the two territories. For example, a single canvasser was responsible for approximately 30% of all new DEC participant registrations during the 2017 program year. According to program staff, this canvasser registered most or all of their new participants at the 30% cycling level, and thus, skewed all DEC participants towards a 30% cycling level. In addition, the time between enrollment and installation varied by region, based on the number of canvassers and installers available.

3. Key Research Objectives

This evaluation of the EWB program includes process and impact assessments and addresses several major research objectives:

- Determine the estimated gross demand response impacts from the program;
- Determine the estimated net energy efficiency impacts from the program;
- Explore how participating customers are interacting with the program, and how satisfied they are;
- Determine whether any modifications or improvements can be made to program design (including eligibility requirements or incentive structures), program operations, or program equipment/software to reduce customer barriers to enrollment and support increasing enrollment and event participation.

In addition to the above objectives, the evaluation plan included the following objectives, which were not addressed in this evaluation:

  - Winter demand response events: The demand analysis did not include winter events as no winter events were called in 2017.
  - Use of AMI data: For the summer demand response analysis, we used telemetry data rather than AMI data. As a result, we conducted the analysis on the population of devices with data, rather than a sample of AMI data. This change was made due to the limited availability and poor quality of the AMI data. This results in gross demand response impacts, rather than net impacts.
  - Demand response forecast models: The evaluation did not develop forecast models for DR impact prediction based on peak standard weather due to changes in evaluation priorities.

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

- What are customers' motivations for enrolling in the program?
- To what extent do implementation staff fully and accurately explain the program to customers? Are there questions that customers have that are not being fully addressed?
- Do customers understand how to use their smart thermostat? Is program training on how to use the thermostat sufficient?
- Do customers understand how to access and interpret information in the program portal?
- Are program implementers offering the winter demand response control option to all customers with electric heat pumps?
- What barriers do customers have that prevent them from enrolling in the program? Why do customers approached by implementers Lime Energy and Threshold Marketing decide not to participate? How could Duke Energy help customers overcome these barriers?
- Are there barriers that prevent customers who enroll in the program from participating in demand response events?
- Why do customers choose to unenroll from the demand response portion of the EWB Program?
- How satisfied are participants with various program elements and the program overall?

- What were customers' experiences during Conservation Periods? Have there been any aspects of their event experience that will influence their willingness to participate in future events?

4. Overview of Evaluation Activities

To address the evaluation research objectives and questions, the evaluation team performed a range of data collection and analytical activities. Table 4-1 provides a summary of evaluation activities and associated areas of inquiry. Following the table, we provide detail on each activity's scope, sampling approach (if applicable), and timing.

Table 4-1. Overview of Evaluation Research Activities

#	Evaluation Activity	Impact	Process	Purpose of Activity
1	Program Staff Interviews		X	▪ Provide insight into program design and delivery ▪ Support process assessment
2	Materials Review	X	X	▪ Provide insight into program design and delivery ▪ Inform planning savings assumptions
3	Early Participant Interviews		X	▪ Identify topics related to participants' experience to explore further through participant survey ▪ Identify and provide early feedback on any issues associated with the program rollout
4	Participant Survey		X	▪ Assess participants' motivations and barriers to participation, experiences with program thermostats and demand responses events, and satisfaction with the program
5	Non-Participant and Un-Enrolled Participant Interviews		X	▪ Understand why customers approached about the program decline to participate ▪ Understand why previously-enrolled customers stop participating in demand response events
6	Participation Analysis	X	X	▪ Provide overall installation count by cycling strategy, jurisdiction, and other features of interest
7	Gross Demand Response Impact Analysis	X		▪ Calculate gross load impacts associated with the five summer Conservation Period events called in 2017
8	Net Energy Savings Impact Analysis	X		▪ Calculate net energy savings impacts associated with thermostats installed in 2017

4.1 Program Staff Interviews

In February and March 2017, the evaluation team completed seven interviews with program staff at Duke Energy and program implementers. In addition to the Duke Energy program manager, the evaluation team talked to program managers and supervisor from Itron (three interviews), Threshold Marketing (two interviews), and Lime Energy (one interview). The interviews explored program design and implementation, program performance, incentivized demand response event specifications, and tracking and communication processes, among other topics. To supplement these interviews, Duke Energy also provided the evaluation team with a demonstration of the program portal.

4.2 Program Materials Review

In support of the impact and process evaluations, the evaluation team reviewed program materials and data, including marketing materials, program plans, training materials, enrollment forms, past research studies. This information informed our research design, provided insight into program design and delivery, and supported the assessment of program impacts.

4.3 Customer Interviews

4.3.1 Early Participant In-Depth Interviews

In preparation for survey design, the evaluation team completed 10 in-depth interviews with early participants (who participated before October 2016).[11] The goals of these interviews were to (1) provide program staff with early feedback about the program roll out and first demand response events and (2) help identify key issues to explore through the larger participant survey effort. Respondents were offered a $25 incentive for completing the interview. The evaluation team conducted a purposive sample of 10 participants based on a review of program-tracking data and interviews with program staff. Program staff indicated interest in the customer experience differences between those customers recruited by Lime Energy versus those recruited by Threshold Marketing. To explore these differences, the evaluation team interviewed five early participants recruited by each contractor for a total of 10 interviews. The interviews were completed between April 25 and May 4, 2017.

4.3.2 Participant Survey

Sample Design and Fielding

The evaluation team fielded an online survey of program participants. As the population of participants was small (2,811 unique 2017 enrolled participants at the time of the survey data request in August 2017), the evaluation team attempted a census of all program participants with a valid email address. Survey participants were offered a $25 incentive to complete the survey. The evaluation team fielded the survey on September 13, 2017, and closed the survey after receiving 242 completes, far exceeding the target of 200 completes. The portion of DEC and DEP respondents was slightly different from the population (Table 4-2).

Table 4-2. Comparison of Participant Survey Respondents to the Program Population

Utility	Percent of Survey Respondents (n=242)	Percent of Population (N=2,811)
DEC	74%	66%
DEP	26%	34%

Note: Population reflects unique customers at the time of survey fielding.

Survey Disposition and Response Rate

The survey response rate was 16.9% for DEC and 17.6% for DEP (Table 4-3). As a census of all program participants was attempted, the evaluation team did not calculate confidence and precision.

[11] Because there was no process evaluation of the 2016 program, the 2017 evaluation included early interviews with participants to provide Duke Energy with advance feedback on any potential issues with the program rollout. These interviews included early 2016 participants to represent customers recruited by Lime Energy, and thereby gather data to assess whether there were meaningful differences between customers recruited by Lime Energy versus Threshold Marketing.

Table 4-3. Participant Survey Response Rate

Disposition	DEC	DEP	Overall
Response Rate (AAPOR RR3)	16.9%	17.6%	17.1%

To develop the sample, we first removed duplicate emails across premises and business with multiple projects. Of all the accounts in the program tracking data, about 50% represented a unique email address of a customer actively enrolled in the program and were included in the survey (1,065 DEC and 353 DEP). Table 4-4 presents the survey dispositions.

Table 4-4. Participant Survey Dispositions

Disposition	DEC	DEP
Complete	180	62
Partial Complete	11	6
Terminate Before Screening Questions	84	36
Refusal	7	2
No Response	783	247
Total	1,065	353

4.3.3 Non-Participant and Unenrolled Participant Interviews

The evaluation team conducted in-depth interviews with 10 "non-participants," defined as customers approached about the program that have decided not to participate, and 10 "unenrolled participants," defined as customers who enrolled in the program but later decided to no longer participate in Conservation Periods (Table 4-5). The evaluation team attempted a census of all unenrolled participants, as well as all non-participant customers tracked in the program database who had declined to participate in the program and did not have valid reason listed (i.e., already had smart thermostat or did not qualify). Both groups were offered a $25 incentive upon completion of the interview. Interviews were completed between July 21 and October 10, 2017.

Table 4-5. Completes and Sample Size

Group	Completes	Sample
Non-participants	10	980
Unenrolled participants	10	100

4.4 Participation Analysis

As part of our evaluation, we summarized program enrollment and demand response event participation based on program-tracking data. As part of these analyses, we reviewed the Duke Energy and Itron program participation databases to determine the total number of enrolled devices and participants, the type of devices installed, the selected cycling strategies, as well as installation dates. In addition, we reviewed thermostat and switch log data to determine device operability and opt-out rates. Notably, different analyses use different subsets of participants, outlined in greater detail in Section 5.

4.5 Gross Demand Response Impact Analysis

Opinion Dynamics conducted a gross demand response analysis to estimate event specific hourly load impacts for installed devices, by jurisdiction, device type, and cycling strategy. We conducted this analysis using device log data supplied by Itron (which provides device run-time data) in combination with program-tracking data, event data, and weather data from the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information.

To estimate impacts, we first cleaned device log data. We then developed a counterfactual for what would have occurred on a non-event day in the absence of the demand response event by identifying similar non-event days (in terms of weather, day of week, and other variables). Using these proxy non-event days, we used linear regression models to estimate changes in run-time during events. The actual run-time during the event is compared to the estimated counterfactual to establish hourly impacts. We then converted run-time impacts to load impacts by applying the full load estimate (HVAC capacity divided by SEER) from program-tracking data. We used the cleaned log data and program-tracking data to determine device operational rates and opt-out rates for each event, and applied the average per-device impacts for each event to the number of operational devices. We used the average of these values across the five events to calculate net realization rates against ex ante goals. A summary of the approach is provided in Section 5.2.

4.6 Net Energy Savings Impact Analysis

Opinion Dynamics conducted a consumption analysis and a cross-participation analysis to estimate net energy savings impacts for thermostats installed in 2017. We conducted the consumption analysis using customer billing data, program participation data and weather data. We used a linear fixed effects regression (LFER) model, which controls for all facility factors that do not vary over time using the individual constant terms in the equation. The consumption analysis used a comparison group matched on pre-period energy consumption patterns.

Our team also conducted a cross-participation analysis. The purpose of the analysis was to adjust consumption analysis results for energy savings as a result of participation in other Duke Energy non-residential programs. To do so, we identified measures installed through the Non-Residential Prescriptive and SBES Programs, and their savings, during the post-participation period. Savings reflect pro-rated net ex post impacts based on the date of installation. Once identified, we removed the difference between cross-participation savings of EWB participants relative to the comparison group. This accounts for the fact that the consumption analysis already nets out equal cross-participation savings for the comparison group and participants.

To calculate total energy savings impacts, our team applied per-device impacts to the total number of thermostats enrolled in 2017. We used this value to calculate net realization rates against ex ante goals. A summary of the approach is provided in Section 5.1.

5. Impact Evaluation

Our impact evaluation included three main research efforts: a participation analysis, a gross demand response impact analysis, and a net energy savings impact analysis. The following subsections describe our approach and the results for each of these research efforts.

5.1 Participation Analysis

As part of our evaluation, we summarized program enrollment and event participation based on program-tracking data. Notably, different analyses use different subsets of participants, as summarized in Table 5-1, and further described in the subsections below.

Table 5-1. Summary of Participation Counts for 2017 Impact Analyses

Participation Type	Description	DEC	DEP
2017 Program Enrollment	Count of all devices (switches and thermostats) installed in 2017 and not deactivated.	4,878	1,915
Demand Response	Count of all devices (switches and thermostats) installed as of the end of the 2017 summer Conservation Period events (program launch to September 30, 2017) that were eligible to participate during an event (i.e., active, enrolled devices with a known cycling strategy), were operational and could be cycled during each 2017 Conservation Period.	2,978	1,800
Energy Savings	Count of *premises with thermostats* installed in 2017, including deactivated devices.	4,490	1,719
Cumulative Program Enrollment	Count of all *devices* (switches and thermostats) installed from program initiation through December 31, 2017 and not deactivated.	5,876	2,635

5.1.1 2017 Program Enrollment

According to information provided by Duke Energy, anticipated participation in the program was 1,848 devices for DEC and 1,132 devices for DEP, for a total of 2,980 devices.

Review of the program-tracking data indicated that, during 2017, the program achieved a total enrollment of 4,878 devices in the DEC service territory (264% of goal) and 1,915 devices in the DEP service territory (169% of goal), for a total of 6,793 devices across both territories. Consistent with 2016, the program-tracking data showed that thermostats were more popular than expected. Nearly all new customers chose the thermostat (91% of installed devices) over the switch (9% of installed devices). Process analysis indicated that most customers with switches had been interested in a thermostat but had an issue with their HVAC unit not being compatible, and thus could only participate using a switch. Table 5-2 provides projected and actual program enrollment in 2017, by jurisdiction and device type.

Table 5-2. 2017 Projected and Achieved EWB Device Enrollment

Jurisdiction	Device Type	# Projected	# Achieved	% Achieved
DEC	Thermostat	1,755	4,490	256%
	Switch	92	388	420%
	Total	**1,848**	**4,878**	**264%**
DEP	Thermostat	1,076	1,719	160%
	Switch	57	196	346%
	Total	**1,132**	**1,915**	**169%**

Note: Reflects devices enrolled from January 1, 2017—December 31, 2017 excluding deactivated devices.

To develop expected savings from Conservation Period events, the program assumed 50% enrollment in the 30% cycling strategy, 30% enrollment in the 50% cycling strategy, and 20% enrollment in the 75% cycling strategy. DEP participant uptake was relatively consistent with these assumptions, but DEC participant uptake tended more heavily towards lower cycling strategies (see Table 5-3). Everything else being equal, a lower cycling strategy will generate lower DR savings. To realize expected demand response load impacts, the program may therefore need to more strongly promote the higher cycling strategies, particularly among DEC customers.

Table 5-3. 2017 Projected and Achieved Enrollment Cycling Strategy Distribution of Cycling Strategies

Jurisdiction	Projected[A]	Achieved[B]
30% Cycling Strategy		
DEC	50%	84%
DEP		53%
50% Cycling Strategy		
DEC	30%	12%
DEP		25%
75% Cycling Strategy		
DEC	20%	5%
DEP		22%

[A] Projected enrollment assumptions based on 8/18/2014 PowerPoint presentation, entitled “Small Business Demand Response – Evaluation Gate Presentation”.
[B] Device counts reflect devices installed from January 2017–December 2017 excluding deactivated devices.

Compared to 2016, DEC enrollment in 2017 shifted towards lower cycling strategies while DEP enrollment shifted towards the 75% cycling strategy (see Table 5-4).

Table 5-4. Comparison of 2016 and 2017 EWB Cycling Strategies Enrollment Distribution

Jurisdiction	2016	2017
DEC		
30%	56%	84%
50%	25%	12%
75%	19%	5%
DEP		
30%	65%	53%

Jurisdiction	2016	2017
50%	25%	25%
75%	10%	22%

We also assessed whether average size and efficiency of units changed from 2016 to 2017, reflecting an attempt by the program to target facilities with larger HVAC units. In our 2016 evaluation, we found that ex ante per-unit savings assumptions were considerably higher than ex post impacts, mostly due to an overestimate of the size (tonnage) of the controlled air conditioning units. Since equipment size is directly correlated with savings, the smaller-than-expected controlled units significantly affected realized energy efficiency and DR impacts. Our review of 2017 participation data showed that the average size of units was virtually identical in 2016 and 2017 (Table 5-5).

Table 5-5. Comparison of 2016 and 2017 EWB Average HVAC Size and Efficiency

	Average SEER Value		Average Tonnage Value		Average Tonnage/SEER Value	
Jurisdiction	2016	2017[A]	2016	2017	2016	2017
DEC	11.2	11.2	4.41	4.35	0.394	0.388
DEP	11.8	11.8	4.08	4.01	0.364	0.340

A: 2017 SEER values were based on 2016 participants, as this data was not available in the 2017 participant data.

5.1.2 Energy and Demand Impacts Participation

As noted earlier, this evaluation used different participation counts to estimate energy efficiency impacts and demand response load impacts (Table 5-6). Energy efficiency savings reflect thermostats installed in 2017 (4,490 devices in DEC service territory and 1,719 devices in DEP service territory). We report participation in 2017 Conservation Period events in terms of the average number of devices that were operational and could be cycled during each 2017 Conservation Period. Therefore, demand response load impacts from Conservation Period events reflect a device-weighted average of operational devices cycled during each 2017 Conservation Period event (2,978 devices in DEC service territory and 1,800 devices in DEP service territory).

Table 5-6. Devices Included in 2017 Energy Efficiency and Demand Response Impacts Analysis

Jurisdiction and Cycling Strategy	2017 Thermostat Installations (EE Impacts)	2017 Conservation Period Devices (DR Impacts)		
		Thermostat	Switch	Total
DEC				
30%	4,490	2,141	143	2,285
50%		406	41	447
75%		234	12	246
Jurisdiction Total		2,781	196	2,978
DEP				
30%	1,719	1,020	99	1,119
50%		413	32	445
75%		223	12	236
Jurisdiction Total		1,656	143	1,800

5.1.3 Cumulative Program Enrollment

Based on the program-tracking database, the program installed a cumulative total of 8,511 devices as of the end of 2017, associated with 4,561 unique customer premises. As with the new 2017 enrollees, customers to date have overwhelmingly opted for smart thermostats (92%) over load control switches (8%). The 30% cycling strategy is the most popular among customers, with 79% of DEC and 58% of DEP devices enrolled into that cycling level. Only 14% of DEC and 23% of DEP devices were enrolled in the 50% cycling strategy and 7% of DEC and 17% of DEP devices enrolled in the 75% cycling strategy. As of December 2017, 218 devices were deactivated (e.g., removed the device), and 343 devices were un-enrolled (e.g., customers who opted out of participating in all Conservation Period events and are listed as 0% cycling).

Table 5-7 provides the distribution of device types and cycling strategies enrolled in the program since inception (2015) through December 31, 2017. Notably, cumulative installed devices suggest that there is an increased potential for Conservation Period summer event participation in 2018, compared to 2017 summer events. Substantial enrollment after the summer 2017 Conservation Period drives this increased potential.

Table 5-7. 2015 – 2017 Enrolled EWB Devices, by Jurisdiction, Type, and Cycling Strategy

Jurisdiction and Cycling Strategy	Number of Devices			Percentage of Total Devices in Jurisdiction		
	Thermostat	Switch	Total	Thermostat	Switch	Total
DEC						
30%	4,316	300	4,616	79%	69%	79%
50%	707	96	803	13%	22%	14%
75%	397	35	432	7%	8%	7%
Multiple/Unknown	24	1	25	0%	0%	0%
Jurisdiction Total	5,444	432	5,876	100%	100%	100%
DEP						
30%	1,377	140	1,517	57%	62%	58%
50%	577	32	609	24%	14%	23%
75%	428	25	453	18%	11%	17%
Multiple/Unknown	26	30	56	1%	13%	2%
Jurisdiction Total	2,408	227	2,635	100%	100%	100%

Note: Device counts reflect all devices from 2015 through December 2017, excluding devices that were deactivated (e.g., removed).

Table 5-8 summarizes device enrollment by the various program design features, such as device type (e.g., thermostat and switch), the choice of cycling strategy, enrollment in summer and/or winter events, one or more locations participating in the program, and others. Note that enrollment is very low for both summer and winter Conservation Period events compared to summer Conservation Period events alone. This is because thermostat customers must have a heat pump and electric resistance heat strips to be eligible to participate in winter events. By participating in the winter events, the program has 100% control of the electric resistance heating elements during the Conservation Period event.

Table 5-8. 2015—2017 EWB Device Enrollment by Program Design Features

Program Design Feature	DEC Devices (n=5,876)[A]	DEP Devices (n=2,635)[A]
Device Type		
Thermostat	93%	91%
Switch	7%	9%

Program Design Feature	DEC Devices (n=5,876)[A]	DEP Devices (n=2,635)[A]
Cycling Levels		
30%	79%	58%
50%	14%	23%
75%	7%	17%
Multiple/Unknown[B]	0%	2%
Summer and Winter Participants		
Summer Only	89%	91%
Summer and Winter	9%	6%
Unknown[B]	2%	3%
Number of Locations Participating in the Program		
One	98%	96%
Two or More	2%	4%
Recruitment/Marketing Source		
Business Energy Advisor	3%	3%
Canvasser	44%	57%
Email	5%	3%
Flyer	4%	8%
Friend	2%	0%
Installer	0%	0%
Small Business Energy Saver (SBES)	1%	1%
Telemarketing	7%	8%
Web	1%	1%
Other	3%	3%
Unknown[B]	31%	15%

[A] Device counts reflect devices installed through December 2017 excluding deactivated devices.
[B] Devices enrolled September through December 2017 did not have vendor data available, so are marked as unknown.

5.2 Gross Demand Response Impact Analysis

5.2.1 Methodology

The demand response impact analysis assessed summer Conservation Period gross impacts from switches and thermostats in place and operational at the time of the 2017 summer Conservation Period events.

For demand response programs, the concept of freeridership is not applicable. This is because customers will rarely, if ever, choose to cycle their units off during a hot day without program intervention. Non-participant spillover is also not applicable because non-participants are not notified of Conservation Period events. Participant spillover is unlikely to occur because customers rarely turn off other equipment during program events. However, takeback effects, such as running fans to compensate for the cycling of the AC unit and/or increased run-time for refrigeration and/or process cooling equipment, may occur. Because we used device-level (thermostat or switch) log data to conduct this analysis, rather than facility-level data, this analysis produces gross impacts, i.e., results are **not adjusted** for takeback effects. Notably, the original evaluation plan sought to assess net demand impacts using AMI (advanced metering infrastructure) data. However, the DEP AMI data had substantial data availability issues, and both DEC and DEP had quality issues related to anomalous load shapes, necessitating the use of device log data for the impact analysis. In particular, the load shapes within the AMI data—based on graphical review—were not consistent with AC load shapes, and the amount of AMI data was insufficient to fully represent the population of participants.

Activities included:

- Cleaned and prepared data by reviewing event data, as well as program participation, weather data and logger data to identify the number of devices eligible and available to participate in summer events;
- Determined baseline load by identifying similar non-event days (in terms of weather, day of week, and other variables);
- Modeled program impacts by conducting linear fixed effects regression analysis with similar non-event days using device log data and weather data to estimate per device run-time impacts;
- Converted run-time impacts to per device load impacts by applying the full load estimate (HVAC capacity divided by SEER); and
- Identified the number of participating devices (i.e., those eligible and operational) and calculated gross event impacts by multiplying the per device full load impacts by the number of participating devices; and
- Calculated gross impacts for each event by multiplying the per device load impacts by the number of participating devices by specific categories, including device type, cycling strategy and jurisdiction. We calculated the average program-level impact as the weighted average of load impacts across events by jurisdiction, weighting by the number of participating devices.

Clean and Prepare Data

As part of the data cleaning process to prepare for modeling, we excluded devices for the following reasons:

- Enrolled after last summer 2017 Conservation Period events
- Deactivated, unenrolled, or failed prior to event period or event
- Unknown cycling strategy
- No run-time during event and non-event days (less than 1% of participating devices)
- Insufficient run-time data (e.g., run-time data had zeroes for each 15-minute interval)
- Run-time greater than 100%

In total, we had 5,398 devices (3,454 in DEC and 1,944 in DEP) in our modeling data set. Table 5-9 shows in detail the total number of devices left after each data cleaning step by jurisdiction.

Table 5-9. Run-Time Modeling Data Cleaning Steps

Jurisdiction	# Devices Left	Drop Reason
DEC	3,645	Initial Count of Devices
	3,615	Missing Run-time Data
	3,565	Missing Run-time Data on Event and Matched Comparison Days

Jurisdiction	# Devices Left	Drop Reason
	3,554	Unknown Cycling Strategy
	3,455	Devices with Insufficient Run-time Data (Run-time is Zero for All Observations)
	3,454	Time Intervals > 60 Minutes/Percent Run-time Greater than 100% in an Interval
DEP	2,031	Initial Count of Devices
	2,009	Missing Run-time Data
	1,984	Missing Run-time Data on Event and Matched Comparison Days
	1,983	Unknown Cycling Strategy
	1,944	Devices with Insufficient Run-time Data (Run-time is Zero for All Observations)
	1,944	Time Intervals > 60 Minutes/Percent Run-time Greater than 100% in an Interval

We applied the modeled impact to all devices that received an event signal and cycled their unit during an event, regardless of their inclusion in the model.

Determine Baseline Load

We used a quasi-experimental design to estimate the load impacts of the EWB program. Our selected approach used proxy weather days[12] (i.e., non-event days with similar weather to event days in May through September 2017) to help replicate baseline conditions for event days (i.e., what would the participant's load have been in the absence of the EWB program event?). To develop matches, we used propensity score matching to select four non-event days that were similar in weather profile for each of the five event days. When using propensity score matching, we first build a logistic regression model to estimate each day's probability of being an event day, or its "propensity score," based on hourly weather. We then match each day to the nearest event day in terms of propensity scores (Figure 5-1 and Figure 5-2). The blue lines in the figures represent the event days, and the gray lines represent the matched non-event days. As can be seen, average hourly temperature profiles match fairly well between event and matched comparison days. It should be noted that Events 1 and 4 had more severe thunderstorms in DEP territory, which limited the quality of relevant proxy days available for analysis. We corrected for this issue through the models.

[12] We used participant addresses to geocode the locations of all participants and found the weather station that was closest to each participant's zip code.

Figure 5-1. Average Hourly Temperatures on Event Days and Matched Non-Event Days in DEC Territory

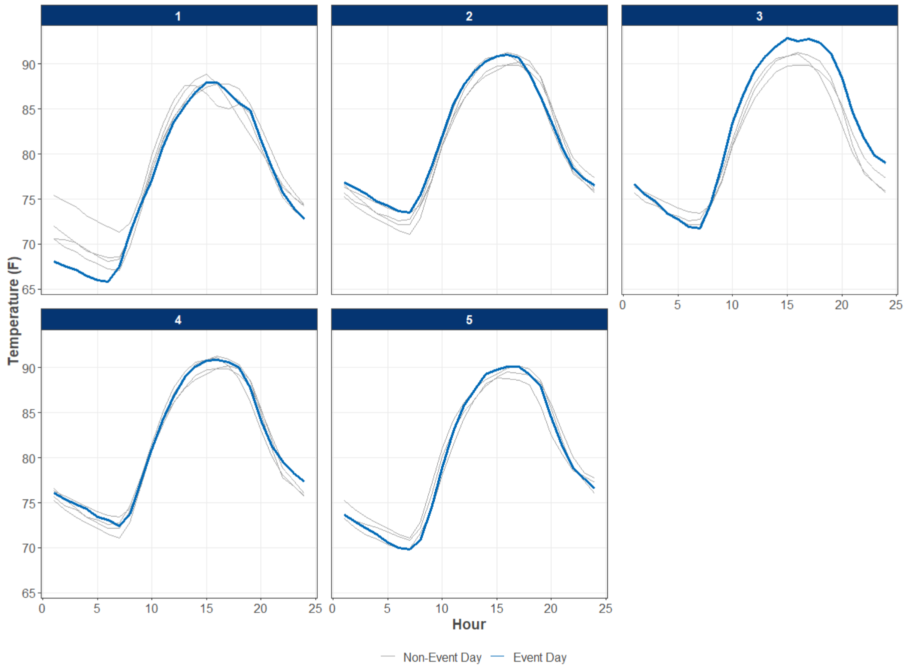
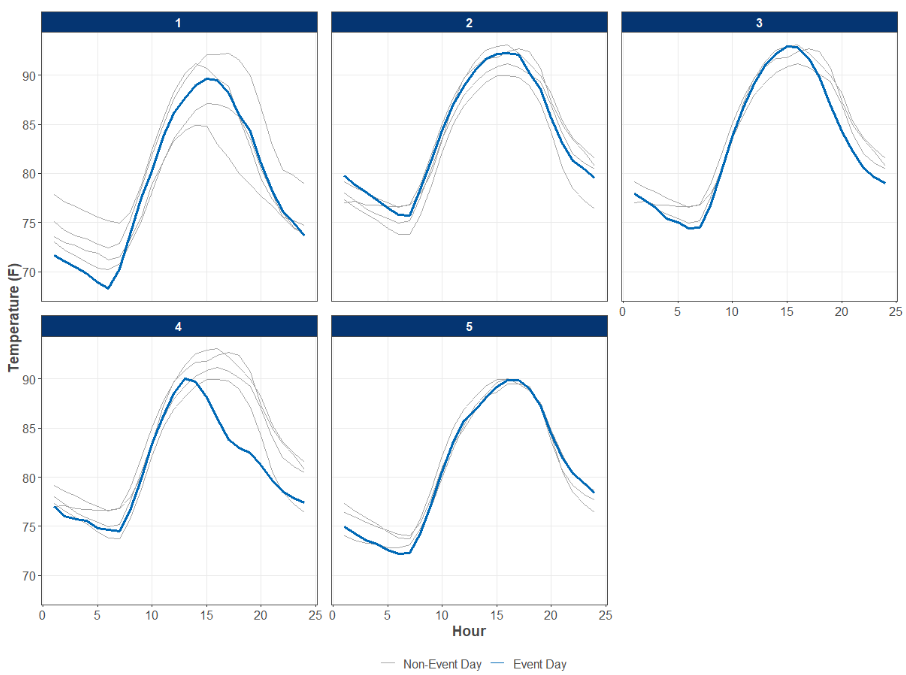


Figure 5-2. Average Hourly Temperatures on Event Days and Matched Non-Event Days in DEP Territory



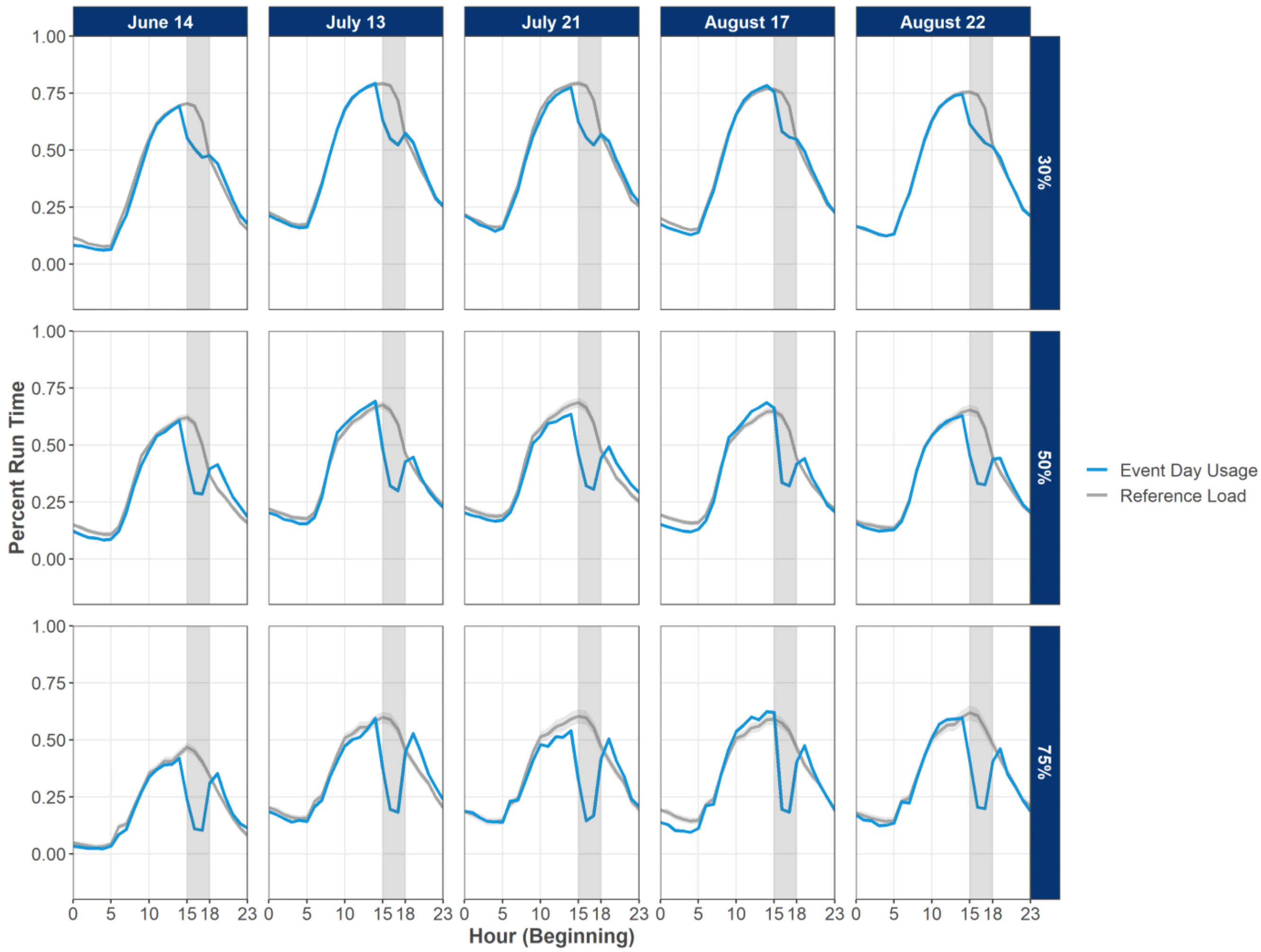
Model Program Impacts

We used a linear fixed-effects regression modeling approach for the demand response impact analysis. The model estimates the percentage of hourly run-time on a per-device level. Event impacts are the mean difference between the modeled (predicted) baseline run-time and the event run-time over the event period,[13] multiplied by mean full load demand (described below). The "fixed-effects" modeling approach allows us to control for the time-invariant device-level factors affecting demand (i.e., factors that do not change over the study period, such as type of facility or square footage) without measuring those factors explicitly in the models. All operational devices were included in the model, including those which opted out of the event. The impact estimates therefore include the effect of any participant opt-outs.

Figure 5-3 provides the actual event day hourly run-time (blue) and predicted run-time (gray) for each event for thermostats in the DEC territory. All events show clear evidence of run-time reduction during event hours. All events also show snapback (an increase in run-time following the event as temperatures are returned to their pre-event levels). The presence of snapback means that energy efficiency savings are likely minimal during the event days.

[13] The statistical regression model used to estimate the baseline hourly run-time during event periods predicts what the hourly run-time would have been during the event, if no event had been called. We then compare this baseline run-time to actual event day run-time to establish the demand savings by hour for each event. We estimated a separate model for each jurisdiction, device (thermostat and switch), cycling strategy (30%, 50%, and 75%), and event. However, because there were so few switches for the 75% cycling strategy, we combined these devices across jurisdictions.

Figure 5-3. Summer Event Day Usage and Estimated Baseline with 90% Confidence Interval (DEC Thermostats)



Convert Run-time Impacts to Demand Impacts

Converting percent run-time impacts to kW reduction involves multiplying the run-time reduction by the assumed full load demand of each device. Opinion Dynamics calculated the full load demand for each device based on Equation 5-1, which uses equipment cooling capacity and efficiency values. We used tonnage values provided in the participant data to calculate equipment cooling capacity (in Btu per hour). The participant data had this information for the majority of devices (81%). If a device did not have a tonnage value, we applied the average tonnage by device and jurisdiction. Efficiency values for the air conditioning systems were not available in the participation data. As a result, we applied the average 2016 evaluated SEER values by jurisdiction.

Equation 5-1. Per Participant Full Load kW for Air Conditioners

$$\text{Full load kW} = \frac{\text{Capacity}}{\text{SEER}}$$

Where:

Capacity = tons * 12 Btu/hour

SEER (Btu/watt-hour) = 11.2 (DEC) or 11.8 (DEP)

Calculated Event Participation and Gross Event Impacts

We first determined device participation for each event by identifying how many devices were (1) operational and (2) eligible. Operational devices are those that received an event signal and could be cycled. This excludes devices that had zero run-time during the day of the event or were in an incompatible mode (e.g., off mode). Eligible devices are defined as those that are active during an event and enrolled with a known cycling strategy. Eligible devices therefore exclude deactivated and unenrolled devices, and devices with an unknown cycling strategy. Notably, because there are five events and enrollment continued throughout the summer period, the number of eligible devices is different for each event.

We calculated gross impacts for each event by multiplying the per device load impacts by the number of participating devices by specific categories, including device type, cycling strategy and jurisdiction. We calculated the average program-level impact as the weighted average of load impacts across events by jurisdiction, weighting by the number of participating devices.

5.2.2 Results

Duke Energy called five summer Conservation Period events during the 2017 cooling season (June 14, July 13, July 21, August 17, and August 22). The temperatures were fairly similar across these events, with an average maximum event temperature of 95°. In Table 5-10, we summarize key features for these events, as well as the total number of eligible and operational devices. Notably, many devices were installed after the summer Conservation Period, and as a result are not included in the analysis because they were not eligible to participate in any events.

Table 5-10. 2017 EWB *Ex Post* Demand Response Events

Event Date	Day of Week	Start Time	End Time	Average Event Temp (F)	Max Event Temp (F)	Devices Eligible to Receive a Signal	Devices that Received a Signal and Cycled During Event	Operational Rate
June 14	Wednesday	3:00 PM	6:00 PM	89	94	4,790	4,334	90%
July 13	Thursday	3:00 PM	6:00 PM	92	96	5,133	4,658	91%
July 21	Friday	3:00 PM	6:00 PM	94	97	5,175	4,698	91%
August 17	Thursday	3:30 PM	6:00 PM	88	95	5,576	5,082	91%
August 22	Tuesday	3:00 PM	6:00 PM	89	95	5,613	5,116	91%
Average				**91**	**95**	**5,257**	**4,778**	**91%**

Note: Averages may not compute correctly due to independent rounding.

We also reviewed opt-out rates by event. Per conversations with Itron, the evaluated opt-out rates are consistent with their expectations for this program. Notably, we identified higher opt-out rates for food / liquor SIC codes, which is consistent with findings from our process survey.

Table 5-11. 2017 Summer Conservation Period Opt-Out Rates by Event and Business Type

Event	Food	Non-Food	Overall
DEC			
June 14	6%	3%	3%
July 13	10%	3%	4%
July 21	13%	4%	5%
August 17	6%	3%	4%
August 22	6%	4%	4%
Average	**8%**	**4%**	**4%**
DEP			
June 14	4%	5%	5%
July 13	13%	3%	4%
July 21	15%	6%	7%
August 17	3%	3%	3%
August 22	3%	3%	3%
Average	**8%**	**3%**	**4%**

Table 5-12 provides per device average load impacts by cycling strategy and device for DEC. As can be seen, customers who enroll in the highest cycling strategy tend to have lower reference loads, but achieve the highest load impacts. In addition, contrary to expectations based on typical customer engagement and opt-out behavior of participants with thermostats, thermostats achieved slightly greater load impacts than switches. According to program staff, this may be driven by the types of facilities that enroll with switches: program staff observed that a greater number of schools and storage facilities enrolled with switches, and these types of facilities may have lower reference load during summer event days compared to the average business.

Table 5-12. 2017 DEC *Ex Post* Average Event Demand Response Load Impacts by Cycling Strategy and Device

Device	Cycling Strategy	Per Device		% Load Impact
		Reference Load (kW)	Load Impact (kW)	
Thermostats	30%	3.355	0.740	22%
	50%	3.348	1.310	39%
	75%	2.471	1.371	56%
	Total	**3.280**	**0.876**	**27%**
Switches	30%	3.240	0.668	21%
	50%	2.777	0.872	31%
	75%	2.006	1.071	53%
	Total	**3.066**	**0.736**	**24%**

Table 5-13 provides per device average load impacts by cycling strategy and device for DEP. Trends in per device reference load and load impacts are similar to those for DEC: customers enrolled in the highest cycling strategy tend to have lower reference loads but achieve the highest load impacts. In DEP, thermostats also achieved greater load impacts than switches.

Table 5-13. 2017 DEP *Ex Post* Average Event Demand Response Load Impacts by Cycling Strategy and Device

Device	Cycling Strategy	Per Device		% Load Impact
		Reference Load (kW)	Load Impact (kW)	
Thermostats	30%	2.993	0.636	21%
	50%	2.393	0.939	39%
	75%	2.396	1.301	54%
	Total	**2.763**	**0.801**	**29%**
Switches	30%	2.925	0.550	19%
	50%	2.572	0.814	32%
	75%	2.006	1.079	54%
	Total	**2.766**	**0.655**	**24%**

Our impact analysis identified average percent load impacts that were routinely under the cycling strategy level. Overall, we found that the percent load impact from devices were lower than the duty cycle enrollment. For example, for DEP the 30% strategy achieved a load reduction of 21%, the 50% strategy a reduction of 39%, and the 75% strategy a reduction of 54%. This is consistent with expectations for a duty cycling[14] strategy, as the average run-time of units during non-events is rarely 100%. We recommend incorporating an adaptive cycling strategy for calling events. Adaptive cycling cycles the air conditioner as a percent of baseline during a hot day run-time rather than as a percent of total run-time. This helps to achieve percent run-time reductions closer to the cycling strategy, and it helps customers who may have over-sized units. Based on information from the program team, Duke Energy will implement this cycling strategy for the 2018 Conservation Period events.

Table 5-14 provides a summary of Conservation Period event impacts for DEC. Overall, DEC achieved 72% of its program-level demand response impact goal. While enrollment exceeded goals (realization rate of 129%), per unit savings for each cycling strategy fell short of expectations (realization rates of 56% for thermostats and 46% for switches). In addition, device enrollment is heavily distributed towards lower cycling strategies. The combination of lower cycling strategies and lower per device impacts drives the overall low realization rate.

Table 5-14. 2017 DEC Average Event Demand Response Load Impact Realization Rates

Device	Cycling Strategy	Participation			Gross Annual Summer Coincident kW/Unit			Gross Annual Summer Coincident Aggregate kW		
		Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR
Thermostat	30%	1,097	2,141	195%	0.927	0.740	80%	1,017	1,585	156%
	50%	658	406	62%	1.729	1.310	76%	1,138	532	47%
	75%	439	234	53%	2.876	1.371	48%	1,263	320	25%
	TOTAL	**2,194**	**2,781**	**127%**	**1.558**	**0.876**	**56%**	**3,417**	**2,438**	**71%**

[14] A *duty cycle* is the fraction of one period in which a system is active. Thus, a 75% *duty cycle means* the unit is off 75% of the time and allowed to operate 25% of the time.

Device	Cycling Strategy	Participation			Gross Annual Summer Coincident kW/Unit			Gross Annual Summer Coincident Aggregate kW		
		Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR
Switch	30%	58	143	247%	1.044	0.668	64%	61	96	158%
	50%	35	41	117%	1.776	0.872	49%	62	36	57%
	75%	23	12	54%	2.820	1.071	38%	65	13	20%
	TOTAL	**116**	**196**	**169%**	**1.617**	**0.736**	**46%**	**188**	**145**	**77%**
All Devices	**TOTAL**	**2,310**	**2,978**	**129%**				**3,605**	**2,582**	**72%**

[A] Ex Ante impact assumptions from Duke Energy. Source file: "DEC-DEP SBDREE Ex-Ante Savings - 05-10-18.xlsx" and "2017 Budget.xlsx".

Table 5-15 provides a summary of Conservation Period event impacts for DEP. Overall, DEP achieved 70% of its demand response impact goal. As with DEC, enrollment exceeded goals (realization rate of 127%), but per participant impacts were lower than expected for each cycling strategy (realization rates of 56% for thermostats and 47% for switches) and enrollment was heavily distributed towards lower cycling strategies. The combination of lower cycling strategies and lower per device impacts results in the lower realization rate.

Table 5-15. 2017 DEP Average Event Demand Response Load Impact Realization Rates

Device	Cycling Strategy	Participation			Gross Annual Summer Coincident kW/Unit			Gross Annual Summer Coincident Aggregate kW		
		Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR	Ex Ante[A]	Ex Post	RR
Thermostat	30%	672	1,020	152%	0.857	0.636	74%	576	649	113%
	50%	403	413	102%	1.600	0.939	59%	645	388	60%
	75%	269	223	83%	2.661	1.300	49%	716	290	41%
	TOTAL	**1,344**	**1,656**	**123%**	**1.441**	**0.801**	**56%**	**1,937**	**1,327**	**69%**
Switch	30%	35	99	283%	0.904	0.550	61%	32	54	172%
	50%	21	32	152%	1.537	0.814	53%	32	26	81%
	75%	14	12	89%	2.442	1.079	44%	34	13	39%
	TOTAL	**70**	**143**	**205%**	**1.402**	**0.655**	**47%**	**98**	**94**	**96%**
All Devices	**TOTAL**	**1,414**	**1,800**	**127%**				**2,035**	**1,421**	**70%**

[A] Ex Ante impact assumptions from Duke Energy. Source file: "DEC-DEP SBDREE Ex-Ante Savings - 05-10-18.xlsx" and "2017 Budget.xlsx".

When looking across both jurisdictions, enrollment exceeded goals, but was heavily distributed towards lower cycling strategies (Table 5-3). Per device load impacts were lower than anticipated across jurisdictions (56% for DEC and 55% for DEP) and cycling strategies (Table 5-14 and Table 5-15). Both utilities underachieved overall total summer coincident demand savings goals (72% for DEC and 70% for DEP); however, DEC had higher average per-event load impacts than DEP, perhaps driven by higher reference loads in the DEC jurisdiction. Conversely, DEP had a larger share of its enrollments on more aggressive cycling strategies than DEC.

Table 5-16. Summary of 2017 DEC and DEP *Ex Post* Average Event Demand Response Load Impacts

Metric	2017 Ex Ante		2017 Ex Post		Realization Rate	
	DEC	DEP	DEC	DEP	DEC	DEP
Participation (devices)	2,310	1,414	2,978	1,800	129%	127%
Per Device Weighted Average Summer Coincident Savings (kW)	1.56	1.44	0.87	0.79	56%	55%
Total Summer Coincident Demand Savings (kW)	**3,605**	**2,035**	**2,582**	**1,421**	**72%**	**70%**

5.3 Net Energy Savings Impact Analysis

5.3.1 Methodology

Opinion Dynamics conducted a series of analytical steps to estimate net energy efficiency savings attributable to thermostats installed in 2017. These steps included:

- Cleaned and prepared data, including review of program participation data to identify the number of premises with enrolled and installed thermostats in 2017;
- Modeled program impacts by conducting a consumption analysis, using a linear fixed effects regression model with a comparison group matched on pre-period energy consumption to estimate premise-level energy efficiency savings;
- Conducted a cross-participation analysis to understand the savings that EWB participants achieved from participation in other Duke Energy programs and account for them in consumption analysis at the premise-level; and
- Calculated total net energy savings by adjusting the average per-premise energy savings for cross-participation and multiplying per-premise savings by the number of premises with a thermostat enrolled in 2017. We then calculated per-device impacts by applying the average number of devices installed per-premise to calculate a realization rate against per-device ex ante goals.

Clean and Prepare Data

We excluded customer accounts from our energy efficiency impact models for the following reasons:

- Switch customers (ineligible for energy efficiency impacts);
- Extremely high (greater than 50,000 kWh/month) or low (less than 500 kWh/month) average daily consumption (10 customers were removed); and
- Inadequate billing history before or after program participation (1,017 customers were removed).

As a result of this data cleaning, we dropped 1,027 of 2,903 premises from the consumption analysis. The primary driver for the removal of these premises was insufficient post-period data, which was a limitation due to the timing of the evaluation rather than any problem inherent in the data. A review of consumption data indicated that customers excluded from the analysis had similar pre-period energy consumption as those included in the analysis. It should also be noted that we applied the estimated savings to all eligible participants, regardless of their inclusion in the model.

Model Program Impacts

Prior to conducting the consumption analysis, Opinion Dynamics created a matched comparison group. Utilizing a comparison group allows us to establish a counterfactual, i.e., the baseline energy that participants likely would have used in the absence of the program. Matched comparison groups consist of non-participants who have similar known traits to participants. We matched participants with non-participants in terms of business type (based on a combination of SIC codes) and monthly energy usage. Within business type, the five non-participants with the closest monthly energy usage to a participant were included in the comparison group.

A consumption analysis with a comparison group inherently provides net impacts. Because the comparison group represents energy use in the absence of the program, results from the consumption analysis are net results, and application of a net-to-gross ratio (NTGR) is unnecessary. Participant spillover, where the participant takes additional non-program energy-saving actions attributable to the program, is directly captured in the consumption analysis results. However, results from the consumption analysis also reflect savings from participation in other Duke Energy programs. As a result, consumption analysis results need to be adjusted for such cross-participation (see next subsection).

The consumption analysis employed a LFER model, which accounted for factors that are not expected to vary over time via the constant terms of the equation, such as square footage. This model also accounts for differences in weather and pre-program energy use between participants. To improve our estimate of what participants' usage would have been absent the program, we added dummy variables for each of the 12 months of the year.[15] Including these variables in the model helped control for monthly trends such as seasonal effects and allowed for a more accurate estimate of pre- and post-program usage. The model included weather terms as well as interaction terms between weather and the post-participation period for the treatment group to account for differences in weather patterns across years. We also included interaction terms to control for any differences in baseline usage between the treatment and comparison groups.

We included 2016 participants in the models to increase the robustness of our model results but did not apply the resulting estimated per-participant savings to 2016 participants when calculating 2017 impacts. We included 2016 participants in the model because many of the 2017 participants enrolled towards the latter half of 2017, resulting in an insufficient sample of 2017 participants with the required months of post-installation energy consumption data. We selected this approach after discussing program design and implementation with program staff, who indicated that there were few changes to implementation across the two program years, suggesting that per unit energy savings would likely be similar. In addition, we confirmed that 2016 and 2017 participants had very similar pre-participation energy usage and HVAC tonnage. A more detailed discussion of the consumption analysis methodology, including data cleaning steps, a comparison group assessment, and the final model, is provided in Volume II.

Apply Cross-Participation Analysis

The consumption analysis not only reflects EWB program savings but also savings from participation in other Duke Energy programs. As a result, the consumption analysis has the potential for overestimating energy savings (if EWB participants have higher cross-participation savings than the comparison group) or

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[15] Dummy variables are binary terms for each month, with "1" signifying that the bill occurred in that month.

underestimating energy savings (if the comparison group has higher cross-participation savings than participants). We conducted a cross-participation analysis for participants and the comparison group to identify and correct for this. To do so, we identified measures that participants and the comparison group customers installed through the Non-Residential Prescriptive and SBES Programs, and their savings, during the post-participation period.[16] Savings reflect pro-rated net ex post impacts based on the date of installation. Once identified, we removed the difference between cross-participation savings of the comparison group and of the EWB participants. This accounts for the fact that the consumption analysis already nets out equal cross-participation savings for the comparison group and EWB participants.

It should be noted that program staff made implementation changes between 2016 and 2017 and discontinued the specific targeting of SBES participants for recruitment into EWB. This change improved cross-participation rates for 2017 EWB participants when compared to 2016 EWB participants.

Calculate Total Energy Savings

Energy efficiency impact estimates reflect changes in energy consumption at a premise level (i.e., billing data is at a premise level). Calculating total energy savings entails multiplying the per-premise savings by the number of thermostats installed between January 1 and December 31, 2017, including deactivated devices.[17] To calculate program realization rates relative to Duke Energy's ex ante assumptions, we converted premise-level energy efficiency savings to the thermostat level by identifying the average number of devices per premise (Table 5-17).

Table 5-17. 2017 EWB Thermostat Enrollments, Premises and Average Devices Per Premise

Jurisdiction	Number of Thermostats Installed in 2017	Number of Premises	Average Number of Devices per Premise
DEC	4,490	2,577	1.7
DEP	1,719	879	2.0
Total	**6,209**	**3,456**	**1.8**

Note: Device counts reflect all devices enrolled in January 2017-December 2017, including devices deactivated in 2017.

5.3.2 Results

Table 5-18 provides a summary of the daily and annual energy savings results by jurisdiction, before accounting for cross-participation. We identified substantial variation in energy efficiency savings between DEC and DEP, with DEC participants saving more than twice (5 kWh per day and over 3% of baseline usage) what DEP participants saved (2 kWh per day and less than 1.5% of baseline usage).

[16] We matched EWB participants to other program-tracking data by account and service point ID.

[17] The consumption analysis credits energy efficiency savings for each participant until the date of deactivation.

Table 5-18. 2017 EWB *Ex Post* Daily and Annual Energy Efficiency Savings

Jurisdiction	Daily Energy Savings Estimate (kWh/Day)			Annual Energy Savings Estimate (kWh/Year)	
	Daily Estimate	Baseline Usage	Percent Savings	Per Premise	Per Thermostat[A]
DEC	5.06	155	3.29%	1,847	1,060
DEP	2.11	145	1.44%	771	394

[A] Converted to thermostat level by applying average number of devices/premise. Results are not adjusted for cross-participation analysis findings.

We have used our knowledge of the program, participants, and similar programs to make conjectures for factors that might explain the differences in energy efficiency between jurisdictions, however, due to the nature of billing analyses results, it is not possible to determine which of these factors is causally related to the savings difference nor how to attribute the quantity of savings differences to each factor. We offer the following series of checks we conducted to identify what may be driving lower energy savings in the DEP territory versus DEC territory.

According to program staff, program design and implementation is relatively consistent across both territories, including the type of facilities targeted and enrolled in the program. Our analysis found the following differences in characteristics between DEC and DEP participants:

- DEP participants tend to have lower annual average baseline usage, compared to DEC participants.
- DEP participants have slightly lower average tonnage in terms of the HVAC units being controlled.
- DEP participants have slightly more thermostats per premise than DEC participants.
- During the cooling season (May through September), DEC participants tend to use their program-controlled air conditioning units slightly more than DEP participants (expressed as runtime percentage).

Individually, these differences between DEC and DEP participants are small and unlikely to fully account for the observed differences in savings. However, all differences directionally support lower savings for DEP participants. Table 5-19 summarizes these participant characteristics.

Table 5-19. Comparison of DEC and DEP Participant Characteristics

Characteristics	DEC	DEP
Average Daily Baseline Usage	155	145
Average AC Size (Tons)	4.35	4.01
Average Cooling Season Run-time	28.7%	27.5%
Average Number of Thermostats per Premise	1.74	1.96

Other factors, such as customer behavior may play a role, e.g., engagement with their thermostat. Survey results suggest that DEP participants may change their set points or use the web portal more frequently than DEC customers. Additionally, the energy-saving benefits of the Wi-Fi-enabled thermostat are largely a function of how customers were using their existing (baseline) thermostat. Other customer behaviors not observable in this evaluation, such as those linked to business types and thermostat set-points, may further drive savings differentials. Future research efforts should assess whether there are differences in enrollment by SIC code that are correlated with lower energy savings impacts and investigate non-event day customer set points.

The cross-participation analysis results call for removing a substantial portion of energy savings from the consumption analysis results (Table 5-20). Approximately 18% of EWB participants also participated in other Duke Energy programs in 2016 and 2017, while 7% of matched comparison group non-participants participated in other Duke Energy programs. The majority of cross-program participation was in the Non-Residential Prescriptive Program, which also contributed the largest share of savings adjustments (60% compared to 40% from SBES). These rates were consistent across jurisdictions.

Table 5-20. Thermostat-Level Cross-Participation Analysis Results

Jurisdiction	(A) Consumption Analysis Savings (kWh)	Pro-Rated Cross-Participation Savings (kWh)			(E) Adjusted Energy Savings (kWh) (A-D)
		(B) EWB Participant	(C) Matched Comparison Group	(D) Difference Between EWB Participant and Matched Comparison Group (B-C)	
DEC	1,060	937	388	549	511
DEP	394	503	128	376	18

Table 5-21 shows the per-thermostat and program-level savings for the program in each jurisdiction. DEC participants saved 2,296 MWh and DEP participants saved 31.7 MWh annually.

Table 5-21. 2017 *Ex Post* Annual EWB Energy Efficiency Savings

	Consumption Analysis Savings (kWh)	Cross Participation Deduction (kWh)	Adjusted Energy Savings (kWh)
DEC			
Thermostat Level	1,060	-549	511
Program Level	4,759,461	-2,463,014	2,296,448
DEP			
Thermostat Level	394	-376	18
Program Level	677,283	-645,546	31,737

Table 5-22 provides the energy efficiency savings realization rate for 2017. Overall, we found that the program overachieved thermostat installation goals across both jurisdictions (realization rates of 256% for DEC and 160% for DEP). However, per device energy savings were lower than expected across jurisdictions (realization rates of 80% for DEC and 3% for DEP), which was largely driven by cross-participation. The resulting overall realization rate is 204% for DEC and 5% for DEP. It should be noted that Duke Energy added an “auto-EE” functionality to their customer portal in 2018. This feature assesses the building’s thermodynamics and auto-adjusts the set points when the facility is closed to generate additional energy savings. These changes could potentially increase the overall energy efficiency savings from the thermostats in future program years.

Table 5-22. Summary of 2017 DEC and DEP *Ex Post* Energy Efficiency Impacts

Metric	2017 Ex Ante		2017 Ex Post		Realization Rate	
	DEC	DEP	DEC	DEP	DEC	DEP
Participation (thermostats)	1,755	1,076	4,490	1,719	256%	160%
Per Participant Average Annual kWh	641	562	511	18	80%	3%
Total Energy Savings (kWh)	**1,124,522**	**605,111**	**2,296,448**	**31,737**	**204%**	**5%**

Note: Averages may not compute correctly due to independent rounding.

6. Process Evaluation

6.1 Methodology

The process assessment leveraged the following data collection methods and research activities:

- Program staff interviews (n=7)
- Materials review
- Program-tracking data analysis
- Early participant interviews (n=10)
- Participant survey (n=242)
- Non-participant interviews (n=10)
- Unenrolled participant interviews (n=10)

We provide a detailed overview of these data collection method and research activities in Section 4.

6.2 Findings

This section provides detailed findings from the EWB process evaluation, starting with the experiences of participants, followed by non-participants and then unenrolled participants. Throughout this section, we include feedback from the program staff interviews to help provide context or explain results, where applicable.

6.2.1 Participant Experiences

This section details participants' experiences with the EWB program. These results draw primarily from the participant survey, with findings from the early participant interviews provided where these results can help complement the survey results. The evaluation team assessed differences in participant survey results based on jurisdiction and the and cycling level chosen by customers.[18]

This section starts by providing context about who survey respondents were, then summarizes participant satisfaction with the program. We then detail the various aspects of program participation, starting with motivations for participation and the enrollment and installation processes, followed by thermostat and portal usage and conservation period experiences.

[18] The evaluation team investigated assessing differences between participants recruited by Threshold Marketing and Lime Energy but was not able to do so as the sample frame only included six participants recruited by Lime Energy, and only one of these six participants completed the survey.

Participant Survey Respondent Firmographics

To provide early process feedback, the participant survey was fielded in September 2017. As a result, the survey sample frame included 2017 program participants enrolled at the time of the data request, in August 2017. A comparison of DEC and DEP participants showed similarities in terms of many elements of program enrollment. However, DEC participants more often chose the lowest (30%) cycling level (86% DEC vs. 56% DEP)[19] and less often installed multiple devices in their businesses (37% DEC vs. 43% DEP).[20] Because there were no other differences in how the program was implemented in each jurisdiction, these differences in participant characteristics across the two jurisdictions likely account for some of the variation in survey responses between the two groups, as survey participants closely mirror the population for both jurisdictions.

Table 6-1. Participant Enrollment Characteristics

Characteristic	DEC		DEP	
	Survey Respondents (n=180)	Population (n=2,699)	Survey Respondents (n=62)	Population (n=943)
Cycling Level				
30%	77%	86%	42%	56%
50%	15%	10%	31%	22%
75%	8%	4%	27%	22%
Enrollment in Summer and Winter Events				
Summer Only	95%	93%	95%	96%
Summer & Winter	5%	7%	5%	4%
Number of Devices Across All Locations				
One	60%	63%	45%	57%
Two or more	40%	37%	55%	43%
Device Type				
Thermostat	96%	92%	95%	90%
Switch	3%	7%	3%	10%
Both	1%	1%	2%	1%
Recruited by Lime Energy or Threshold Marketing				
Yes	84%	89%	85%	85%
No	16%	11%	15%	15%

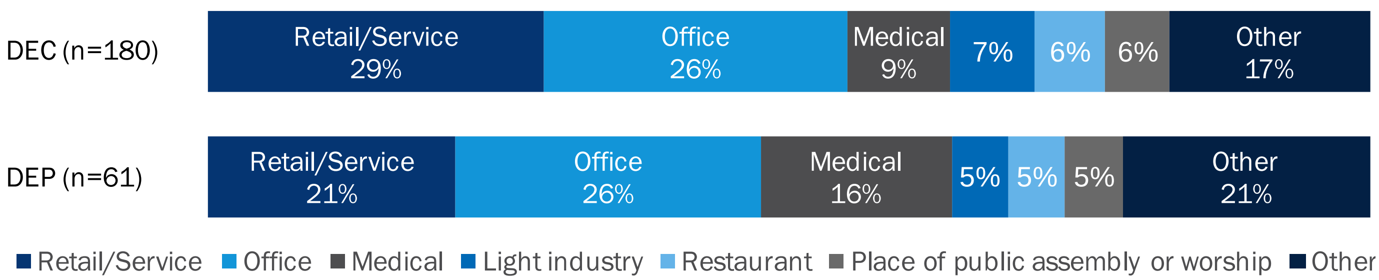
Note: The sample frame includes all 2017 participants enrolled when data was requested for the survey in August 2017, with customers who participated at multiple locations de-duped to one observation. The population data include all 2017 participants enrolled through December 2017.

[19] During conversations with program staff, the evaluation team learned that the activities of one canvasser may be responsible for most of the disparity between cycling levels in the two jurisdictions. A single canvasser for DEC was responsible for approximately 30% of all new participant registrations during the 2017 program year. The canvasser registered most or all of their new participants at the 30 percent cycling level, and thus, skewed all DEC participants towards a 30 percent cycling level.

[20] By the end of the evaluated period, DEC and DEP participants showed increasingly similar rates of multiple-device installations.

Business types of survey respondents are similar across the two jurisdictions, with most being retail/service, office, or medical businesses (see Figure 6-1).

Figure 6-1. Participant Survey Respondent Business Type

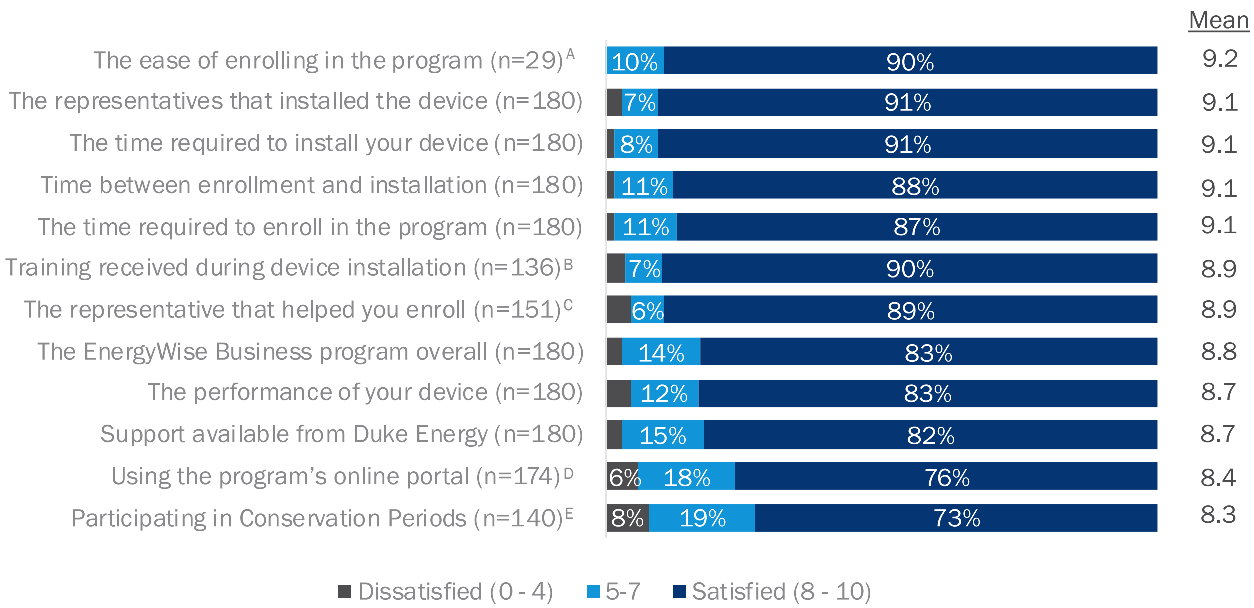


Participant Satisfaction

Overall, participants report high satisfaction with program elements. In general, participants are highly satisfied with the program enrollment and installation processes, the performance of their thermostat or switch, and the Duke Energy and implementation vendor staff. While still generally satisfied, average satisfaction is lower for the program portal and the Conservation Period events, as quantified for each jurisdiction below and detailed throughout the remainder of the participant survey results section.

DEC participants highly rate their satisfaction with their enrollment experiences, whether they enrolled on their own or through a canvasser. DEC participants highly rate their satisfaction with the ease of program enrollment when enrolling on their own (mean of 9.2, see Figure 6-2). On average, DEC participants provide the same high rating for their satisfaction with the representatives who installed the device, the time required to install the device, the time between enrollment and installation, and the time required to enroll in the program (mean of 9.1). Program data suggests that the average time between enrollment and installation is 26.1 days, and typically it takes longer in DEP territory and for switches. DEC participants report lower satisfaction with participation in Conservation Periods (mean of 8.3) and with their use of the program's online portal (mean of 8.4).

Figure 6-2. DEC Participant Satisfaction

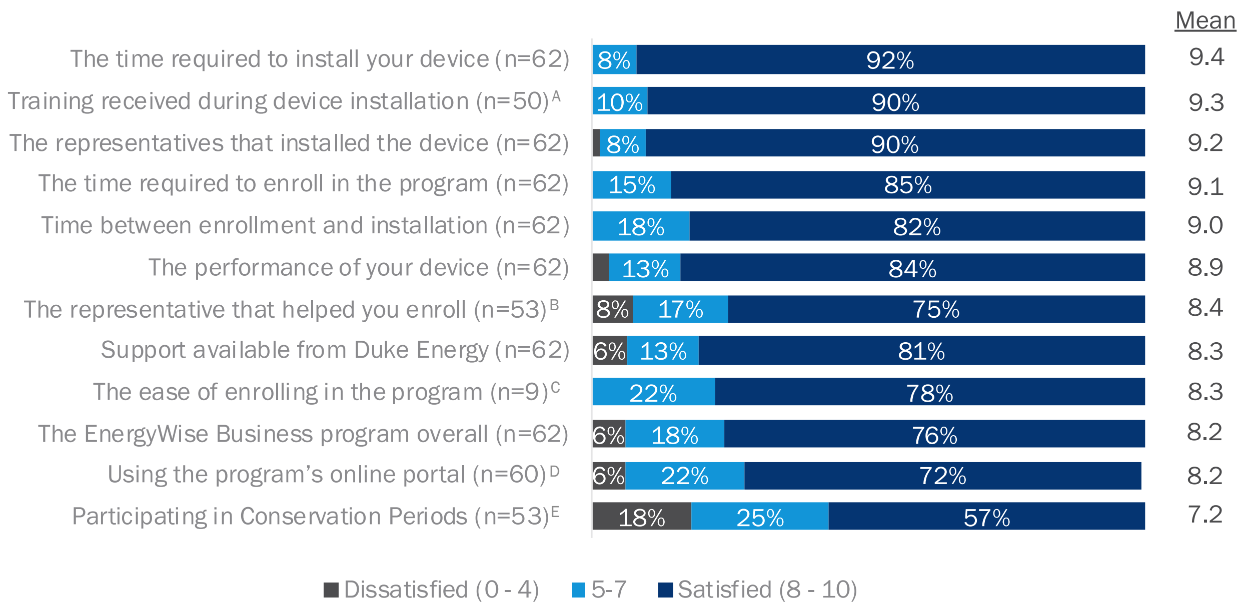


A: Only includes customers not recruited by canvassers.
B: Only includes customers present during installation.
C: Only includes customers recruited by canvassers.
D: Only includes customers receiving at least one thermostat.
E: Only includes customers recalling participation in any Conservation Period.

DEP participants most highly rate satisfaction with the time required to install their device (mean of 9.4, see Figure 6-3), the training received during installation if they were present for it (mean of 9.3), and the representative that installed their device (mean of 9.2). Like DEC participants, DEP participants report lower satisfaction with participation in Conservation Periods (mean of 7.2) and with their use of the program's online portal (mean of 8.2). Though DEP participants highly rate satisfaction with most program elements, DEP participants are significantly less satisfied with the program overall than DEC participants and report they are less likely to continue to participate in the program.[21]

[21] The evaluation team explored the relationship between cycling level differences between the two jurisdictions and their satisfaction with the program overall. Though sample sizes are too small to produce significant results, DEP customers still report lower satisfaction with the program than DEC participants after controlling for differences in cycling levels.

Figure 6-3. DEP Participant Satisfaction



A: Only includes customers present during installation.
B: Only includes customers recruited by canvassers.
C: Only includes customers not recruited by canvassers.
D: Only includes customers receiving at least one thermostat.
E: Only includes customers recalling participation in any Conservation Period.

One noteworthy finding is the high satisfaction with the time between enrollment and equipment installation for both DEC and DEP participants. After Threshold Marketing was brought on board and the program enrollment rate increased, the time between enrollment and installation increased until Itron could hire more installers. For that period, the wait between program enrollment and thermostat installation increased to two to three months, exceeding the target of four weeks. Based on the results above, this lag does not seem to have impacted participants' satisfaction with the program.[22]

Participant survey findings reflect similar sentiments from early participant interviews. Like most participants, early participants highly rate their satisfaction with the program overall (mean of 9.2) and with the Wi-Fi enabled thermostat they received from the program (mean of 9.3). During one interview, an early participant mentioned that "everybody [associated with Duke Energy] was polite and easy to get along with."

Motivations for Participation

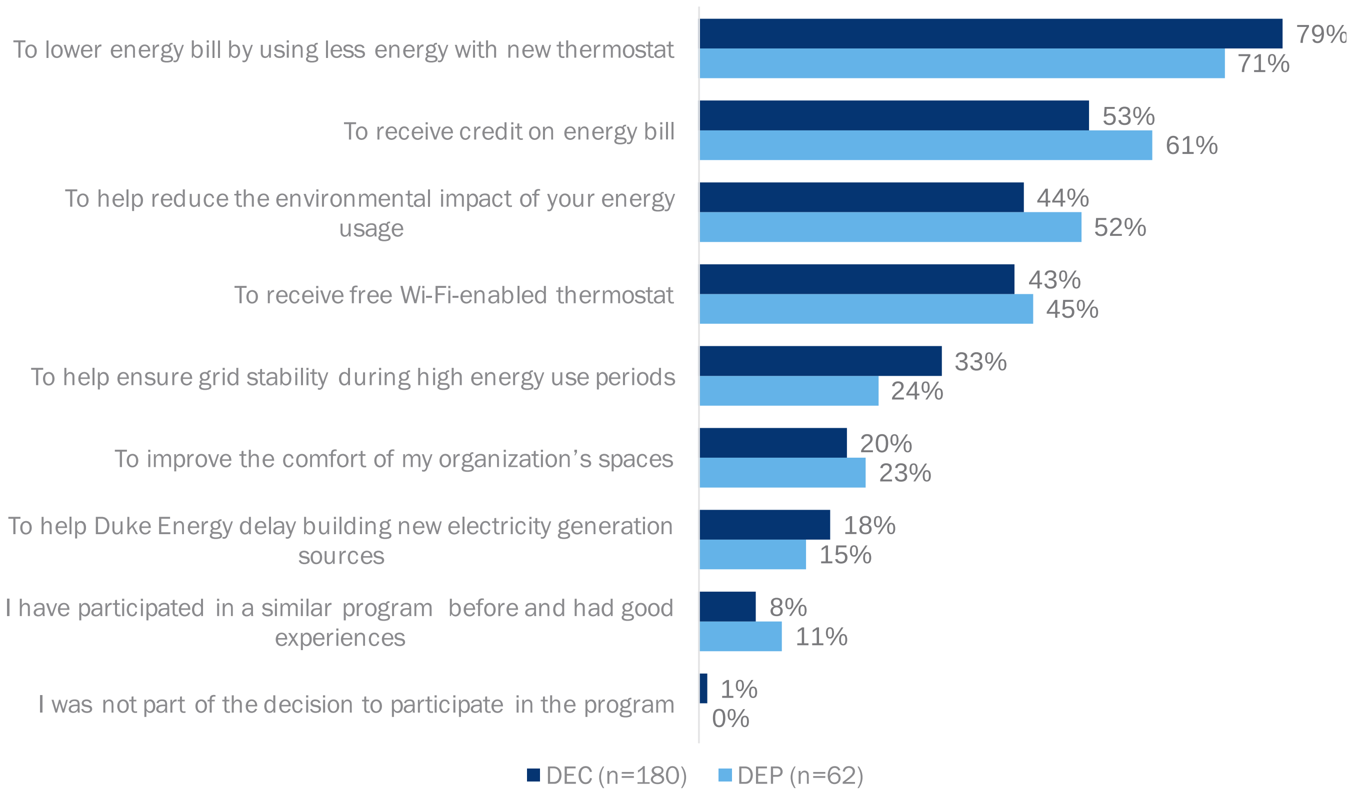
When asked about customers' reasons for participating in the program, Threshold Marketing managers reported that customers enroll for the free thermostat installation and energy savings. Their canvassers tell

[22] The evaluation team tested the correlation between the days from enrollment to installation and customer satisfaction and found no meaningful correlation.

customers they can expect five percent savings with the new thermostat and find that business owners are especially interested in the benefits of being able to remotely track and control their thermostat(s). The Threshold Marketing program managers reported typically using the energy savings and benefits of the free thermostat first to get customers interested, and then explaining the Conservation Periods second. Similarly, Duke Energy's program marketing collateral also leads with the benefits of the smart thermostat.

Survey respondents report a variety of motivations for participating in the program. Participants most commonly cite bill savings (79% for DEC and 71% for DEP, see Figure 6-4) and bill credits (53% for DEC and 61% for DEP) as a motivation for enrolling in the program, followed by environmental benefits (44% for DEC and 52% for DEP), and the free thermostat itself (43% for DEC and 45% for DEP).

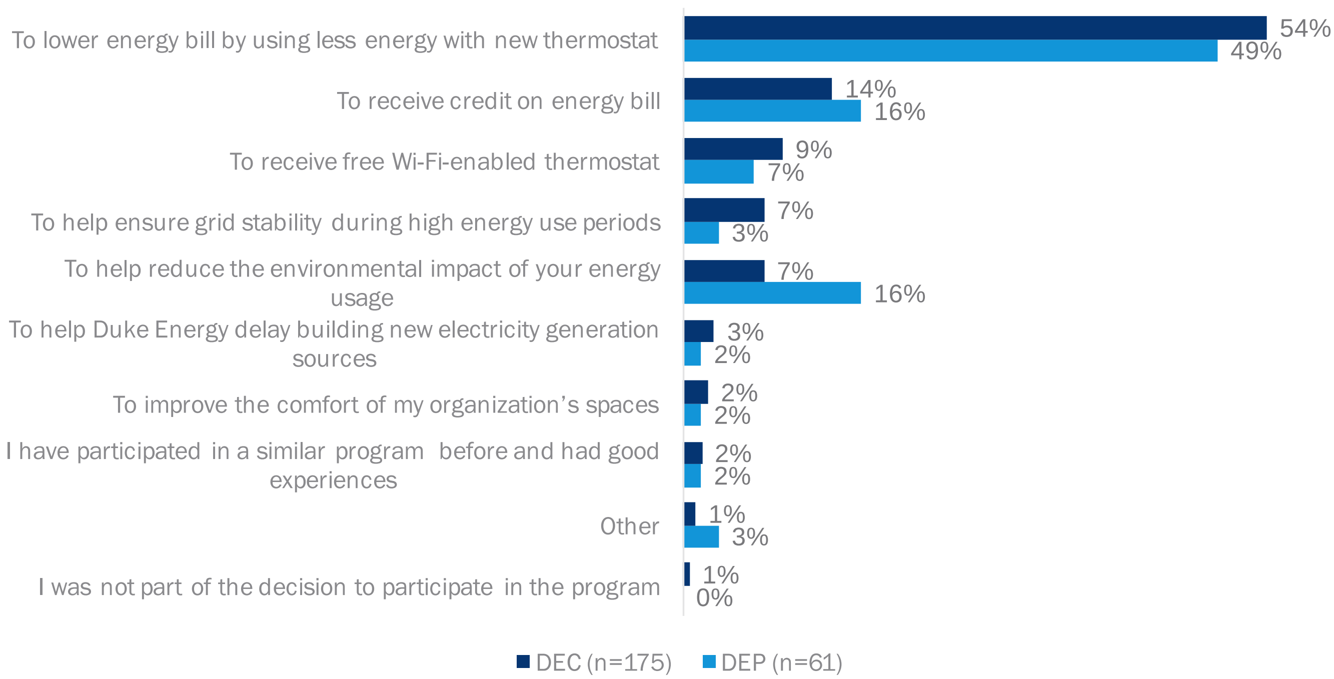
Figure 6-4. Participant Motivation for Enrollment: All Reasons



Note: Figure includes all reasons for enrolling.
This question allowed for multiple responses.

When participants were asked for the most important motivation for program participation, about half reported the most important motivation was lowering their energy bill (54% DEC, 49% DEP, see Figure 6-5), which is consistent with how the program is marketed. When comparing responses between general motivations and the primary motivation among those respondents who reported more than one motivation to participate, receiving a bill credit, reducing the environmental impact of energy usage, and receiving a free Wi-Fi-enabled thermostat appear to be secondary motivations.

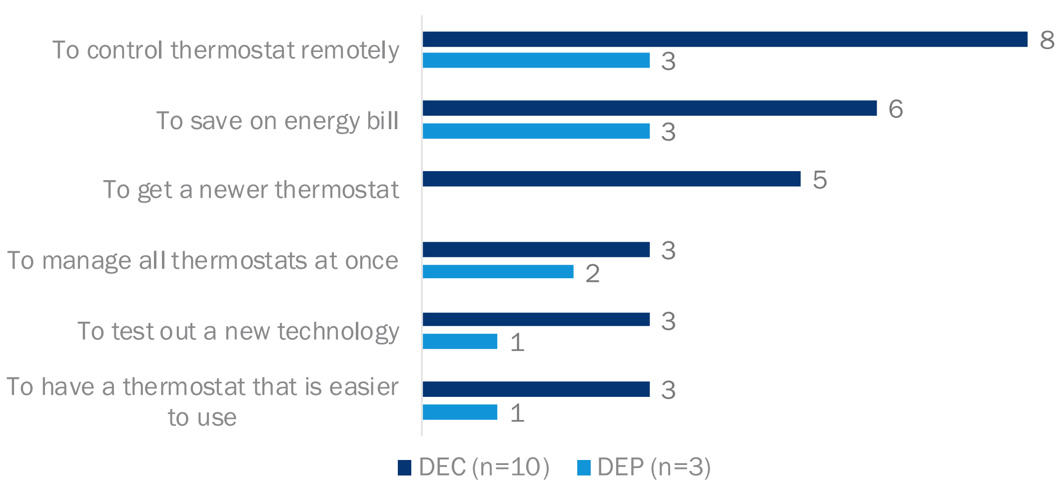
Figure 6-5. Participant Motivation for Enrollment: Primary Reason



Note: Figure includes only most important reason for enrolling.

Participants who cite receiving a free Wi-Fi-enabled thermostat as a motivation for program participation were also asked about the elements of the thermostat that were most appealing. Most cite the ability to remotely control their thermostat as an appealing element (8 of 10 DEC, 3 of 3 DEP, see Figure 6-6). Responses are similar for early program participant interviews. One early program participant interviewee additionally cites the "lockout" feature, which password protects changes to the thermostat, as the most appealing feature.

Figure 6-6. Thermostat Features Appealing to Participants



Note: Figure reports counts of participants indicating each feature was appealing, and includes all features mentioned by respondents.

Enrollment Process

Most participants were initially recruited to participate in the program by a canvasser (84% DEC, 86% DEP). Almost all participants who had been recruited by a canvasser recall the canvasser visit (97% DEC, 98% DEP) and most report that based on their conversation with the canvasser, they understood program elements very well when they enrolled.

To characterize customer understanding of specific program elements, the evaluation team first asked participants if they recalled a visit from the canvasser and then if they recalled specific pieces of information discussed by the canvasser. The responses from these two questions were then aggregated together to describe the understanding of all participants. Of the various program elements asked about in the survey, participants report having the best understanding of elements related to the thermostat, including when they could expect their device to be installed (77% DEC, 85% DEP, see Figure 6-7 and Figure 6-8) and the benefits of a Wi-Fi thermostat or switch (72% DEC, 81% DEP). Participants who did not recall discussions with the canvasser are labelled in the graph as “did not recall the discussion at all.”

Participants report lower understanding with the DR components of the program, including that Duke Energy would temporarily lower HVAC usage during Conservation Periods, the bill credits for participating in Conservation Periods, and the cycling level they could choose. While about half of participants (51% DEC, 56% DEP) understood cycling levels very well, 39% of DEC and 21% of DEP participants did not remember discussing cycling levels at all. These results are consistent with how program staff described the recruitment and enrollment process: canvassers would lead with the benefits of the thermostats to interest customers and explain the Conservation Periods second. Itron program managers also mentioned that, at the time of installation, customers were not always well-informed about the program. While it was unclear if that was because customers did not recall conversations with canvassers or if canvassers were not providing all the information, Itron did find that installers sometimes had to explain the program to customers.

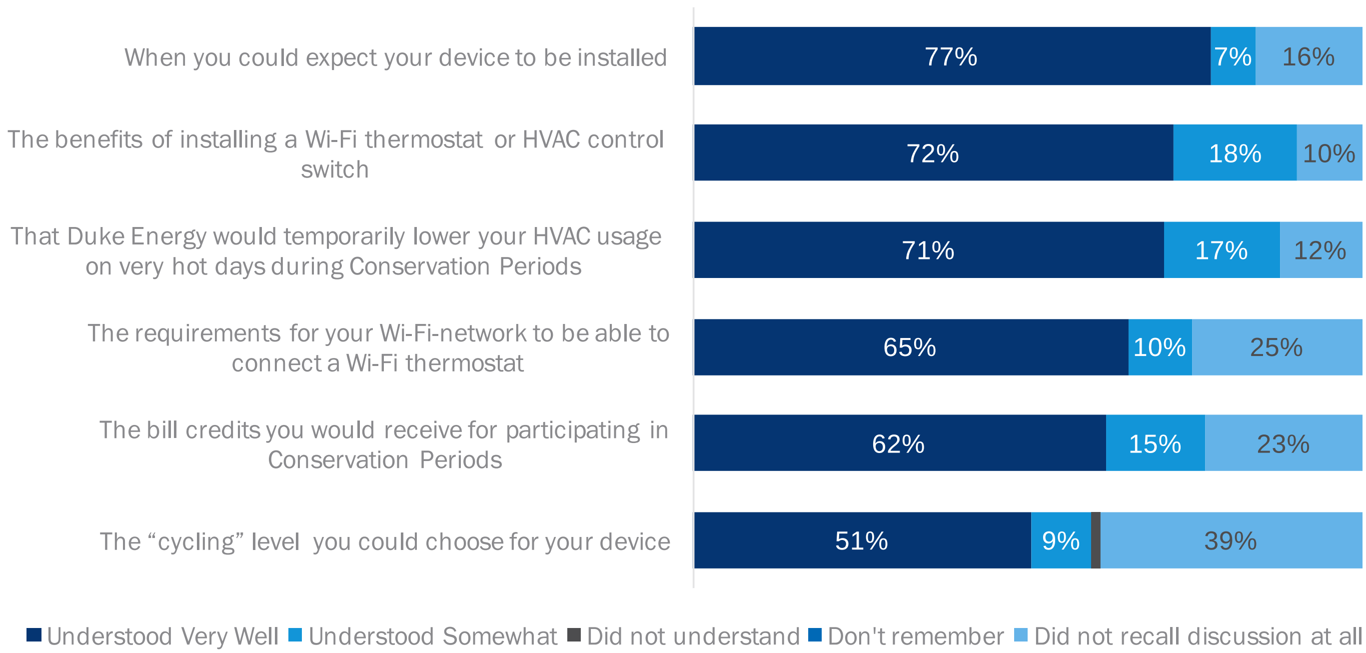
While most participants understood the Wi-Fi network requirements for the program, 25% of DEC and 13% of DEP participants do not remember discussing Wi-Fi requirements with their canvasser. Again, while it is unclear if this is related to customer recall versus what canvassers emphasized during their recruitment pitch, this finding is interesting since Wi-Fi network issues are one of the top two reasons[23] that recruited customers turn down the thermostat at installation. Threshold Marketing managers reported that canvassers do check for Wi-Fi connectivity when qualifying customers but err on the side of enrolling customers when there are doubts about their eligibility, to give the Itron installers the opportunity to make the installation happen.

More DEP participants report understanding each program element very well compared to DEC participants. The differences between the two jurisdictions are unlikely to result from differences in program design, as the programs are run virtually identically in the two jurisdictions. The differences also do not appear to result from firmographic differences between the two jurisdictions as respondents report a similar composition of business types. It is likely that the differences arise from services delivered by different implementation staff in the two jurisdictions. As the jurisdictions are serviced by different individual canvassers and different individual installers, the differences between jurisdictions may be the result of particular staff members servicing the two territories.

[23] Program staff reported that Wi-Fi issues were tied with HVAC equipment issues as the top reason for turn downs.

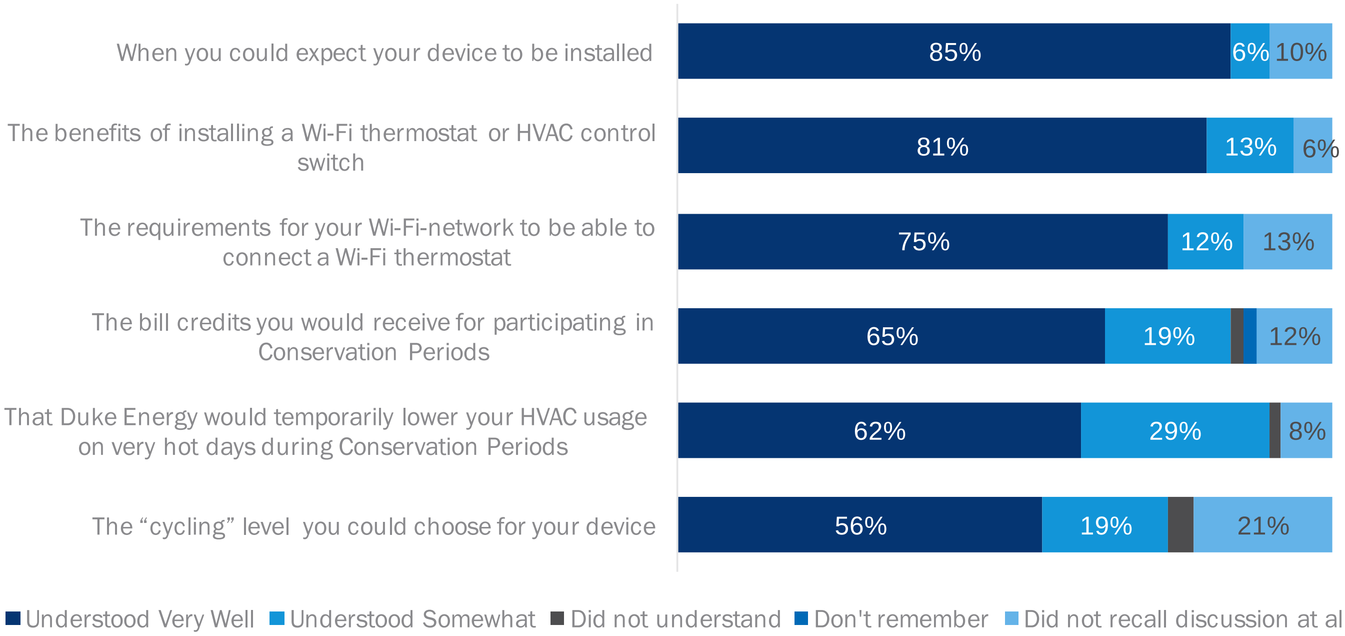
After enrolling in the program, most participants did not have any additional questions about the program (DEC 90%, DEP 82%). For those who did, questions typically related to bill credit timing and the number of demand response events Duke Energy planned to call.

Figure 6-7. Recruited Participants' Understanding of Elements: DEC (n=146)



Note: "Did not recall discussion at all" represents customers who did not recall talking about program elements with a Duke Energy representative during enrollment. "Don't remember" indicates customers who recalled talking about the element but did not remember how well they understood.

Figure 6-8. Recruited Participants' Understanding of Elements: DEP (n=52)



Note: "Did not recall discussion at all" represents customers who did not recall talking about program elements with a Duke Energy representative during enrollment. "Don't remember" indicates customers who recalled talking about the element but did not remember how well they understood.

Survey participants who were not recruited by a canvasser[24] report lower understanding of program elements before enrolling in the program than participants recruited by a canvasser. Most non-recruited participants report being unaware of the cycling level they could choose for their device (19 of 27 DEC, 6 of 9 DEP, see Figure 6-9 and Figure 6-10), when they could expect their device to be installed (18 of 29 DEC, 6 of 9 DEP), and the requirement for their Wi-Fi network to connect a Wi-Fi enabled thermostat (17 of 29 DEC, 6 of 9 DEP). The majority of DEC non-recruited participants also report being unaware that Duke Energy would call demand response events (17 of 29).

[24] The customers would have heard about the program through one of Duke Energy's other marketing channels and enrolled themselves online or by calling.

Figure 6-9. Non-Recruited Participants' Understanding of Elements: DEC (n=29)

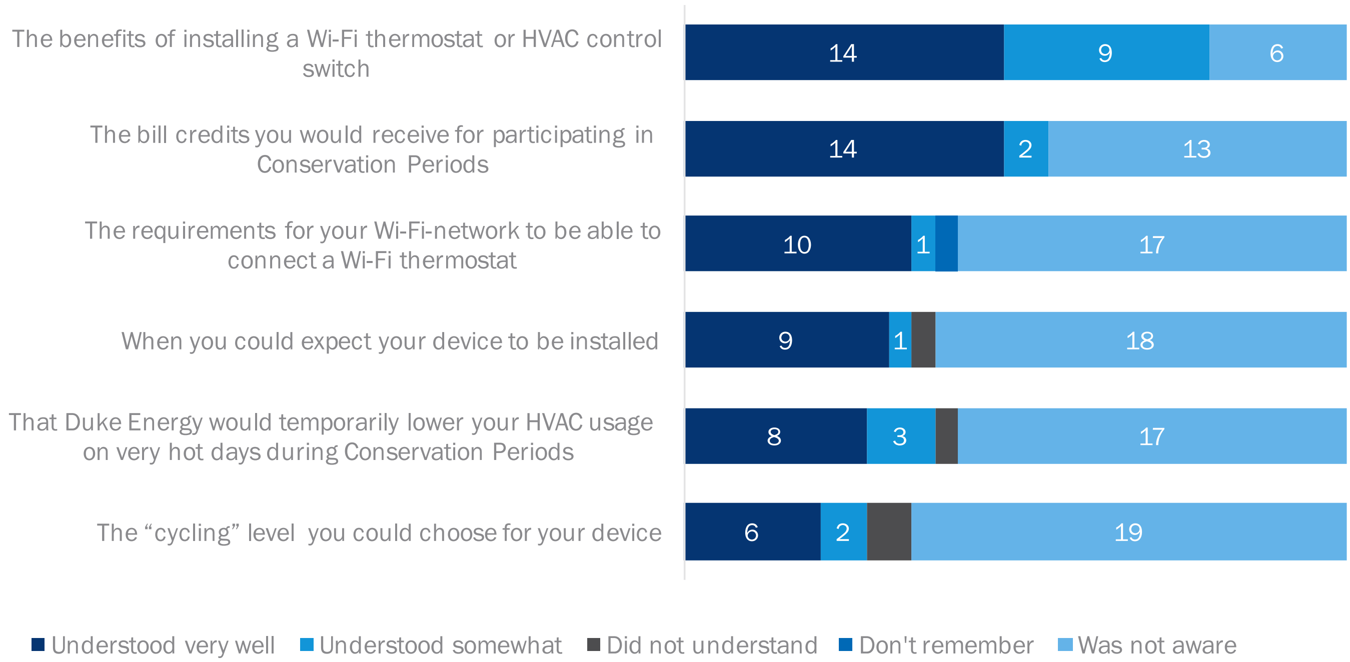
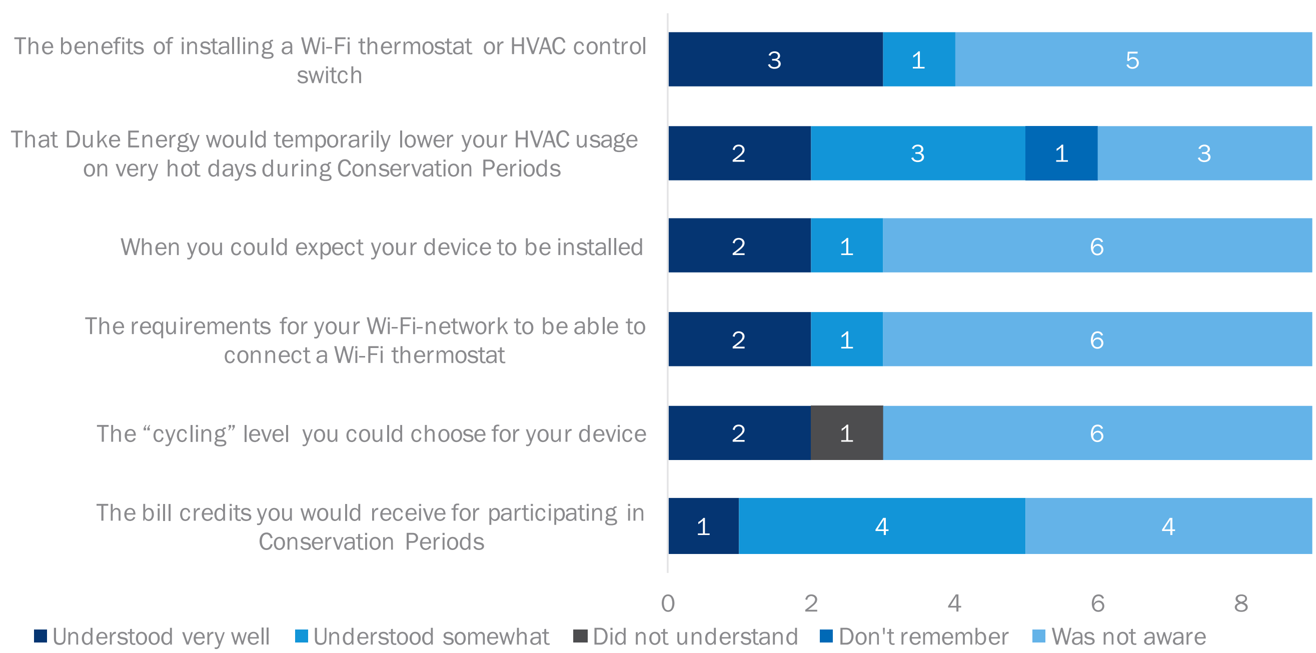


Figure 6-10. Non-Recruited Participants' Understanding of Elements: DEP (n=9)



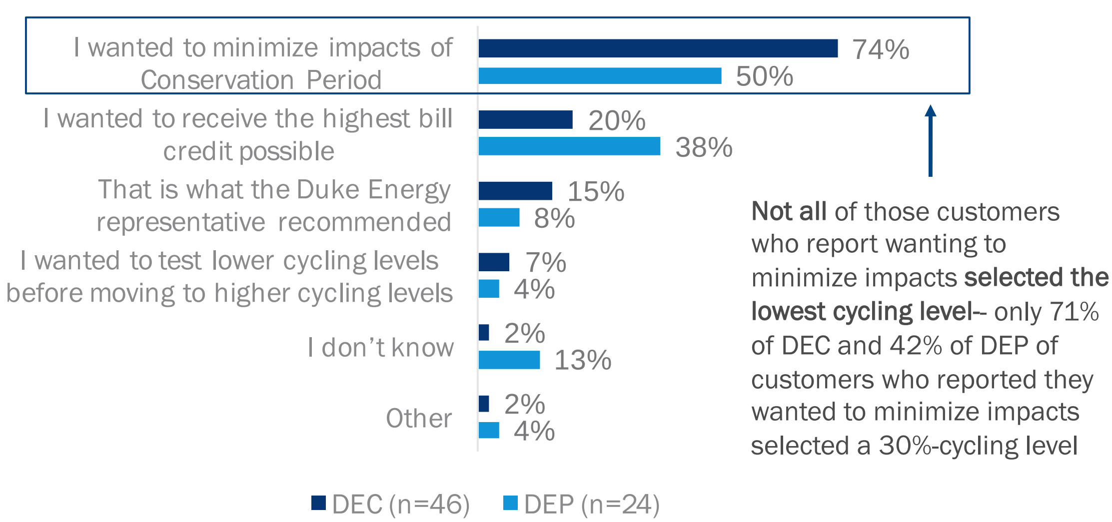
During program enrollment, customers are asked to select their cycling level. To better understand how well they understand cycling levels, participants were asked about their chosen cycling level. About half of DEC participants and almost two-thirds of DEP participants recall choosing a cycling level (52% DEC, 61% DEP, see Table 6-2). However, only about one-quarter of all participants correctly recall the cycling level they chose (22% DEC, 31% DEP). The evaluation team analyzed responses and did not find any correlation between the accuracy of cycling level recall and the cycling level the customer chose. These results further demonstrate the earlier finding that few participants understand their cycling levels; even amongst customers who remember choosing a cycling level, less than half knew what their cycling level was.

Table 6-2. Participant Recall of Cycling Levels

Recall of Cycling Level	DEC (n=180)	DEP (n=62)
Recalled correct cycling level	22%	31%
Recalled incorrect cycling level	5%	10%
Recalled choosing a level, but did not recall the level itself	25%	21%
Did not recall choosing cycling level	48%	39%

When asked their rationale for choosing their cycling level, most participants report a desire to minimize the impacts of Conservation Periods on their business (74% DEC, 50% DEP, see Figure 6-11). Surprisingly, a large portion of these participants selected a cycling level that did not align with this stated rationale. Of those who reported that they chose their cycling level to minimize the impact of Conservation Periods, only 71% (DEC) and 42% (DEP) selected the lowest (30%) cycling level. The remaining 29% of DEC and 58% of DEP participants chose a higher cycling level, meaning their selected cycling strategy would not minimize the impacts of Conversation Periods.

Figure 6-11. Participant Rationale for Choosing Cycling Level

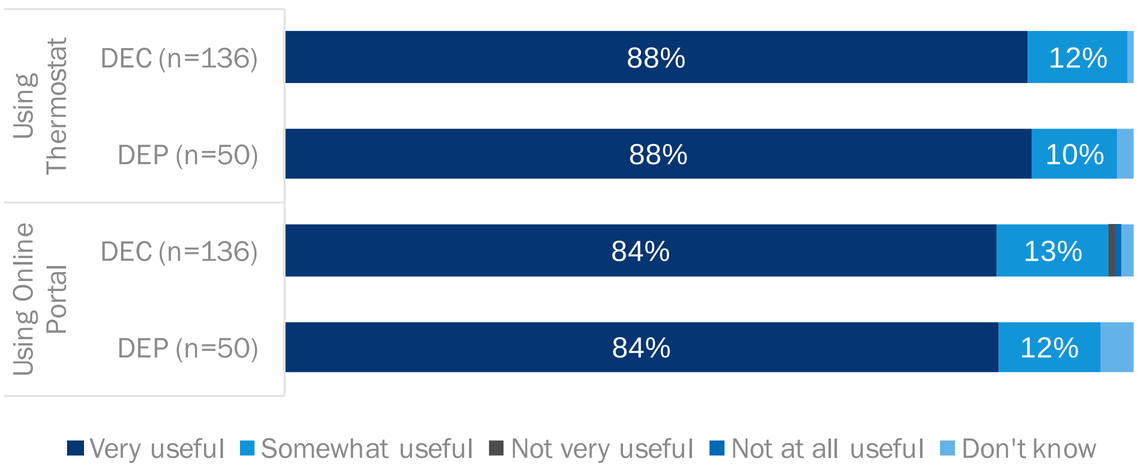


Note: Figure includes only customers who recalled their cycling level, even if recalled incorrectly.
This question allowed for multiple responses.

Installation Process

After enrolling in the program, customers schedule a time for program implementation staff to install their new equipment. During the installation, program implementation staff are tasked with conducting training regarding the thermostat itself and the online portal. Most participants in both jurisdictions report they were present during installation (82% DEC, 90% DEP). Of these, almost all recall the training administered by implementation staff (94% DEC, 93% DEP). Most participants report that both the thermostat training and portal training were very useful (88% for thermostat training and 84% for portal training, see Figure 6-12).

Figure 6-12. Participant Rating of Usefulness of Training about Using the Thermostat and the Online Portal



Note: Figure includes only customers who recalled training.

Program implementation staff are also tasked with programming new thermostats after installation. More than four-fifths of participants recall the installer programming their thermostat directly following the installation (88% DEC, 85% DEP, Table 6-3) and did not have additional questions for implementation staff. Of those whose thermostats were programmed, almost all report installers programmed their thermostat as requested (96% DEC and DEP). Of those instances where the installer did not program the thermostat, participants most often asked installers not to program the thermostat (6 of 14 DEC, 2 of 5 DEP), and only a few reported installers not offering to program their thermostats (3 of 14 DEC, 2 of 5 DEP). Very few participants have lingering questions about their thermostat (7% DEC, 6% DEP). Questions include how to set the thermostat to turn off the AC on weekends and how to switch between heating and cooling functions.

Table 6-3. Participant Recall of Representative Programming Thermostat

Representative Programmed Thermostat	DEC (n=144)	DEP (n=54)
Programmed	88%	85%
Did not program	10%	9%
Don't know	2%	6%

Note: Table includes only those customers present at time of installation.

One process-related research question for this evaluation was to understand how well Itron installers are doing in terms of enrolling customers with heat pumps into winter demand response events. Because winter DR is only applicable to customers with specific electric heating types, Duke Energy decided not to let canvassers or customers directly sign up for winter Conservation Period events. Instead, Itron installers are tasked with confirming customers' heating systems and asking eligible customers if they would like to participate in winter Conservation Period events. To assess how well that was happening, survey respondents were first asked about their heating equipment, and then, if applicable, whether they were offered winter event participation. Of survey participants who report having heat pumps, about half (45% DEC, 50% DEP, see Table 6-4) recall being offered the opportunity for winter participation, while one-third said they were not (36% DEC, 33% DEP).

Table 6-4. Participant Recall of Winter Participation Offered by Duke Energy Canvasser

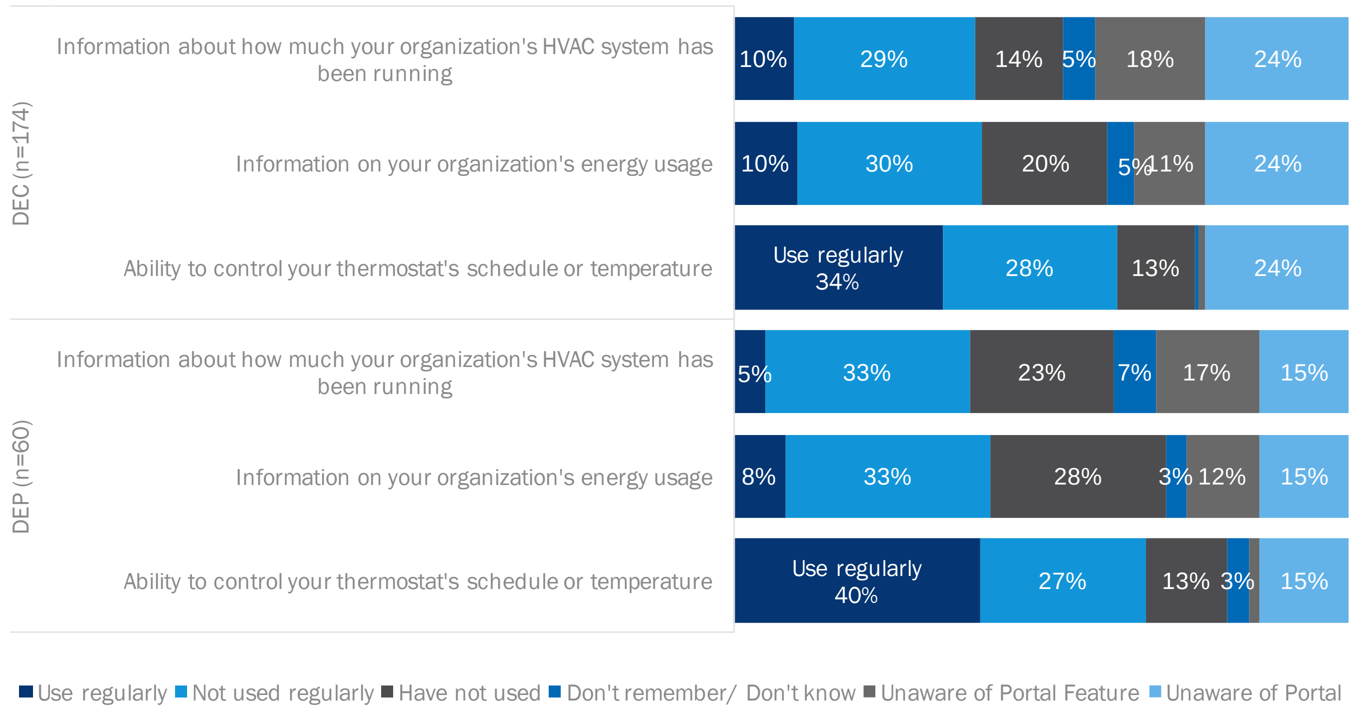
Winter Participation Offered by Duke Energy Canvasser	DEC (n=75)	DEP (n=18)
Yes	45%	50%
No	36%	33%
Don't Know	19%	17%

Note: Table includes only those customers who report having a heat pump

Portal and Thermostat Usage

Participants were also asked about their usage of the program online portal and thermostat. More than three-quarters of participants were aware of the online portal prior to completing the survey, with DEP participants reporting higher awareness (85%) than DEC participants (76%). Of those who were aware of the portal, more than one-third report using the portal to control their thermostat's temperature (34% DEC, 40% DEP, see Figure 6-13). Few report regularly viewing information about how much their HVAC system has been running (10% DEC, 5% DEP) or information on their organization's energy use (10% DEC, 8% DEP). A large portion of customers are unaware of specific portal features or unaware or the portal altogether; taken together, about one-third of DEC and DEP participants are unaware of the portal's ability to display information about how much their HVAC system has been running (42% DEC, 32% DEP) and more than one-quarter are unaware of the portal's ability to display information on their organization's energy use (35% DEC, 27% DEP).

Figure 6-13. Participant Online Portal Awareness and Usage



Participants report lower satisfaction with the portal than with any other program element with the exception of their participation in Conservation Periods. Few participants regularly use portal features, which likely drives their dissatisfaction. Though the program has a smart phone application through which participants can control their thermostats, when asked how the portal could be improved, a small percentage of participants (6%) recommend improvements such as linking the portal to a phone app. These participants may not be familiar with the program's smart phone application. Participants also mentioned portal improvements such as the ability to switch between heating and cooling on the portal (2%),[25] making the website faster (2%), and allowing control of multiple thermostats from a single page (1%).

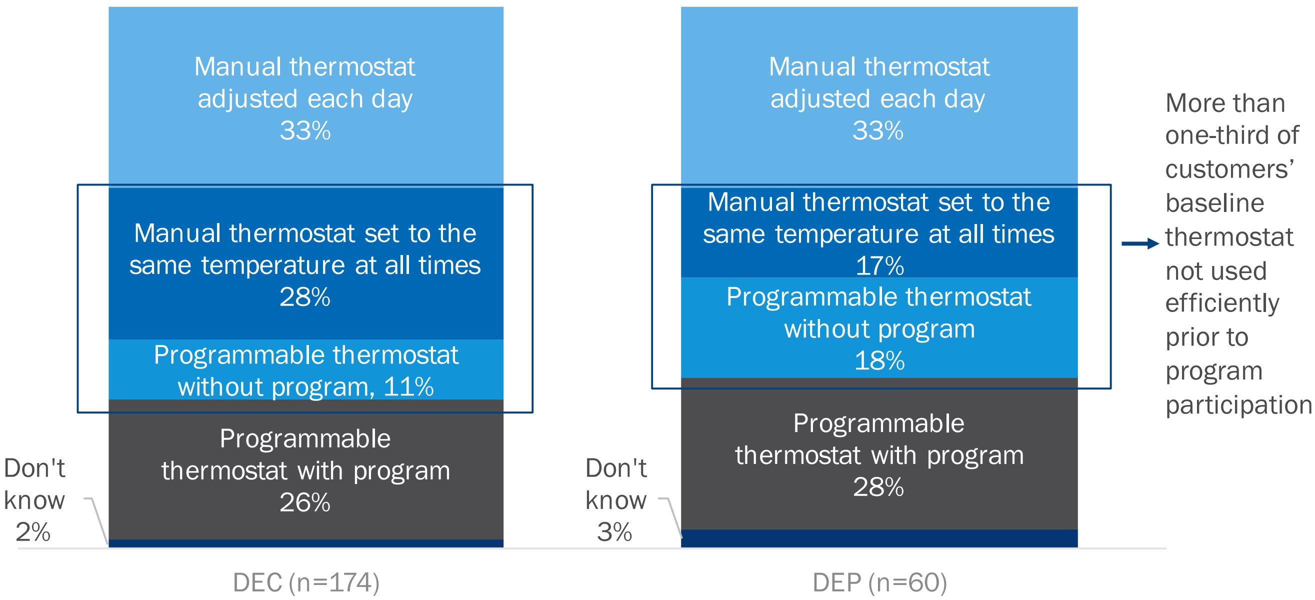
Early participants provided additional insights into the benefits of the portal. Most early participants have accessed the online portal (8 of 10) and have used the portal to control their HVAC systems over the weekend or at night (3 of 8) or to control multiple thermostats from a single page (3 of 8). One early participant who uses the portal to remotely control their AC felt the function was extremely useful, stating that "if my guys had set the air conditioning on at 70 degrees and then forgot to raise it when they went home or on a Sunday when we're closed, that was the critical thing for me." Another early participant lived far from his business and asked the interviewer to "imagine what it's like to get a call about a room being too hot and having to drive an hour to fix it." Another survey participant who controlled multiple thermostats at once commented: "[I decided to

[25] The Itron thermostat does not have the ability to automatically switch between heating and cooling.

enroll in the] program for thermostats, that it could be programmed and set to one location. 'Cause if I went out and set all 10 of them right now, just walking it, I'd have a 30 minute walk."

The energy-saving benefits of the Wi-Fi-enabled thermostat are largely a function of how customers were using their existing (baseline) thermostat. More than one-third of participants report their baseline equipment was not adjusted daily and was therefore energy inefficient (39% DEC, 35% DEP, see Figure 6-14). Conversely, a little more than one-quarter of participants report having had a programmable thermostat that was programmed with a schedule (26% DEC, 28% DEP), while one-third had been adjusting the temperature on their manual thermostat every day.

Figure 6-14. Participant Thermostat Use Before Participation



Few participants report difficulties changing the programming of their Wi-Fi-enabled thermostats. About two-thirds of participants have changed their thermostat schedule since installation (65% DEC, 68% DEP). Of those who have not changed the schedule, most have had no need to change it (77% DEC, 93% DEP). Of those who have tried to change their schedule, almost all are able to do so successfully (95% DEC and DEP). Approximately two-thirds of participants report that making changes to their thermostat was very easy (63% DEC, 59% DEP, see Table 6-5) and most of the remaining participants report it was fairly easy (36% DEC, 38% DEP).

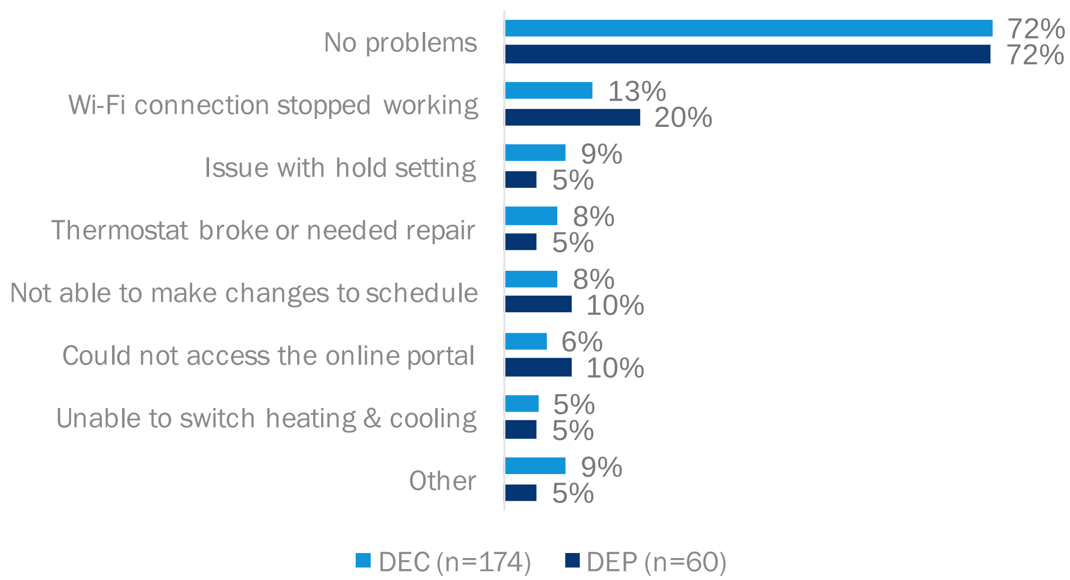
Table 6-5. Participant Thermostat Use After Participation

Difficulty of Making Changes to Thermostat	DEC (n=107)	DEP (n=39)
Very easy	63%	59%
Fairly easy	36%	38%
Somewhat difficult	2%	3%

Note: Table includes only those customers who were able to make changes to their thermostat's schedule.

Most participants have not experienced any problems with their new thermostat (72% DEC and DEP, see Figure 6-15). The most common issues reported by participants are losing the Wi-Fi connection with the thermostat (13% DEC, 20% DEP), problems with the hold setting (9% DEC, 5% DEP),[26] or that the thermostat broke or needed repairing (8% DEC, 5% DEP).

Figure 6-15. Participant Difficulty with Thermostat



Note: This question allowed for multiple responses.

Only about one-quarter of participants have contacted a program representative for any reason (19% DEC, 29% DEP). Of these, most were able to contact the appropriate support staff member (94% DEC and DEP) and most were able to resolve their issue (77% DEC, 83% DEP). Survey participants generally called about lost Wi-Fi signals (6 of 35 DEC, 6 of 18 DEP), event opt-outs (4 of 34 DEC, 1 of 18 DEP), and hold issues (3 of 35 DEC). After talking with a program representative, most were able to resolve their issue (77% DEC, 83% DEP).

Summer Conservation Period Experiences

Nearly all participants recall participating in a summer Conservation Period event (89% DEC, 91% DEP). As noted above, participants rate their satisfaction with participation in these Conservation Periods lower than any other program element. Of those recalling Conservation Period events, almost all recall receiving some type of notification prior to the event (94% DEC, 96% DEP). Most participants recall receiving an email notification (82% DEC, 74% DEP, see Figure 6-16) and few recall notifications through the program's online portal (5% DEC, 7% DEP) or receiving a notification by the alert light on their thermostat (4% DEC, 10% DEP). Responses to the participant survey stand in contrast to responses from customers who unenrolled in the program, as described later in this section. Less than half of unenrolled customers (4 of 10) recall receiving advanced notification of a Conservation Period event.

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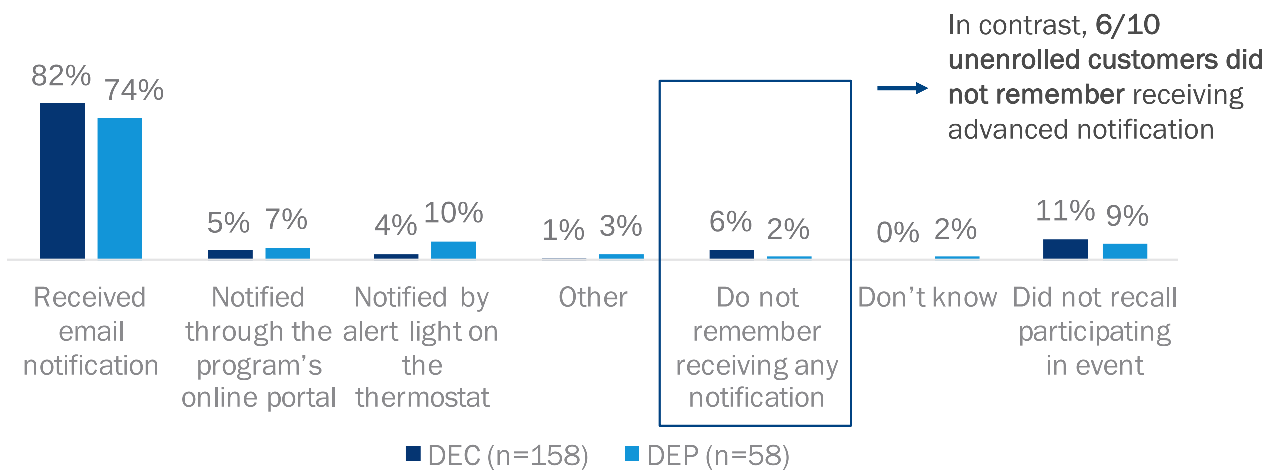
[26] The hold function allows the user to override the pre-set temperature and thermostat setting.

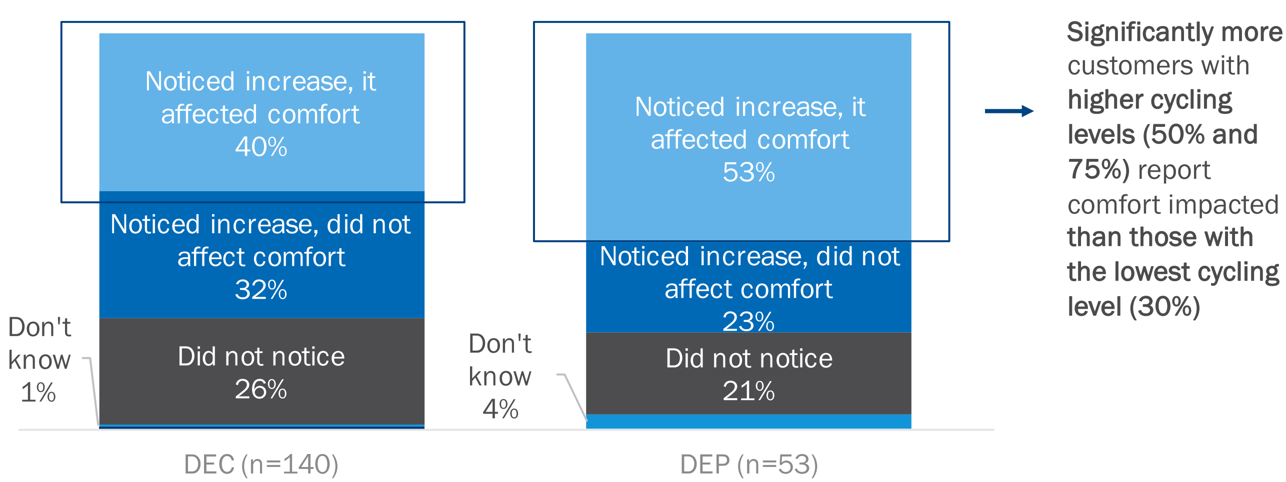
Figure 6-16. Participant Types of Advanced Notification



Note: This question allowed for multiple responses.

Participants recalling events had different perceptions of how the events affected their facilities' temperature and comfort. About one-quarter of participants (26% DEC and 21% DEP) did not notice any changes in temperature during the events (see Figure 6-17). Slightly more (32% DEC and 23% DEP) noticed temperature increases that did not impact their comfort. However, two-fifths of DEC participants and about half (53%) of DEP participants did report that temperature increases during the Conservation Periods impacted their comfort. When comparing perceived impacts of Conservation Periods to cycling levels, significantly more participants with higher cycling levels (50% or 75% cycling levels) report that their comfort was impacted by Conservation Periods than those with the lowest cycling level (30%).

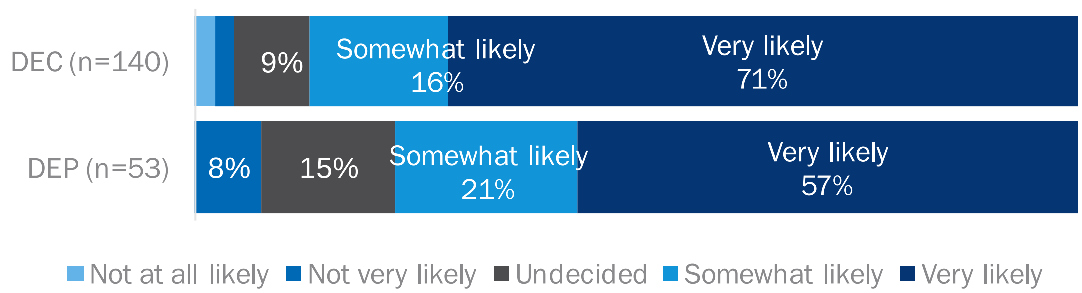
Figure 6-17. Participant Perceived Impact of Conservation Periods on Temperature and Comfort



Note: Totals may not sum to 100% due to rounding.

The majority of participants report they are very likely to continue participating in Conservation Periods in future years (71% DEC, 57% DEP, see Figure 6-18). Participants who are unlikely to participate in future years mentioned the high number of Conservation Periods[27] (2 of 6 DEC, 1 of 4 DEP) and Conservation Periods impacting business (1 of 6 DEC, 1 of 4 DEP) as the reasons why they are unlikely to participate. One survey participant reports "we noticed the temperature change and made it vastly uncomfortable for my employees and we needed to close."

Figure 6-18. Participant Likelihood of Continued Participation



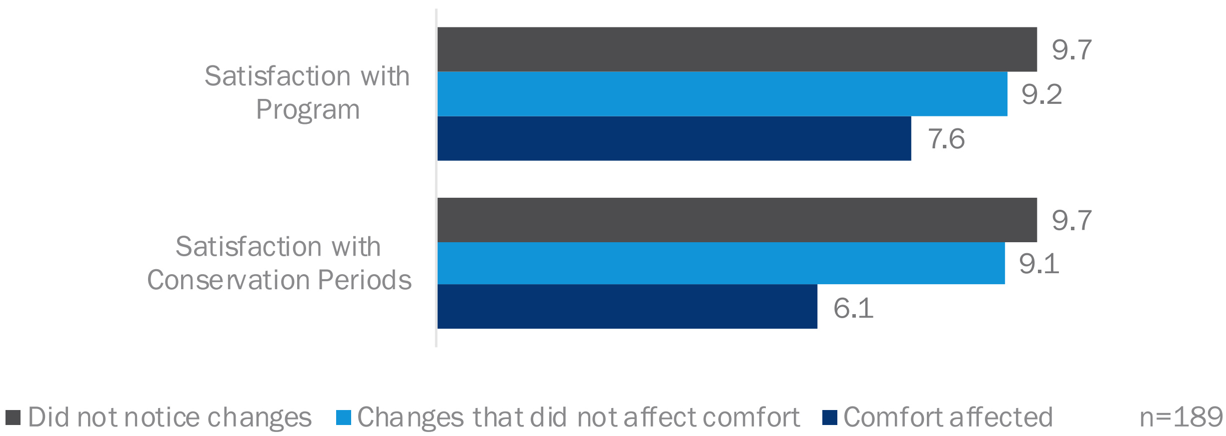
Note: Figure includes only customers who recall Conservation Periods.

To better understand the implications of discomfort during events on customers' experiences and likelihood of continuing in the program, the evaluation team explored the statistical relationships between participants' cycling level, satisfaction, and likelihood to participate in the program in the future. First, the evaluation team found that experiences during Conservation Periods are highly correlated with overall satisfaction with the program and program elements. Compared to those whose comfort was not affected, participants whose comfort was affected have significantly lower satisfaction with events (mean of 6.1 versus 9.1 and 9.7, see Figure 6-19) and the program overall (mean of 7.6 versus 9.7 and 9.2); they are also significantly less likely to participate in the future.[28]

[27] The program called five events in 2017 out of the maximum of ten events allowed through the enrollment contract.

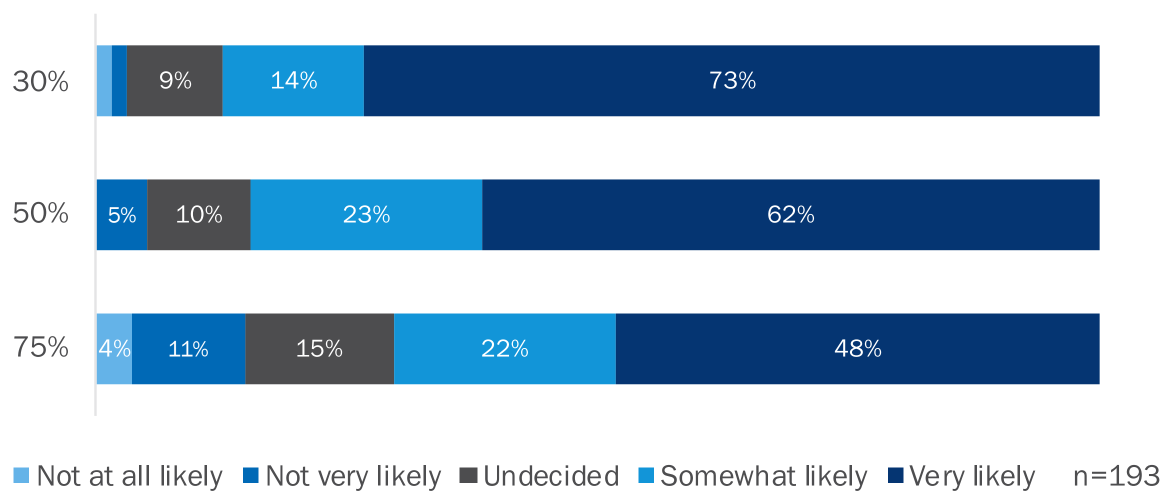
[28] Testing of statistical significance was conducted on the combined DEC and DEP results.

Figure 6-19. Mean Participant Satisfaction by Conservation Period Experience (DEC and DEP Combined)



The evaluation team also explored how this dynamic varied across cycling levels. The evaluation team found that participants with the lowest cycling level are significantly more satisfied with Conservation Periods and more often report they are very likely to participate in the program in the future (73% versus 62% and 48%, see Figure 6-20).

Figure 6-20. Participant Likelihood of Participating in Future by Cycling Level (DEC and DEP Combined)



Given the earlier finding that some customers did not understand cycling levels and Conservation Periods well when enrolling in the program, the evaluation team explored how much of the pattern between satisfaction, cycling level, and future participation was driven by customers' understanding of the program when they enrolled. Participants who understood Conservation Periods very well when enrolling are significantly more satisfied with the program and Conservation Periods than those who only somewhat understood the Conservation Periods (mean of 8.9 versus 8.3, see Figure 6-21). Those who understood cycling levels very well when enrolling are significantly more satisfied with the program than those who only somewhat understood cycling levels (mean of 8.4 versus 6.8, see Figure 6-22.

Figure 6-21. Participant Satisfaction by Understanding of Conservation Periods (DEC and DEP Combined)

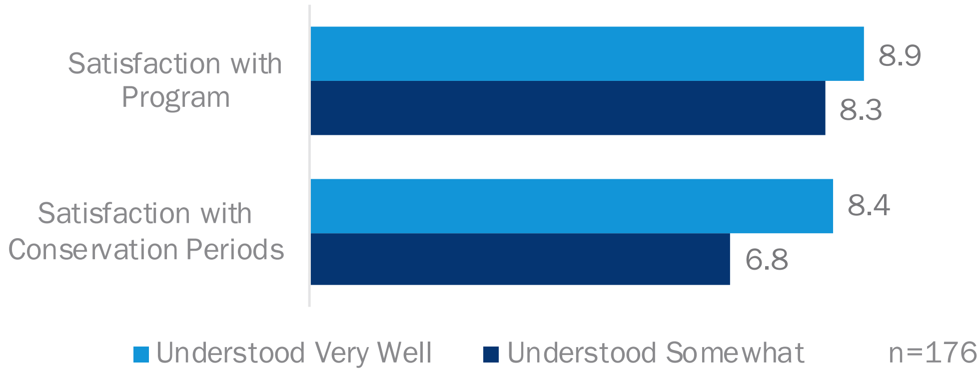
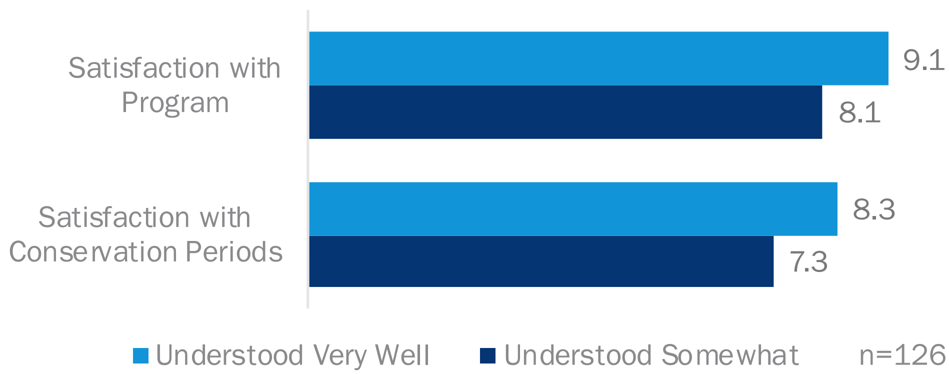


Figure 6-22. Participant Satisfaction by Understanding of Cycling Levels (DEC and DEP Combined)



The evaluation team also examined the statistical relationship between business type and participant satisfaction. The team found that restaurants have significantly lower satisfaction with the program overall (7.5) and with Conservation Periods (5.4) than other business types (8.7, 8.2).[29] These results are unsurprising as over three-quarters of restaurant participants report that Conservation Periods affected their comfort. Restaurant participants also report they are less likely to participate in the Conservation Periods in the future. In line with this customer feedback, opt-out analysis indicates that restaurants and food service establishments tended to opt out of 2017 Conservation Periods at a higher rate (5% to 14% per event) than non-food businesses (3% to 5% per event).

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[29] The evaluation team did not find statistically significant differences for other common participant business types (medical, office, retail, light industry, or place of public assembly or worship). The evaluation team may have been unable to detect differences among these groups due to smaller sample sizes.

Based on program-tracking data, a small share of survey participants opted out of at least one Conservation Period (6% DEC, 15% DEP).[30] When asked, almost all of these participants recalled their request (9 of 10 DEC, 7 of 8 DEP). Some of these participants simply had a special need on the day of the event, such as a "changing daily work load [that] can cause higher need on some afternoons" or that the Conservation Period "was supposed to happen during a time when we had many clients scheduled." Others noted that Conservation Periods were impacting business functions. One participant mentioned that their "office was getting too warm to the point that productivity was lost and some employees left early." Participants who opt out of Conservation Periods are also significantly less likely to participate in the program in the future compared to those who did not opt out of an event.

6.2.2 Non-Participant Customer Experiences

The following section presents results from the non-participant customer interviews. The evaluation team conducted 10 interviews with customers who were approached about the program but decided not to participate. The interviews explored non-participant customer barriers to enrolling in the program, understanding of program elements, and understanding of Conversation Periods.

Firmographics

The evaluation team spoke with representatives from ten companies who were recruited by a canvasser but declined to participate in the program ("non-participants").[31] The evaluation team spoke with these companies' managers (6 of 10) and company owners (4 of 10). Non-participants were fairly evenly split between companies with few employees and companies with a moderate number of employees (4 companies employ fewer than 10 employees at all locations; 6 employ between 10 and 55 employees at all locations). More of the interviewed non-participants are in the retail business sector (5 of 10, Table 6-6) compared to respondents to the participant survey (29% DEC, 21% DEP).

[30] In the final year-end population, about 11% of customers across both jurisdictions opted out of at least one event.

[31] Due to the small sample size, the evaluation team did not break out results by jurisdiction.

Table 6-6. Non-Participant Firmographics

Characteristic	Count (n=10)
Business Type	
Retail	5
Restaurant	3
Construction	1
Office	1
Tenure	
Lease	6
Own	4
Thermostats	
One	7
Two or more	3

Barriers to Enrollment

Most interviewed non-participants were aware of the program (8 of 10), and for those unaware, interviewers described the main features of the program. Though most non-participants were visited by canvassers according to the program-tracking data (7 of 10), only a few recalled the visit (3 of 10). Others heard about the program through mailers (3 of 10), phone calls from Duke Energy representatives (3 of 10), and email (1 of 10).

The most common reason for non-participation was the perception that the program would negatively impact business (6 of 10, Table 6-7). Other reasons for non-participation included satisfaction with current thermostat systems (2 of 10), a lack of trust of networked devices (1 of 10), distrust of an outsider controlling the thermostat (1 of 10), and currently ineffective air conditioning equipment (1 of 10).

Table 6-7. Non-Participant Barriers to Program Enrollment

Barrier to Enrollment	Count (n=10)
Would negatively impact business	6
No need for more complicated system	2
Does not trust networked infrastructure	1
Did not like concept of outsider controlling thermostat	1
Air conditioning currently struggling to cool business	1

Note: Barriers to participation coded from customer open end responses.

Interviewed non-participants generally fall into one of two groups: those who felt their business was not a good target for the program (4 of 10), and those who felt their outdated equipment or uninsulated facility would increase the impact of the Conservation Periods (3 of 10). One non-participant who thought their business was not a good target owns a massage parlor and reported that "...people are pretty picky about being comfortable while they're getting their massage. Noise level and air quality are probably the two really important things for my type of business." Among those who felt Conservation Periods would overly impact their businesses, one non-participant thought that their facility "...heats up in here really quick. We've had a couple problems over the years with our AC, and when it stops working you know it very, very quickly."

Understanding of the Program and Events

The evaluation team also asked questions to understand whether these customers' decision not to participate was related to an incomplete understanding of the program. For non-participants who were familiar with the program (8 of 10), most understood the program when declining participation (6 of 8). Only one non-participant was not familiar with the cycling level options and one other non-participant was not familiar with the ability to opt out of events. Interviewed non-participants did not have any additional questions about the program and were not interested in learning more about the program.

Though our sample size was too small to extrapolate findings to the population, interviewed non-participants generally did not seem like good candidates for program participation or likely future participants. In other words, it did not appear that there was an opportunity to increase their participation by better explaining the program.

6.2.3 Unenrolled Participant Experiences

The following section presents results from interviews with 10 customers who enrolled in the program but later decided to no longer participate in Conservation Periods ("unenrolled participants"). These interviews explored reasons for unenrollment, reasons for initial enrollment, understanding of program elements, understanding of Conservation Periods, and experiences with the program call center.[32]

Firmographics

Interviewed unenrolled participants included company executives, such as owners (5 of 10, see Table 6-8), managers (3 of 10), and CFOs (2 of 10). Most interviewed unenrolled participants employ fewer than 10 employees (6 of 10) and the remaining companies employ between 10 and 49 employees (4 of 10). Many are retailers (5/10) and most are renting their facilities (8/10). More of the unenrolled participants are in the retail business sector (5/10, see Table 6-8) compared to respondents to the participant survey (29% DEC, 21% DEP). The evaluation team interviewed approximately the same portion of single thermostat unenrolled participants (6 of 10) as we did for the participant survey (60% DEC, 45% DEP).

[32] Due to the small sample size, the evaluation team did not break out results by jurisdiction.

Table 6-8. Unenrolled Participant Firmographics

Characteristic	Count (n=10)
Business Type	
Retail	5
Gym/exercise facility	2
Restaurant	2
Place of worship	1
Tenure	
Lease	8
Own	2
Thermostats	
One	6
Two or more	4

Reasons for Unenrollment

Almost all interviewed customers (9 of 10) chose to unenroll their thermostats because higher temperatures during Conservation Periods were impacting business. One customer noted that “it [getting over 90 degrees] was happening all the time.” Another unenrolled participant stated that on “one day in particular, it was 90-some degrees outside, and within 20 minutes, my restaurant was over 95 degrees.” A third reported that Conservation Periods were getting “extremely prohibitive because when that would happen, it would get up to like 85, 90 degrees in here... It was driving off customers.” Based on these responses, the evaluation team expected unenrolled participants to have selected higher cycling levels, however, most had selected the lowest possible cycling level (Table 6-9).[33]

Table 6-9. Unenrolled Participant Customer Cycling Level

Cycling Level in Program Data	Count (n=10)
30%	7
50%	2
75%	1

Undersized equipment or lack of insulation may have caused higher indoor temperatures during Conservation Periods for unenrolled participants. Three unenrolled participants specifically mentioned that lack of insulation or undersized equipment made participation in Conservation Periods more difficult.[34] One customer stated that "This is an older building, but we also have a blower on the oven, and that helps reduce some of the excess heat from the oven, but when you got the sun bearing down... We got those sun bearing down on those rooftops, they're metal rooftops... It's just going to cause it to get really hot." Another customer reported that their air conditioners could not keep up with the cooling load, stating that “by 3:30, 4:00 in the afternoon, bam, there, we got to turn the air on.... I mean, I don't know if it's because of the space we have, or if it's our

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[33] Only a few unenrolled participants recall the cycling level (3 of 10).

[34] Statements were collected from the customers who explicitly mentioned their facilities and equipment in the interviews.

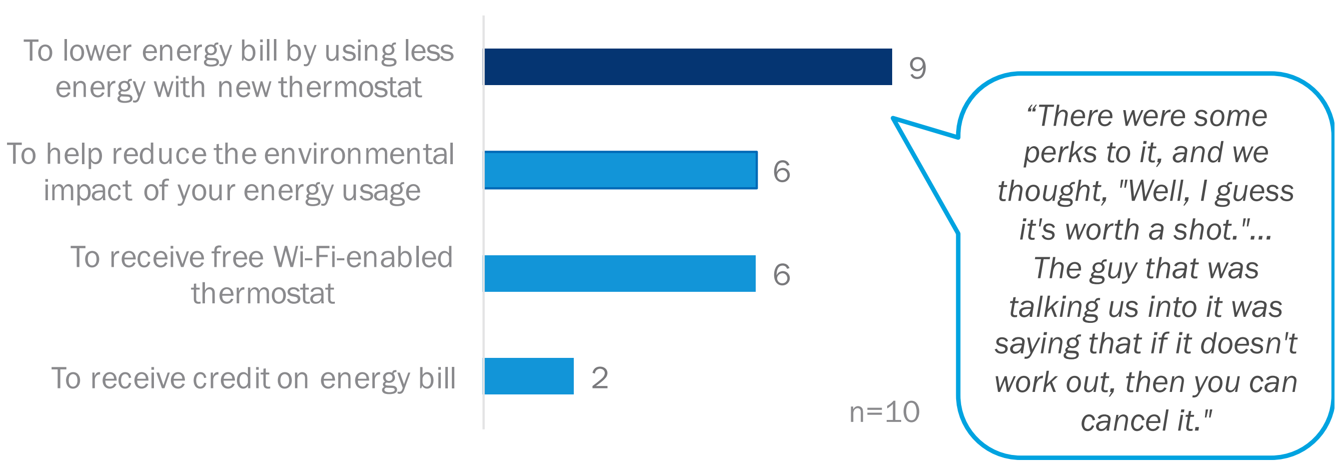
... Or if our air conditioners are just ... I mean, I know they're not efficient." Another customer noted that their space was not well-suited to changes in the temperature and that "it takes about an hour to cool down our warehouse, so it's not gonna be cool out there even when our last group starts [during the Conservation Period]." These experiences could explain why 30% cycling levels produced such high temperatures for several interviewed unenrolled participants.

Eight of the ten unenrolled participants reported they would have never enrolled if they had understood the full ramifications of the program. Notably, both of the interviewed staff representing gym facilities mentioned that demand response programs were not appropriate for their business type. One gym facility staffer reported that participation in the program did not fit the national gym standard their facility subscribed to, stating that "it's even like an ACSM [American College of Sports Medicine] guideline that you do not go above 72 in those conditions." However, when compared to participant survey responses, results were mixed in terms of whether gym customers were satisfied with the program.

Reasons for Initial Enrollment

The evaluation team explored whether there are any differences in the rationale for initial program enrollment between unenrolled participants versus on-going participants, to better understand why customers unenroll from the program. Similar to ongoing participants, almost all interviewed unenrolled participants were originally motivated by lower energy bills (9 of 10, see Figure 6-23). On-going participants are more often also motivated by receiving a bill credit (53% DEC, 61% DEP) than unenrolled participants (2 of 10), and conversely, unenrolled participants are more often motivated by receiving a free Wi-Fi enabled thermostat. Thus, these unenrolled customers may have less motivation to continue DR participation, as they still continue to utilize the program Wi-Fi enabled thermostat (which was more often cited as a motivation for initial participation) and only lose out on the bill credits (which was less often cited as a motivation for initial participation). One unenrolled participant reported that implementation staff stated, "that if it doesn't work out, then you can cancel it."

Figure 6-23. Unenrolled Participant Reasons for Initial Enrollment

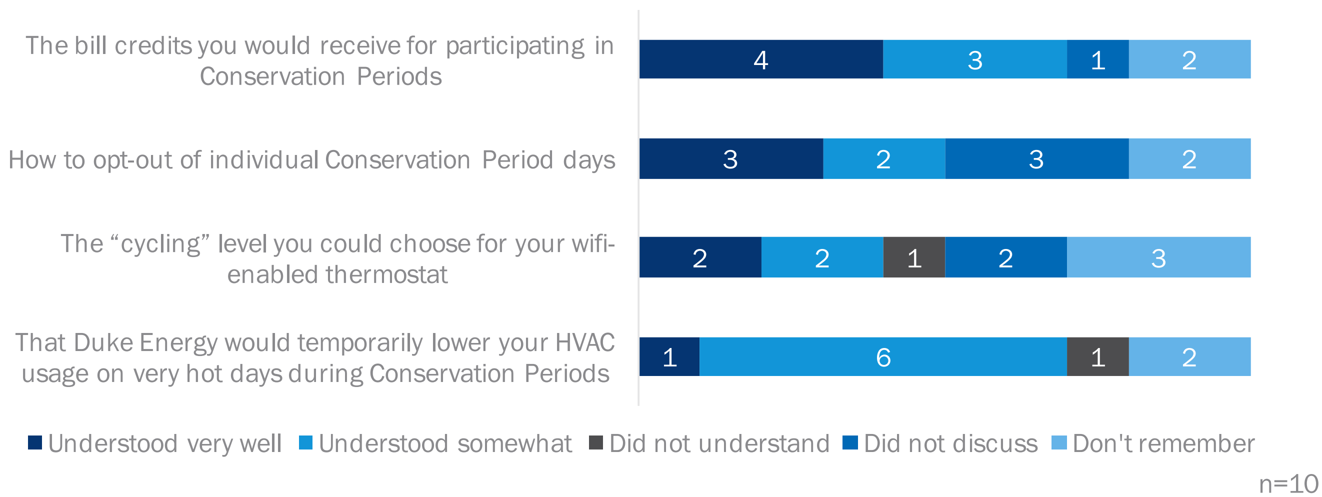


Note: This question allowed for multiple responses.

Understanding of the Program and Events

Interviewed unenrolled participants generally seemed less familiar with program elements than on-going participants, which may have contributed to their unenrollment. Fewer unenrolled participants (1 of 10, see Figure 6-24) reported understanding very well when they enrolled in the program that Duke Energy would lower HVAC usage during events, compared to ongoing participants (68%). Unenrolled thermostat customers generally had very high temperatures in their facilities and participating in any event seemed like an issue – not just an issue of them not understanding how to opt out of the occasional Conservation Periods that might pose an issue for their business. Most unenrolled participants understood in a general sense that Duke Energy would lower their HVAC usage, but many did not have a sense of the timing or the impact of that timing. The program could very well have given customers information about the program and the various elements, but customers did not recall it and did not feel they have a firm understanding.

Figure 6-24. Unenrolled Participant Understanding of Program Elements



More than half of interviewed unenrolled participants felt they had an incorrect understanding of Conservation Periods when they enrolled (6 of 10). Before experiencing Conservation Periods, one customer thought that Conservation Periods would be called at different times of the day instead of just during the peak hours. Another customer reported that information about Conservation Periods was not shared, and felt that Duke Energy staff "need to say, 'This happens every year, this is exactly how it's gonna work, it's a three-hour time period, your air condition's gonna be on for this amount of time, it's gonna be off for this amount of time' … It's just … And there's no documentation to explain the Conservation Period or how much that works."

Experiences with the Call Center

Unenrolled participants generally had positive experiences with the program call center, though few mentioned that call center staff had employed retention strategies when they called to unenroll. Almost all (9 of 10) unenrolled participants reported that call center staff were friendly and helpful. When customers called to unenroll, the only drop-out prevention strategy customers described being used by call center staff was discussing the loss of their Conservation Period rebate (2 of 10). The evaluation team did not ask explicitly about retention strategies for the program but asked generally about unenrolled participants' experience with the call center. One customer reported that they did not realize they would receive a rebate for participation in Conservation Periods until they called to unenroll. Another customer mentioned a drop-out prevention strategy to the call center staff, recalling that “after we opted out of the first one, I called back and said, ‘Hey can we go down to like the next lowest one?’ Which was I think 50%." Call Center staff may be employing these or other retention strategies, but the small sample of unenrolled participants the evaluation team spoke with did not mention them when asked generally about the call center staff.

7. Conclusions and Recommendations

7.1 Conclusions

Our evaluation of the 2017 EWB program found that program participants are satisfied with the program and are motivated to enroll to save money on their energy bill. Further, despite participants indicating that they understand program elements very well overall, survey results suggest that participants have a relatively low understanding of cycling levels, and only a quarter of participants could correctly recall their cycling level. Despite overachieving device installation goals, the program did not achieve its per device impact goals, and device enrollment was heavily skewed towards the lower cycling strategies. Overall, the program achieved demand impact realization rates of 72% for DEC and 70% for DEP and energy impact realization rates of 204% for DEC and 5% for DEP.

The following bullets present key findings and conclusions from our evaluation.

- Total participation exceeded expectations, but participant characteristics are different than Duke Energy's expectations. Overall, we found that customers enrolled 6,793 devices in 2017, achieving 182% of the program enrollment goal.
    - The majority of enrolled devices were in DEC territory (72%) compared to DEP (28%). Most participants selected thermostats (91%), exceeding the anticipated share (60%).
    - The majority of participants selected the 30% cycling strategy, which is the lowest strategy available: 84% of DEC participants are enrolled in the 30% cycling strategy compared to 53% of DEP participants. For DEC, enrollment shifted towards lower cycling strategies from 2016 to 2017.
    - Average size of HVAC units controlled by devices installed in 2017 remained relatively unchanged from 2016, at 4.2 tons.
- The program called five summer Conservation Period events in 2017 and achieved average per event demand savings of 2,582 kW in DEC and 1,421 kW in DEP.
    - As noted above, both utilities underachieved their goals, despite overall enrollment exceeding goals. Device enrollment was heavily distributed towards lower cycling strategies.
    - Per device load impact realization rates were lower than anticipated goals across jurisdictions (56% for DEC and 55% for DEP) and cycling strategies.
    - Operational rates and opt-out rates were consistent with Itron's expectations for the program (on average, of the eligible units, 4% to 7% opted-out and 91% cycled).
- The thermostats installed through the program in 2017 achieved energy savings of 2,296,448 kWh in DEC and 31,737 kWh in DEP.
    - Despite exceeding thermostat installation goals across both jurisdictions, per device energy efficiency savings realization rates were lower than expected in both jurisdictions.
    - Cross-participation adjustments substantially reduced energy impacts for both jurisdictions.
    - Despite similar program design and implementation, and few differences in the types of facilities enrolled, the evaluation identified substantial variation in energy efficiency savings between DEC

and DEP: consumption analysis results showed unadjusted energy savings for DEC participants more than 2.5 times those of DEP participants. While the cross-participation analysis found a smaller savings adjustment for DEP participants in absolute terms, it was much higher than for DEC participants as a percentage of unadjusted energy savings. Our analysis found that DEP participants tend to have lower annual average baseline usage and summer average baseline usage than DEC participants, as well as slightly lower average tonnage in terms of the HVAC units being controlled. Other factors, such as customer behavior, e.g., engagement with their thermostat, may play a role. Survey results suggest that DEP customers may change their set points or use the web portal more frequently than DEC customers.

- Participants are generally satisfied with the program overall (mean ratings of 8.8 for DEC and 8.2 for DEP).
  - There are small, but significant, differences in participant satisfaction across territories. DEP participants report significantly lower satisfaction with the program overall (mean 8.2) and with Conservation Periods (mean of 7.2) than DEC participants (means of 8.8 and 8.3, respectively).
  - Participants with the 30% cycling level are significantly more satisfied with Conservation Periods and more often report that they are very likely to participate in the program in the future, compared to those enrolled in higher cycling levels.
  - Restaurants have significantly lower satisfaction with the program overall (mean rating of 7.5) and with Conservation Periods (5.4) than other business types (8.7 program overall, 8.2 Conservation Periods). Restaurants and food service establishments tended to opt out of Conservation Periods at slightly higher rates than other types of businesses.
- Participants most often report being motivated to enroll in the program to lower their energy bills (79% DEC, 71% DEP).
- Most participants report understanding program elements very well, and this understanding is linked to participant satisfaction.
  - Participants who understood Conservation Periods very well when enrolling are significantly more satisfied with the program and Conservation Periods than those who only somewhat understood the Conservation Periods.
  - Participants who understood cycling levels very well when enrolling are significantly more satisfied with the program than those who only somewhat understood cycling levels.
  - Few participants correctly recall which cycling level they chose (22% DEC, 31% DEP).
- Of those participants who have tried to change their thermostat schedule, almost all are able to do so successfully (95% DEC; 95% DEP).
- Less than half of participants use the online portal to control their thermostat's schedule or temperature.
  - About one-third of DEC and DEP participants are unaware of the portal's ability to display information about how much their HVAC system has been running (42% DEC, 32% DEP) and more than one-quarter are unaware of the portal's ability to display information on their organization's energy use (35% DEC, 27% DEP).
- About half of participants with electric heat pumps recall implementers offering the winter demand response option (45% DEC, 50% DEP).

- About one half of DEP participants (53%) and two-fifths of DEC participants (40%) experienced discomfort during the Conservation Periods.
  - Participants whose comfort was affected report significantly lower satisfaction with Conservation Period events and the program overall and are less likely to participate in Conservation Periods in the future.
- Non-participants most often report not enrolling in the program because they feel their business would be negatively impacted by the Conservation Periods (6 of 10).
- Participants chose to unenroll from Conservation Periods because higher temperatures were impacting their business (9 of 10).

7.2 Recommendations

Our recommendations focus on a core set of actionable efforts to increase program impacts while maintaining customer satisfaction, including those related to customer recruitment, education, and retention; program implementation enhancements; device functionality and operations optimization; and data tracking improvements. Notably, we understand that Duke Energy developed this program to provide small business customers an opportunity to participate in demand response, since these customers pay a surcharge but did not have an opportunity to participate in these programs. As a result, recommendations must be considered in light of enhancing program cost-effectiveness as well as equitably serving this historically underserved population.

Recommendation: Customer Recruitment, Education, and Retention

The EWB program staff and their implementation contractors far exceeded enrollment goals in 2017. In fact, recruiters were so successful that the program experienced a backlog in the second half of 2016 where recruited customers had to wait two to three months to have their thermostat or switch installed, instead of the target of four weeks. Building on this success, we recommend that Duke Energy focus on recruiting customers that evaluation results suggest are optimal from a demand response and energy savings impact perspective.

- **Optimize customer recruitment targeting.** Evaluation results from 2016 and 2017 both suggest that the program should seek to recruit customers with specific attributes, such as customers with larger HVAC units and higher monthly usage in summer months. In terms of event participation, several unenrolled participants mentioned that they felt their business segment was not appropriate for event participation. Specifically, unenrolled participants with gyms, massage parlors, and florists report that their business segment do not tolerate large temperature changes. Additionally, a review of event participation data suggests that restaurants tend to have higher opt-out rates than other business types. When examining unenrollment by NAICs code, restaurants are unenrolling at more than double the average rate. We recommend:
  - Continuing to target customers with larger HVAC units and higher average summer consumption.
  - Conducting in-depth upfront vetting customers within specific business types that are less able to accommodate changes in temperature in their facilities to reduce Conservation Period opt-outs, unenrollment, and potentially lower impacts.

- **Enhance customer education for Conservation Period participation.** Our process research found that better participant understanding of program elements is correlated with higher participant satisfaction. Participants report relatively low understanding of cycling levels, and only a quarter of participants could correctly recall their cycling level. In addition, participants who unenrolled from Conservation Periods were less familiar with program elements than on-going participants, which may have contributed to their unenrollment. To minimize participant unenrollment and opt-outs, and increase satisfaction, we recommend:
  - Ensuring canvassers and installers fully explain cycling levels and Conservation Periods, including strategies for minimizing impacts of the events. This could include additional training for canvassers and installers, as well as adjustments to canvassers incentives, as described further below.
  - Developing additional leave-behind materials or welcome email blasts for newly-enrolled program participants. These materials should describe what a customer should expect during Conservation Periods. The materials may also provide suggestions for minimizing the impact of Conservation Periods such as pre-cooling facilities or reducing the use of heat-emitting technologies during Conservation Periods.
- **Encourage customer retention strategies.** The only drop-out prevention strategy noted by participants who unenrolled from the program was the loss of the Conservation Period bill credit. Most interviewed participants who dropped out of the Conservation Periods did so due to discomfort during events. In some cases, the discomfort was exacerbated by issues with their facilities' HVAC systems and building envelopes. We recommend Duke Energy staff:
  - Consider having the program call center employ additional drop-out prevention strategies, such as providing tips for mitigating discomfort during events, or helping them understand how to opt out of events. We suggest informing customers about how to opt-out since opting out of some events will yield higher impacts overall than if the customer is to drop out entirely. In addition, the call center might refer customers mentioning issues with their building's HVAC system or building envelope to other Duke Energy programs. While this may not stop a customer from dropping out of the program, it would provide Duke Energy with increased energy savings through the relevant energy efficiency programs.
- **Encourage adoption of, or conversion to, higher cycling strategies.** Enrollment in the lower cycling strategies, especially the 30% strategy, is higher than expected, leading to lower than anticipated per participant impacts.
  - Test options to support converting existing customers to higher cycling strategies. We understand that Duke is already in the process of an analytics project to help identify customers that could use higher cycling strategies. These analytics could inform Itron work with customers during the installation to assess if customers could increase their cycling strategy, without jeopardizing comfort. An additional option would be to promote higher cycling strategies on the customer portal; especially for customers with higher reference loads. Customers can currently change strategies after they enroll, but according to the program manager, most customers who change after enrollment change to a lower cycling strategy. It should be noted that more aggressive cycling strategy enrollment goals should be balanced with customers' comfort, as we found that higher cycling strategies are tied to more noticeable reductions in comfort, higher opt-out rates, and reduced likelihood of participating in the future.

Recommendation: Program Implementation Enhancements

The program uses a series of marketing channels, including door-to-door marketing ("canvassing"), phone recruitment, email and direct mail, website, and digital marketing. Door-to-door marketing was a successful strategy in 2017, and program enrollment increased considerably after Duke Energy engaged Threshold Marketing canvassers.

Duke Energy pays Threshold Marketing a set fee for every account enrolled in the program. This fee does not vary based on the size or number of HVAC devices that a customer has, or the cycling level chosen. Perhaps as a result, the Threshold Marketing program managers describe focusing their efforts on customers where they can likely engage with an on-site decision maker (e.g., "mom and pop" businesses), and described how it was easier and more lucrative for canvassers to enroll customers with fewer HVAC units, since customers with more complex systems required more time to enroll for the same commission. Although engaging willing participants benefits marketing cost-effectiveness and increases participation, these enrollment strategies may not capture the most optimal savings opportunities from an impacts perspective. We recommend:

- **Aligning enrollment incentives with factors known to produce higher impacts to maximize cost-effectiveness.** Threshold's enrollment incentives were not aligned with Duke Energy's goals as they are paid per account regardless of characteristics that affect potential kW and kWh savings (e.g., cycling strategy, number of devices enrolled, baseline usage, or HVAC size). We recommend revisiting how Threshold is compensated by developing a tiered incentive strategy that provides greater compensation for customers with greater savings potential or interest in higher cycling levels. At the same time, customer comfort matters: higher cycling strategies are tied to more noticeable reductions in comfort, higher opt-out rates, and reduced likelihood of participating in the future. Accordingly, any tiered incentive strategy will need to balance recruitment into aggressive cycling strategies with continued support for customer comfort.

- **Considering adjustments to education or incentives to ensure installers offer participants with heat pumps winter Conservation Period participation.** Only half of participants with heat pumps recall installers offering participation in winter Conservation Periods. To increase the number of winter participants, the evaluation team recommends increasing installer education on the benefits of winter participation and on the program goals related to winter participation. The program may also consider adjusting installer incentives for enrolling winter participants.

Recommendation: Device Functionality and Operations Optimization

Our demand response impact analysis identified average percent load impacts that were routinely under the cycling strategy amount. This is consistent with expectations for a duty cycle strategy, as the average run-time of units during non-events is rarely 100%. We also found that energy efficiency savings were lower than anticipated, which may be driven by customer engagement with their set points. We recommend:

- **Incorporating an adaptive cycling strategy for Conservation Period events.** Adaptive cycling replaces the baseline run-time of 100% with an actual run-time percentage during a non-event hot day. For example, in simple 30% duty cycling where the baseline is 100%, event period run-time is limited to 70% (100%-30%). Adaptive cycling, which uses a previous measurement of run-time during hot days for the particular device (e.g., 90%) would limit event period run-time to 63% e.g., 90%* (100%-30%)). This helps to achieve percent run-time reductions closer to the cycling strategy, and it helps customers who may have under- or over- sized units. We understand that Duke Energy will be implementing this approach to cycling for the 2018 Conservation Period events.

- **Implementing strategies to optimize energy efficiency settings for thermostats.** Notably, Duke Energy implemented an "auto-EE" functionality to their customer portal in 2018. This feature assesses the building's thermodynamics and auto-adjusts the set points when the facility is closed to generate additional energy savings compared to customer setpoints. These changes could potentially increase the overall energy savings from the thermostats in future program years. We also recommend assessing set points for thermostats to understand programming behavior of installers and customers. Educational materials that help customers optimize their own comfort, while also yielding bill savings, may help customers achieve higher energy savings associated with their devices.

Recommendation: Data Tracking

- **Enhance data tracking across Duke Energy program participation databases, customer billing data, and AMI data, as well as with Itron device log data.** Throughout this evaluation, we encountered a number of data issues that limited our ability to execute the planned analyses and increased evaluation cost and time frames. For example, the original evaluation plan sought to assess net demand impacts using AMI data. However, the DEP AMI data had substantial data availability issues as well as quality issues in terms of anomalous load shapes, necessitating incorporating device log data for the impact analysis. In particular, the load shapes within the available AMI data (based on graphical review) were not consistent with expected AC load shapes, and the amount of AMI data was insufficient to fully represent the population of participants. We offer the following set of recommended data tracking enhancements:
  - Develop an identical set of unique identifiers across datasets and include Account ID and Source Account ID and Source Service Point ID in every dataset. If an identical set of unique identifiers is unavailable due to the data existing in different systems, consider developing a crosswalk that links Source Service Point ID and Service Point ID. Currently, Duke Energy program data tracks participation at the Account level, while the vendor tracks participation at the Source Service Point Level. In addition, for DEP consumption data, provide an identifier that links Meter Number to Source Service Point ID and Account Number. This can support effective identification of the meter associated with a device installation.
  - Track changes in cycling strategies across time rather than replacing the strategies with the latest enrollment status. This will allow us to correctly classify participants by cycling level for each event, even if their cycling level or status changed. For example, a participant who participated with a 30% cycling strategy in July events but then changed their cycling strategy in September would be tracked as at the latest cycling strategy. Since the tracking data currently does not reflect the original cycling strategy and when it changed, we cannot accurately analyze the impacts of a past event.
  - Differentiate between unenrollment date and deactivation/removal date in the program-tracking data. Currently, the Duke Energy program-tracking data records two dates for each measure, start date (start_dt) and end date (end_dt). The start date corresponds to the installation date in Itron's data, while and the end date can correspond to either the unenrollment date or the removal date in Itron's data. The distinction between the two end dates in the Itron data is important because unenrolled devices can still achieve energy savings while removed devices achieve neither energy nor demand response savings.

8. Summary Form

Duke Energy Carolinas and Progress EnergyWise Business Program

Completed EMV Fact Sheet

Duke Energy Progress' and Carolinas' EnergyWise Business Program is a demand response program that provides small businesses with the opportunity to participate in DR events, earn incentives, and realize additional EE benefits. The program offers customers either a programmable, two-way Wi-Fi Smart Thermostat or a Load Control Switch. Customers can select one of three levels of DR participation: 30% cycling, 50% cycling, and 75% cycling, with varying levels of earned incentives based upon the selected cycling strategy. Thermostat participants with a heat pump with electric resistance heat strips are also offered the option of participating in winter DR events and can earn additional incentives per season.

Date	November 9, 2018
Region(s)	Duke Energy Carolinas & Progress
Evaluation Period	1/1/17 through 12/31/17
Annual kWh Savings	DEC: 2,296,448 DEP: 31,737
Coincident kW Impact	DEC: 2,582 DEP: 1,421
Measure Life	Not evaluated
Net-to-Gross Ratio	Not evaluated
Process Evaluation	Yes
Previous Evaluation(s)	2016

To determine program impacts, the evaluation team used a three-step process: (1) we conducted a participation analysis; (2) we assessed energy savings impacts via a consumption analysis and cross-participation analysis; and (3) we estimated ex post gross demand impacts through a regression analysis. These results were then used to calculate realization rates.

Step 1: Participation Analysis. Reviewed program-tracking data to assess program participation during the evaluation period.

- Reviewed program participation database to determine device and participant counts, types of devices installed, and cycling strategies employed, as well as installation dates.
- Reviewed thermostat and switch log data to determine device operability rates and identify opt-outs.

Step 2: Net Energy Savings Analysis. Conducted a regression analysis and cross-participation analysis to estimate energy savings impacts for thermostats installed in 2017.

- Cleaned participation and customer billing data; developed matched comparison group to assess net energy impacts. Conducted regression analysis by jurisdiction.
- Conducted cross-participation analysis to deduct any double counted savings from other Duke Energy programs.
- Applied per-device impacts to enrolled thermostats and calculated net realization rates.

Step 3: Gross Demand Response Analysis. Conducted a regression analysis to estimate event-specific load impacts across cycling strategy, jurisdiction and device type.

- Cleaned participation and device log data; developed matched proxy-weather days to assess counterfactual. Conducted regression analysis by jurisdiction.
- Calculated opt-out and operational rates for devices.
- Converted run-time to kW by applying full load capacity.
- Applied per-device impacts to operational devices and calculate net realization rates.

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Smart $aver® Non-Residential Custom Program Years 2016-2017 Evaluation Report

Submitted to Duke Energy Carolinas
in partnership with Tetra Tech

November 29, 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 Carolinas (DEC) and Duke Energy Progress (DEP) service territories to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The program is designed to meet the needs of 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 companies' technical or financial assistance.

1.2 Evaluation Objectives and High Level Findings

This report presents the results and findings of evaluation activities for DEC's and DEP's NR Custom program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Tetra Tech, for the period of January 2016 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 energy efficient (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 – DEC

The impact evaluation results indicate that program internal processes for project review, savings estimation, and installation verification are producing quality estimates of project impacts. For DEC energy realization rates exceed 100% for three of the four strata (Lighting - Large, Lighting - Small, and Non-lighting - Large). The realization rate for the Non-lighting - Small strata was better than 96%. Realization rates for Summer and Winter demand were also above 100% at the program level. Findings from the gross impact evaluation of DEC projects are summarized in Table 1-1, Table 1-2, and Table 1-3.

Table 1-1 DEC Program Reported and Verified Gross Energy Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	RR (%)
Lighting	Large (>1,000 MWh)	35,491,559	37,792,452	106.5%
	Small (<1,000 MWh)	34,500,751	37,552,406	108.8%
Non-lighting	Large (>2,000 MWh)	21,661,701	23,301,600	107.6%
	Small (<2,000 MWh)	22,645,465	21,862,911	96.5%
Total		**114,299,476**	**120,509,369**	**105.4%**

Table 1-2 DEC Program Reported and Verified Gross Summer Demand Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kW)	RR (%)
Lighting	Large (>1,000 MWh)	4,854	5,636	116.1%
	Small (<1,000 MWh)	6,151	6,758	109.9%
Non-lighting	Large (>2,000 MWh)	2,107	3,369	159.9%
	Small (<2,000 MWh)	3,276	3,237	98.8%
Total		**16,389**	**19,000**	**115.9%**

Table 1-3 DEC Program Reported and Verified Gross Winter Demand Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	RR (%)
Lighting	Large (>1,000 MWh)	4,398	5,031	114.4%
	Small (<1,000 MWh)	5,218	5,996	114.9%
Non-lighting	Large (>2,000 MWh)	2,559	5,372	209.9%
	Small (<2,000 MWh)	2,933	2,316	79.0%
Total		**15,108**	**18,715**	**123.9%**

1.2.3.2 Gross Impact Evaluation Key Findings – DEP

The impact evaluation results indicate that program internal processes for project review, savings estimation, and installation verification are producing quality estimates of project impacts. For DEP, energy realization rates exceed 100% for three of the four strata (Lighting - Large, Non-lighting - Large, and Non-lighting - Small). The realization rate for the Lighting - Small strata was better than 97%. Realization rates for Summer and Winter demand were 99.5% and 122.7%, respectively. Findings from the gross impact evaluation of DEP projects are summarized in Table 1-4, Table 1-5, and Table 1-6.

Table 1-4 DEP Program Reported and Verified Gross Energy Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Energy Savings (kWh)	Gross Verified Energy Savings (kWh)	RR (%)
Lighting	Large (>250 MWh)	3,289,490	3,662,303	111.3%
	Small (<250 MWh)	3,204,111	3,119,250	97.4%
Non-lighting	Large (>500 MWh)	5,979,116	6,075,769	101.6%
	Small (<500 MWh)	3,667,824	4,202,872	114.6%
Total		**16,140,541**	**17,060,194**	**105.7%**

Table 1-5 DEP Program Reported and Verified Gross Summer Demand Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Summer Demand Savings (kW)	Gross Verified Summer Demand Savings (kW)	RR (%)
Lighting	Large (>250 MWh)	475	519	109.4%
	Small (<250 MWh)	518	450	86.8%
Non-lighting	Large (>500 MWh)	531	519	97.7%
	Small (<500 MWh)	386	413	106.9%
Total		**1,910**	**1,901**	**99.5%**

Table 1-6 DEP Program Reported and Verified Gross Winter Demand Impacts for Projects Completed January 2016 – December 2017

Measure Category	Strata	Gross Reported Winter Demand Savings (kW)	Gross Verified Winter Demand Savings (kW)	RR (%)
Lighting	Large (>250 MWh)	499	667	133.8%
	Small (<250 MWh)	379	532	140.3%
Non-lighting	Large (>500 MWh)	632	622	98.5%
	Small (<500 MWh)	512	659	128.5%
Total		**2,022**	**2,480**	**122.7%**

1.2.3.3 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. A large portion of the free-ridership 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 efficiency project. A small number of customers also rated all aspects of the program as having no influence on their project decisions.

Findings from the net impact evaluation are summarized in Table 1-7. While the table presents territory-specific findings for DEP, these results are based on a small number of survey responses and therefore have a higher statistical precision (±16%) than industry standard.[1] The evaluation team recommends using the Combined net-to-gross results for reporting DEP net impacts, which has the same precision as DEC-specific results at ±4.5%. Because the DEC results do fall within ±10% on their own, the evaluation team recommends using the DEC-specific results for reporting DEC net impacts.

Table 1-7 Net-to-Gross Evaluation Results

Net-to-Gross Component	DEC	DEP	Combined
Net of Free-ridership	78.9%	70.8%	78.5%
Program-influenced Spillover	0.4%	0.0%	0.4%
Net-to-Gross	**79.2% ***	**70.8%**	**78.8%**

* Note: Sum of Net of Free-ridership and program-influenced spillover equals 79.2% due to rounding.

1.2.3.4 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 efficiency equipment. Contractors felt the program was influential in getting customers to move forward with projects where they would not have otherwise. Participants provided similar feedback, stating they have appreciated the support they received from trade allies and Duke Energy. Numerous customers mentioned they have previously participated in the program, speaking to their satisfaction and the ease of participation.

Additional high-level findings include the following:

- The primary source of participants' program awareness is their contractor.

[1] A common industry standard for evaluation is ±10% precision at the 90% confidence level, meaning if the research were repeated with the same sample size, the result would fall within ±10% of the estimate 90% of the time.

- 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 efficiency equipment.
- Program application and processes are geared to lighting projects, leading to some confusion.
- The tracking database was occasionally missing phone numbers and email addresses for participants requiring follow-up data requests

[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 105.4% realization rate (energy) for the DEC NR Custom Program and 105.7% for the DEP NR Custom Program. The strong realization rates indicate 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 for customers was 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 two-thirds of contractors and one-third of participant respondents indicated they have used Duke's tools to calculate savings. Contractors who used Duke Energy's provided tools rated their usefulness high. That said, contractors who install non-lighting equipment were more likely to use their own calculators or rated the usefulness of Duke's calculators low.

Recommendation 2a: 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. **Recommendation 2b:** Consider reviewing the calculators for non-lighting equipment to ensure they perform as expected and do not require lighting-specific information.

Conclusion 3: Almost all customer and contractor respondents found the time to review applications acceptable.

Program participants were generally satisfied with the review process. Most contractors were also satisfied with the process. However, five contractors felt the preapproval process could be improved. Specifically, three indicated that the non-lighting preapproval process can take significantly longer than lighting preapproval. As different technologies come into the market, it will be important to ensure customers are getting feedback in a timely manner.

Recommendation 3: Monitor the time it takes to review applications for preapproval to ensure the time does not exceed six weeks.

Conclusion 4: Most participant respondents reported high satisfaction with the application process, although five respondents indicated the program could benefit from simplifying the application. A few contractors also recommended the application is geared towards lighting projects, leading to some confusion in what information is needed.

Recommendation 4: Streamline the application paperwork to minimize customer burden and collect only the information relevant to specific equipment types.

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 Carolinas (DEC) and Duke Energy Progress (DEP) service territories to enhance their ability to adopt and install cost-effective electrical energy efficiency projects.

The program is designed to meet the needs of each 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 application (doc or pdf) is 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
    - Process VFDs
    - Compressed Air

The Companies contract with Alternative Energy Systems Consulting (AESC) to perform technical review of applications. The Weidt Group is an energy modeling and outreach consultant that provides energy consulting services and whole-building energy modeling to facilitate and guide the process designing energy efficiency measures into new buildings and major renovations. 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 – DEC

Table 2-1 summarizes program participation and reported energy savings for the full evaluation period of January 2016 through December 2017 for the DEC service territory. There were a total of 334 projects completed during the evaluation period. For the purposes of this report a project is defined as a unique enrollment ID. These 334 projects collectively accounted for a total of 944 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. Adams Outdoor Advertising). Table 2-2 outlines the reported summer and winter demand (kW) for the evaluation period for the DEC service territory.

Table 2-1 DEC NR Custom Program Participation and Energy Summary

Category & Strata		Database Line Items		Enrollment IDs		Reported Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go Gross MWh	Classic Custom Gross MWh
Lighting	Large (>1,000 MWh)	-	206	-	18	-	35,492
	Small (<1,000 MWh)	336	311	144	117	16,471	18,030
Non-lighting	Large (>2,000 MWh)	-	5	-	5	-	21,662
	Small (<2,000 MWh)	9	77	8	42	1,881	20,764
Total		**345**	**599**	**152**	**182**	**18,352**	**95,947**
Grand Total		**944**		**334**		**114,299**	

Table 2-2 DEC NR Custom Program Demand Savings Summary

Category & Strata		Enrollment IDs		Summer Demand		Winter Demand	
		Custom-To-Go	Classic	Custom-To-Go Gross Summer kW	Classic Custom Gross Summer kW	Custom-To-Go Gross Winter kW	Classic Custom Gross Winter kW
Lighting	Large (>1,000 MWh)	-	18	-	4,854	-	4,398
	Small (<1,000 MWh)	144	117	3,062	3,089	2,401	2,818
Non-lighting	Large (>2,000 MWh)	-	5	-	2,107	-	2,559
	Small (<2,000 MWh)	8	42	110	3,167	138	2,795
Total		**152**	**182**	**3,172**	**13,217**	**2,539**	**12,569**
Grand Total		**334**		**16,389**		**15,109**	

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 for the DEC service territory.

Figure 2-1 Distribution of Reported Energy Savings from NR Custom DEC Program Projects by Technology

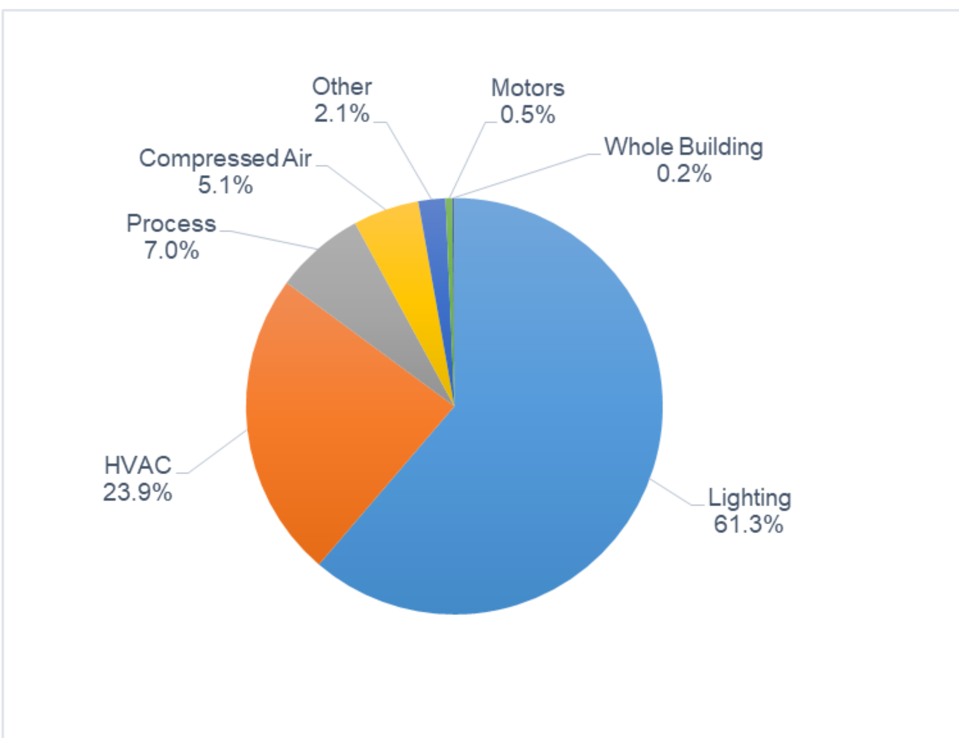


Figure 2-2 Distribution of Reported Summer Demand Savings from DEC NR Custom Projects by Technology

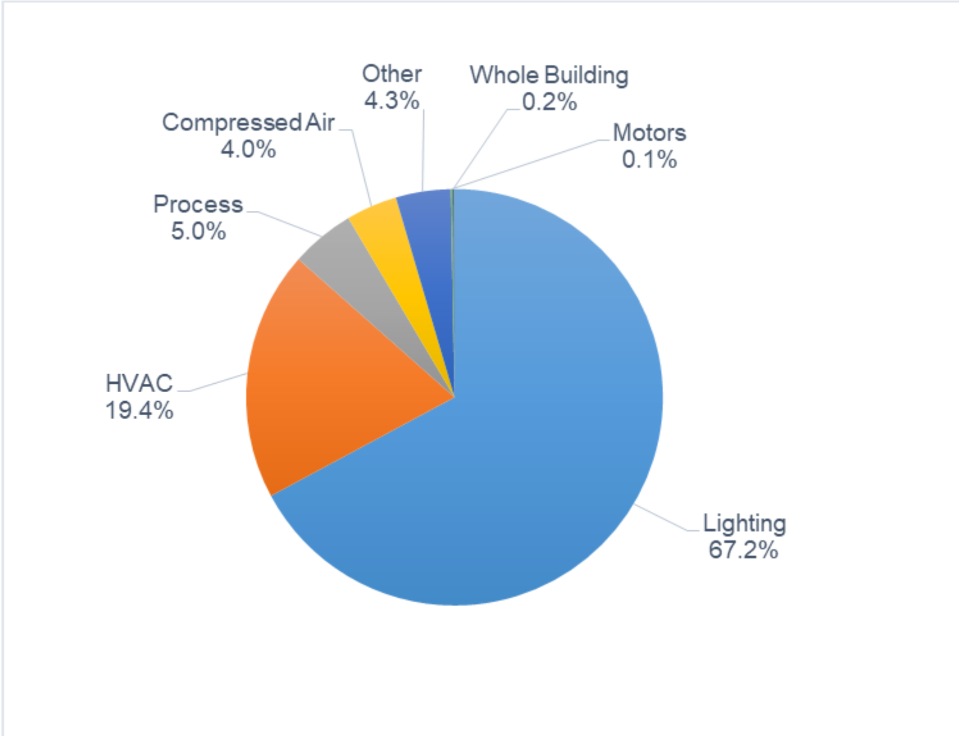
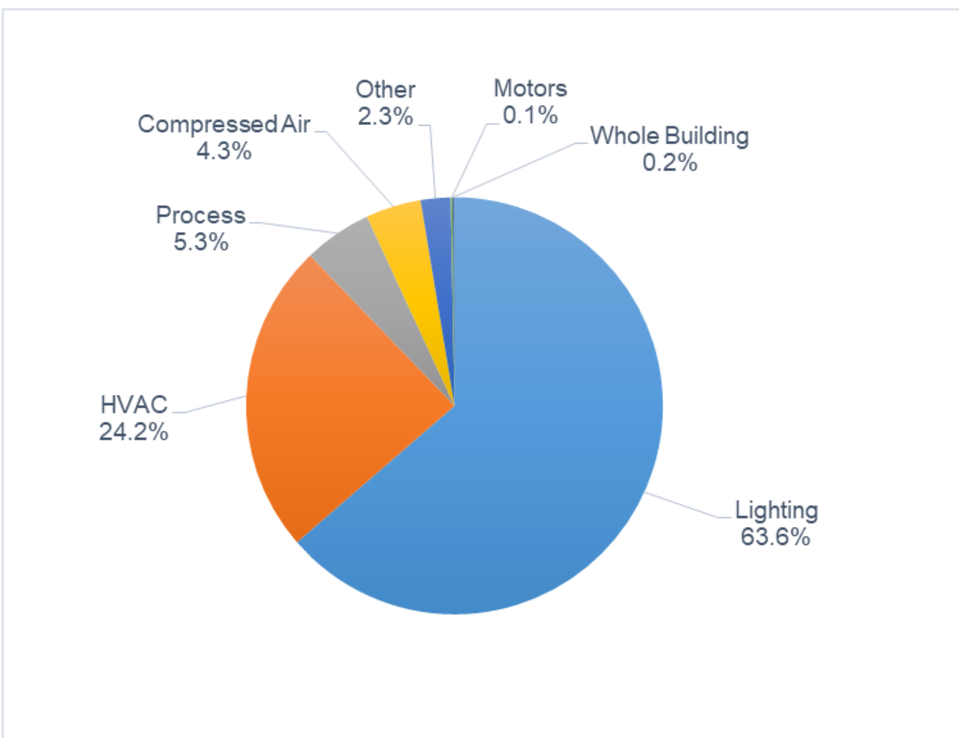


Figure 2-3 Distribution of Reported Winter Demand Savings (kW) from DEC NR Custom Projects by Technology



2.1.2 Participation Summary – DEP

Table 2-3 summarizes program participation and reported energy savings for the full evaluation period of January 2016 through December 2017. There were a total of 117 projects completed during the evaluation period. These 117 projects collectively accounted for a total of 276 unique database line items. Table 2-4 outlines the reported summer and winter demand (kW) for the evaluation period for the DEP service territory.

Table 2-3 DEP NR Custom Program Participation and Energy Summary

Category & Strata		Database Line Items		Enrollment IDs		Reported Savings	
		Custom-To-Go	Classic	Custom-To-Go	Classic	Custom-To-Go Gross MWh	Classic Custom Gross MWh
Lighting	Large (>250 MWh)	15	55	3	6	835	2,454
	Small (<250 MWh)	83	65	51	31	2,071	1,124
Non-lighting	Large (>500 MWh)	3	7	1	4	541	5,438
	Small (<500 MWh)	5	43	5	16	781	2,896
Total		**106**	**170**	**60**	**57**	**4,228**	**11,912**
Grand Total		**276**		**117**		**16,140**	

Table 2-4 DEP NR Custom Program 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 (>250 MWh)	3	6	237	237	237	262
	Small (<250 MWh)	51	31	350	166	236	143
Non-lighting	Large (>500 MWh)	1	4	41	490	71	561
	Small (<500 MWh)	5	16	94	294	38	475
Total		**60**	**57**	**722**	**1,188**	**581**	**1,441**
Grand Total		**117**		**1,910**		**2,022**	

Figure 2-4, Figure 2-5, and Figure 2-6 summarize the distribution of reported energy (kWh) and demand (kW) savings at the program level by technology category for the DEP service territory.

Figure 2-4 Distribution of Reported Energy Savings from DEP NR Custom Program Projects by Technology

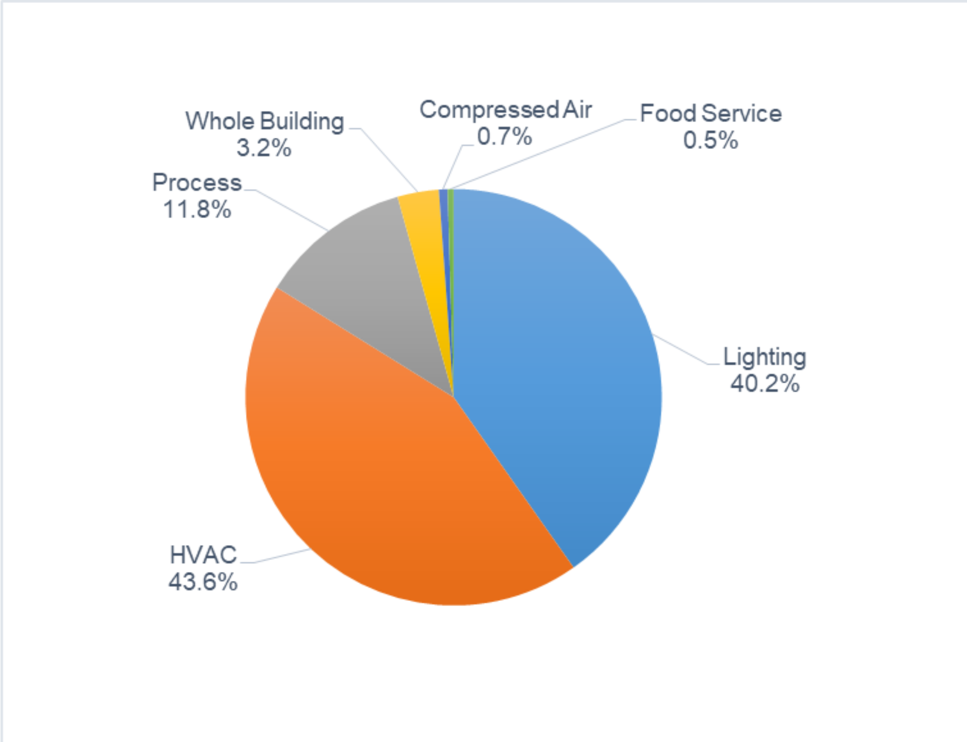


Figure 2-5 Distribution of Reported Summer Demand Savings from DEP NR Custom Projects by Technology

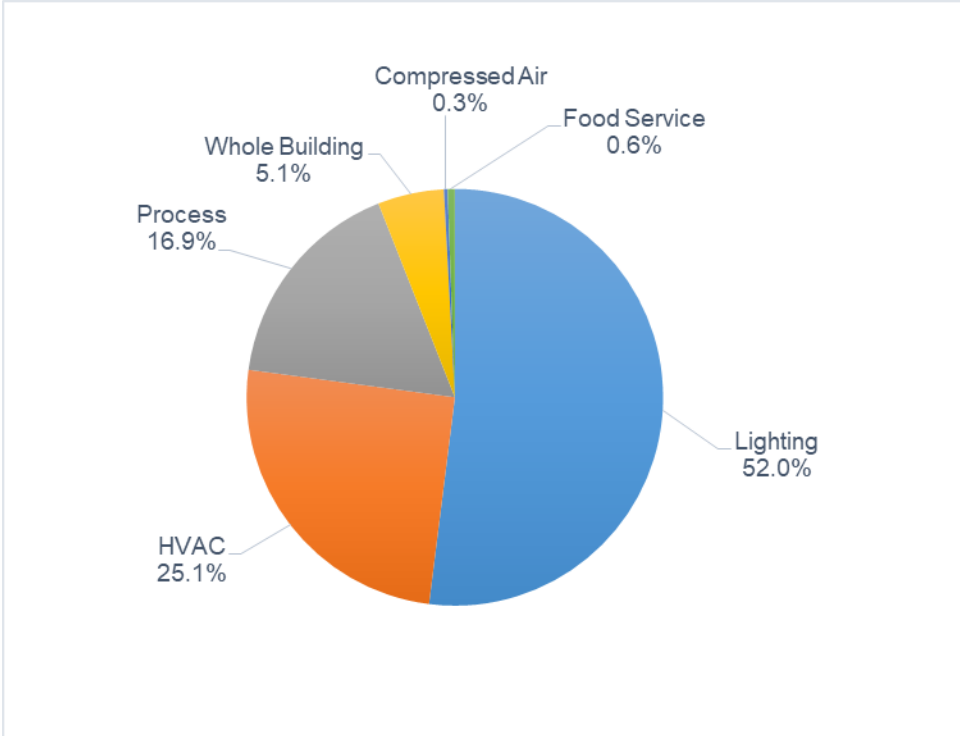
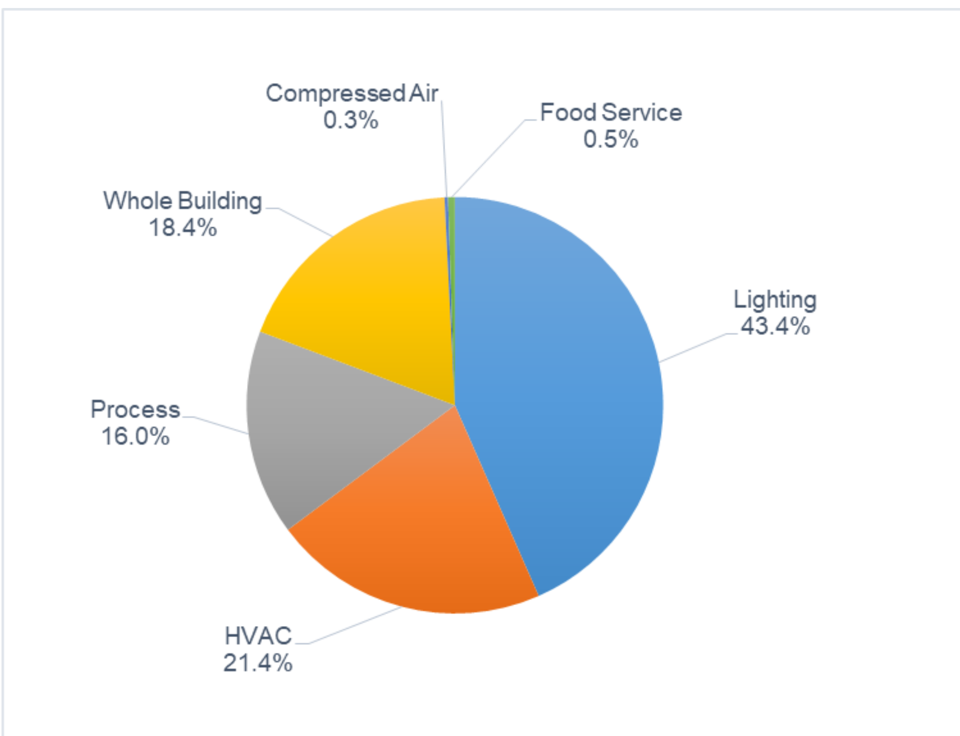


Figure 2-6 Distribution of Reported Winter Demand Savings (kW) from DEP NR Custom Projects by Technology



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 in the DEC service territory, the DEP service territory, and for both territories combined
- 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 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

A single NTG value was determined jointly for the DEC and DEP jurisdictions.

[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. Because the program is delivered the same in both DEC and DEP territories, the process evaluation reports on the overall program. 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?	✓		✓	✓

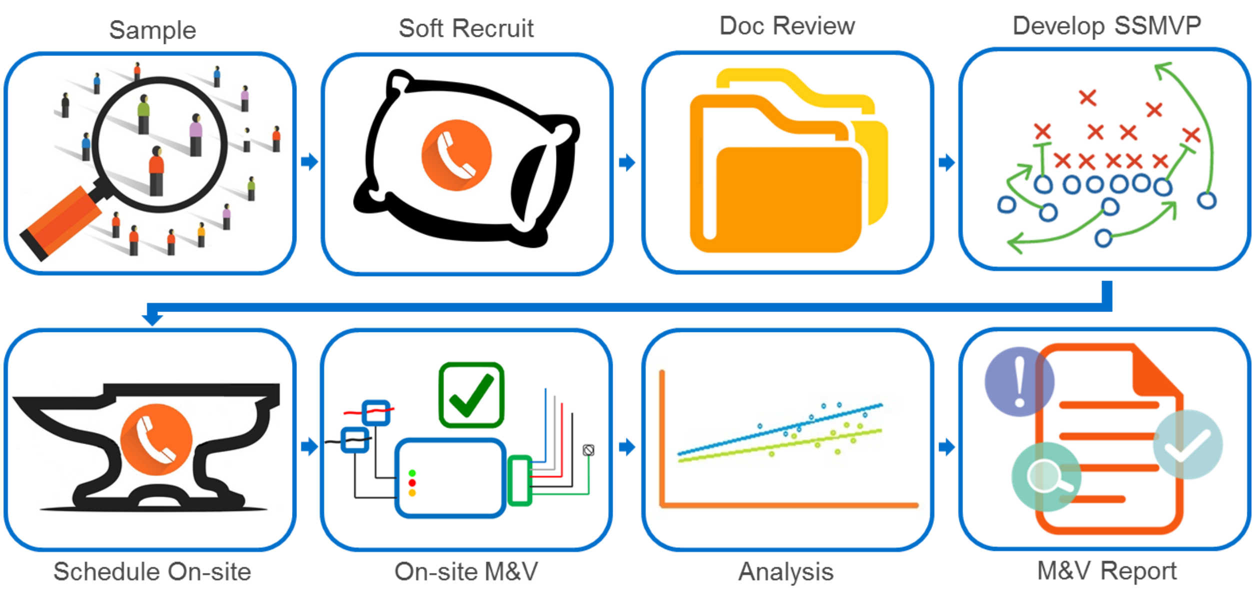
4 Impact Evaluation

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 January 2016 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. Starting in 2016 participation database extracts were requested and received quarterly in real time with the program implementation. Data included customer contact, measures, and savings information. A random sample of projects was then drawn from the population of new projects and the the evaluation team would receive site contact information and sufficient project details so as to initiate preliminary “soft-recruiting” efforts.

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 (January 2016 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.
- 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 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 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.

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 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 in both the DEC and DEP service territories. 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 Indiana 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

4.4.1 DEC Sampling

Table 4-3 presents the final achieved sample size for the DEC 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 (January 2016 - December 2017) to help ensure proper representation of measure types and program approaches as the program progressed.

Table 4-3 DEC NR Custom Sampling Plan Custom-to-Go vs. Custom Classic - Achieved

Utility	Data Collection Activity	Custom to Go	Classic	Total
Duke Energy Carolinas	Share of Participation	24%	76%	100%
	Site Visits – On-site Measurement	10	28	38
	Site Visits – On-site Verification	4	17	21
	Total	**14**	**45**	**59**

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 DEC NR Custom Stratified Sampling - Achieved

Strata	Population	Pop Reported Savings (kWh)	Achieved Sample Size
L-Large (>1,000 MWh)	18	35,491,559	5
L-Small (<1,000 MWh)	261	34,500,751	27
NL-Large (>2,000 MWh)	5	21,661,701	2
NL-Small (<2,000 MWh)	50	22,645,465	25
Total	**334**	**114,299,476**	**59**

The evaluation team used a savings threshold of 1,000 MWh as the threshold for large Lighting (L) projects and 2,000 mWh for large Non-Lighting (NL) projects. The thresholds were chosen based upon an analysis of the distribution of participant savings.

4.4.2 DEP Sampling

Table 4-5 presents the final achieved sample size for the DEP service territory. The evaluation team stratified the DEP participant population by technology category (lighting vs. non-lighting) and relative magnitude of savings (kWh). The evaluation team used a savings threshold of 250 MWh for large Lighting (L) projects and 500 MWh for large Non-Lighting (NL) projects. Our stratification approach and achieved sample sizes are summarized in Table 4-6.

Table 4-5 DEP NR Custom Sampling Plan Custom-to-Go vs. Custom Classic - Achieved

Utility	Data Collection Activity	Custom to Go	Classic	Total
Duke Energy Progress	Share of Participation	44%	56%	100%
	Site Visits – On-site Measurement	11	8	19
	Site Visits – On-site Verification	9	5	14
	Total	**20**	**13**	**33**

Table 4-6 DEP NR Custom Stratified Sampling - Achieved

Strata	Population	Pop Reported Savings (kWh)	Achieved Sample Size
L-Large (>250 MWh)	9	3,289,490	4
L-Small (<250 MWh)	82	3,195,020	19
NL-Large (>500 MWh)	5	5,979,116	3
NL-Small (<500 MWh)	21	3,676,915	7
Total	**117**	**16,140,541**	**33**

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 4-7 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 4-7 Key Data Points Gathered for Commonly Encountered ECMs

Measure Name	Baseline or Retrofit
Interior Lighting Retrofits	Quantity of existing fixtures Fixture type of existing fixtures Quantity of retrofit fixtures Fixture type of 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[4] 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)*

[4] 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 4-8 shows the average percent power versus percent capacity for rotary screw compressors with various control methods[5].

Table 4-8 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%

5 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 4-9.

Table 4-9 Definition of Peak Demand Periods

	Summer	Winter
Month	July	January
Hour	4pm – 5pm	7am – 8am

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 94 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 in both service territories. 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. In fact, the evaluated energy and demand realization rates indicate that the program is conservative when developing savings estimates. 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. Five sets of models was developed for the DEC and DEP service territories using TMY3 weather data from Raleigh-Durham, Charlotte, Asheville, Greensboro and Greenville. Table 4-10 presents the interactive factors developed by the evaluation team for each building type and weather station.

Table 4-10 Interactive Factors by Facility Type and Weather Station

Building Type	Asheville, NC	Greensboro, NC	Greenville, SC	Raleigh-Durham, NC	Charlotte, NC
Assembly	104.4%	107.6%	108.6%	108.7%	109.0%
Bio Tech Manufacturing	107.1%	112.2%	113.7%	114.0%	114.4%
Community College	104.1%	107.1%	108.0%	108.2%	108.4%
Hospital	106.0%	110.3%	111.6%	111.8%	112.2%
Hotel	105.5%	109.4%	110.5%	110.8%	111.1%
Light Industrial Manufacturing	100.1%	100.1%	100.1%	100.1%	100.1%
Motel	114.4%	124.6%	127.7%	128.3%	129.1%
Nursing Home	113.2%	122.7%	125.6%	126.2%	126.9%
Office Large	103.1%	105.3%	106.0%	106.1%	106.3%
Office Small	101.4%	102.5%	102.8%	102.8%	102.9%
Primary School	100.6%	101.1%	101.2%	101.3%	101.3%
Restaurant Fast Food	101.7%	102.9%	103.2%	103.3%	103.4%
Restaurant Sit Down	98.4%	97.2%	96.9%	96.8%	96.7%
Retail Large	102.2%	103.8%	104.2%	104.3%	104.5%
Retail Small	100.4%	100.7%	100.8%	100.8%	100.8%
Secondary School	101.1%	101.8%	102.1%	102.1%	102.2%
University	108.2%	114.0%	115.8%	116.1%	116.6%
Warehouse Conditioned	105.7%	109.7%	111.0%	111.2%	111.5%

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 4-11 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 724,277 kWh or 4.6% of total verified energy savings (15,678,725 kWh) for all lighting projects. Interactive effects account for approximately 6.0% of verified energy savings for projects with space cooling.

Table 4-11 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
Warehouse	7,330,480	662,018	9.03%
Light Industria/Manufacturing	3,727,968	3,458	0.09%
University	517,321	52,058	0.80%
Retail	371,303	2,971	10.06%
Office	44,378	1,049	2.36%
Primary School	32,236	413	1.28%
Assembly	22,484	1,973	8.78%
Healthcare	5,598	335	5.99%
Total	**12,051,767**	**724,277**	**6.01%**

4.8.2 Gross Impacts - DEC

Table 4-12, Table 4-13, and Table 4-14 summarize gross impact results for energy (kWh), Summer demand (kW), and Winter demand (kW) for the DEC service territory. Detailed results for each sampled project are provided in the standalone M&V Reports.

Table 4-12 DEC 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 (>1,000 MWh)	18	5	35,491,559	37,792,452	106.5%	4.4%
L-Small (<1,000 MWh)	261	27	34,500,751	37,552,406	108.8%	30.7%
NL-Large (>2,000 MWh)	5	2	21,661,701	23,301,600	107.6%	9.2%
NL-Small (<2,000 MWh)	50	25	22,645,465	21,862,911	96.5%	38.0%
Total	**334**	**59**	**114,299,476**	**120,509,368**	**105.4%**	**12.0%**

Table 4-13 DEC 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 (>1,000 MWh)	18	5	4,854	5,636	116.1%	4.8%
L-Small (<1,000 MWh)	261	27	6,151	6,758	109.9%	29.8%
NL-Large (>2,000 MWh)	5	2	2,107	3,369	159.9%	38.5%
NL-Small (<2,000 MWh)	50	25	3,276	3,237	98.8%	76.6%
Total	**334**	**59**	**16,389**	**19,000**	**115.9%**	**18.2%**

Table 4-14 DEC 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 (>1,000 MWh)	18	5	4,398	5,031	114.4%	6.5%
L-Small (<1,000 MWh)	261	27	5,218	5,996	114.9%	33.8%
NL-Large (>2,000 MWh)	5	2	2,559	5,372	209.9%	9.2%
NL-Small (<2,000 MWh)	50	25	2,933	2,316	79.0%	126.9%
Total	**334**	**59**	**15,109**	**18,716**	**123.9%**	**19.3%**

4.8.2.1 Custom-to-Go vs. Custom Classic - DEC

Custom-to-Go realization rates were higher primarily based upon the fact that the majority of savings come from lighting measures. Lighting measures represent 89.7% of total Custom-to-Go project reported energy savings, whereas for Classic Custom projects lighting measures account for only 55.8% of gross reported energy savings. Figure 4-2 shows the distribution of reported energy savings for classic custom projects broken down by technology category. Figure 4-3 shows the distribution of reported energy savings for Custom-to-Go projects.

Figure 4-2 Distribution of Reported Energy Savings for DEC Classic Custom Projects by Technology Category

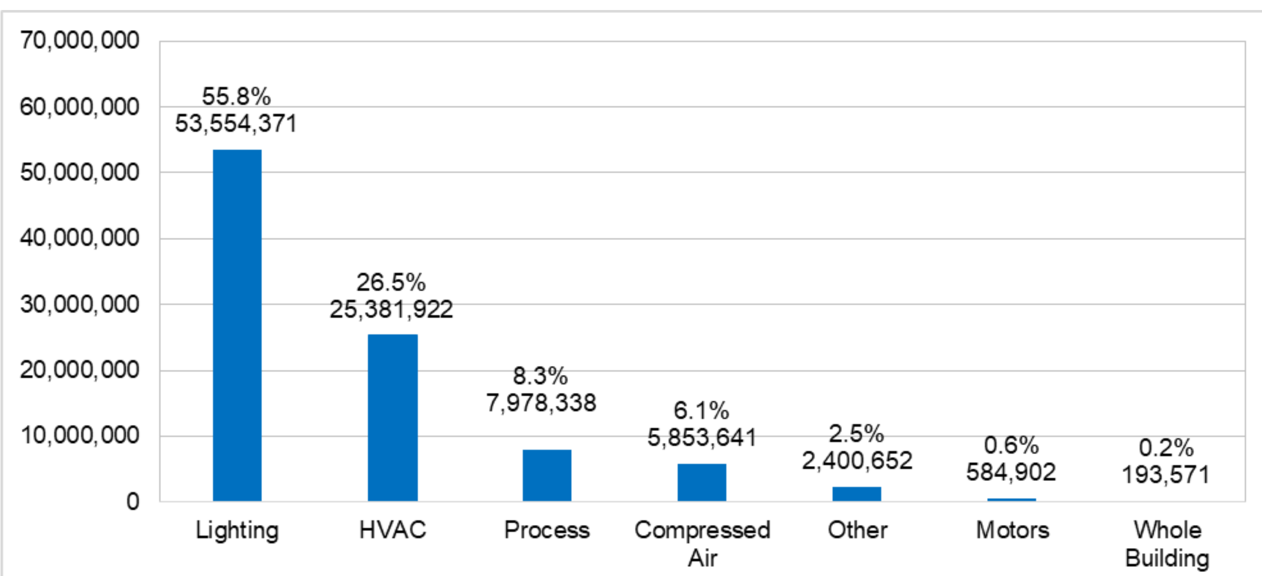


Figure 4-3 Distribution of Reported Energy Savings for DEC Custom-to-Go Projects by Technology Category

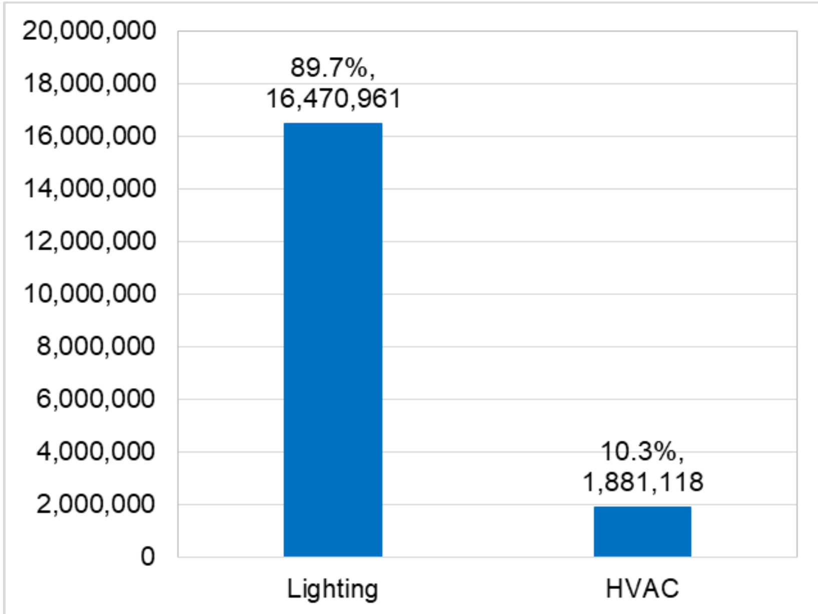


Table 4-15 shows the reported and verified energy (kWh) savings stratified by technology category (lighting vs. non-lighting) and participation track (Custom Classic vs. Custom-to-Go) for the evaluated sample.

Table 4-15 Comparison of Strata-Level Realization Rates - Classic vs. Custom-to-Go - DEC

Track	Measure Category	Sample	Sample Reported (kWh)	Sample Verified (kWh)	Realization Rate (%)
Classic	Lighting	21	10,890,605	11,648,353	107.0%
	Non-lighting	24	21,982,540	22,212,501	101.0%
	Total	**45**	**32,873,146**	**33,860,855**	**103.0%**
Custom-to-Go	Lighting	11	805,776	901,186	111.8%
	Non-lighting	3	834,272	820,142	98.3%
	Total	**14**	**1,640,048**	**1,721,328**	**105.0%**

4.8.3 Gross Impacts - DEP

Table 4-16, Table 4-17, and Table 4-18 summarize gross impact results for energy (kWh), Summer demand (kW), and Winter demand (kW) for the DEP service territory. Detailed results for each sampled project are provided in the standalone M&V Reports.

Table 4-16 DEP 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 (>250 MWh)	9	4	3,289,490	3,662,303	111.3%	6.6%
L-Small (<250 MWh)	82	19	3,195,020	3,110,400	97.4%	41.0%
NL-Large (>500 MWh)	5	3	5,979,116	6,075,769	101.6%	0.9%
NL-Small (<500 MWh)	21	7	3,676,915	4,213,289	114.6%	20.6%
Total	**117**	**33**	**16,140,541**	**17,061,762**	**105.7%**	**9.2%**

Table 4-17 DEP 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 (>250 MWh)	9	4	475	519	109.4%	11.4%
L-Small (<250 MWh)	82	19	516	448	86.8%	143.0%
NL-Large (>500 MWh)	5	3	531	519	97.7%	0.7%
NL-Small (<500 MWh)	21	7	388	415	106.9%	55.7%
Total	**117**	**33**	**1,910**	**1,901**	**99.5%**	**36.1%**

Table 4-18 DEP 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 (>250 MWh)	9	4	499	667	133.8%	27.7%
L-Small (<250 MWh)	82	19	379	532	140.3%	227.8%
NL-Large (>500 MWh)	5	3	632	622	98.5%	1.8%
NL-Small (<500 MWh)	21	7	512	659	128.5%	17.2%
Total	**117**	**33**	**2,022**	**2,480**	**122.7%**	**49.6%**

4.8.3.1 Custom-to-Go vs. Custom Classic - DEP

Custom-to-Go realization rates were higher primarily based upon the fact that the majority of savings come from lighting measures. Lighting measures represent 68.7% of total Custom-to-Go project reported energy savings, whereas for Classic Custom projects lighting measures account for only 30.1% of gross reported energy savings. Figure 4-4 shows the distribution of reported energy savings for classic custom projects broken down by technology category. Figure 4-5 shows the distribution of reported energy savings for Custom-to-Go projects.

Figure 4-4 Distribution of Reported Energy Savings for DEP Classic Custom Projects by Technology Category

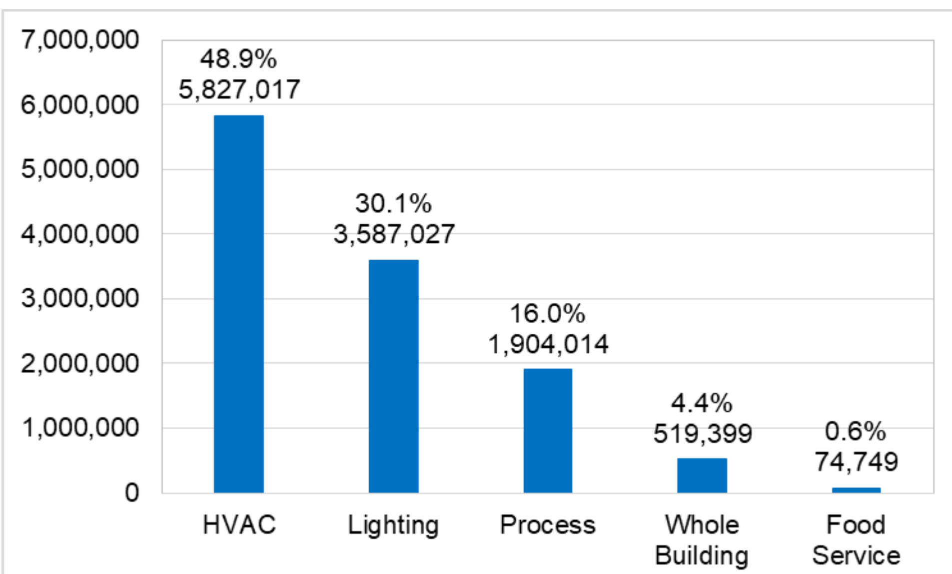


Figure 4-5 Distribution of Reported Energy Savings for DEP Custom-to-Go Projects by Technology Category

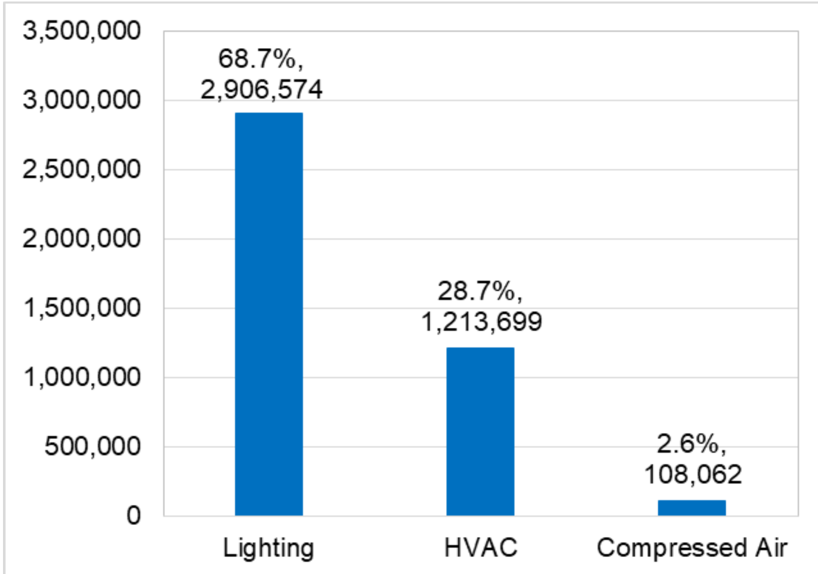


Table 4-19 shows the reported and verified energy (kWh) savings stratified by technology category (lighting vs. non-lighting) and participation track (Custom Classic vs. Custom-to-Go) for the evaluated sample.

Table 4-19 Comparison of Strata-Level Realization Rates - Classic vs. Custom-to-Go - DEP

Track	Measure Category	Sample	Sample Reported (kWh)	Sample Verified (kWh)	Realization Rate (%)
Classic	Lighting	7	948,608	958,886	101.1%
	Non-lighting	6	2,993,031	3,090,401	103.3%
	Total	**13**	**3,941,639**	**4,049,287**	**102.7%**
Custom-to-Go	Lighting	16	1,373,216	1,477,834	107.6%
	Non-lighting	4	909,075	979,924	107.8%
	Total	**20**	**2,282,292**	**2,457,759**	**107.7%**

4.8.3.2 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 Rending 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 Indiana, Ohio, North Carolina, and South Carolina.

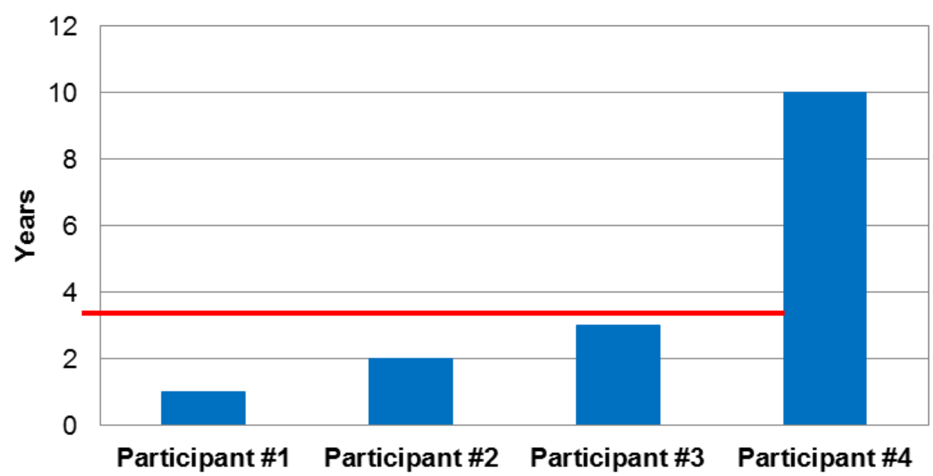
In an effort to gain direct insights on this issue from participants and trade allies, the evaluation team developed a battery of survey questions for each program participant and incorporated them into the survey instruments developed for this evaluation. The set of survey questions developed for participants was only fielded by those who implemented lighting retrofits involving linear fluorescent T12s, which was very limited (total of four across all jurisdictions being evaluated and only one from DEI). 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?"*
  - 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 4-6)

Figure 4-6 How Long Participant Could Have Continued Using T12 Fixtures

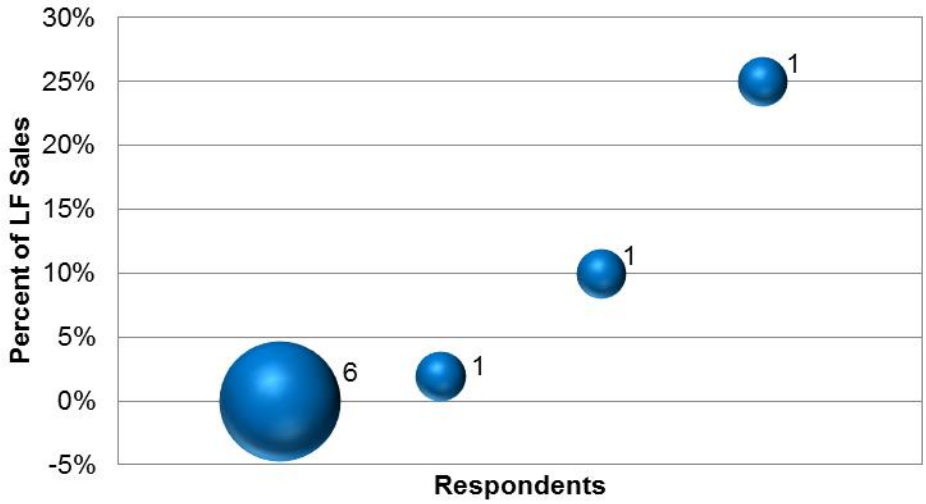


Trade Ally Surveys

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 4-7)

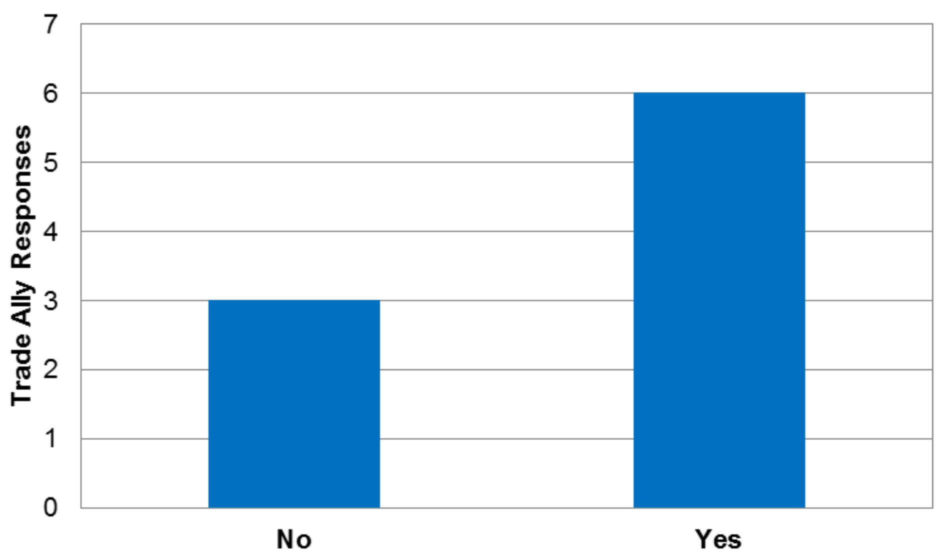
Figure 4-7 Percentage of 2017 Linear Fluorescent Lighting Sales that were T12 According to Surveyed Trade Allies



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 4-8)

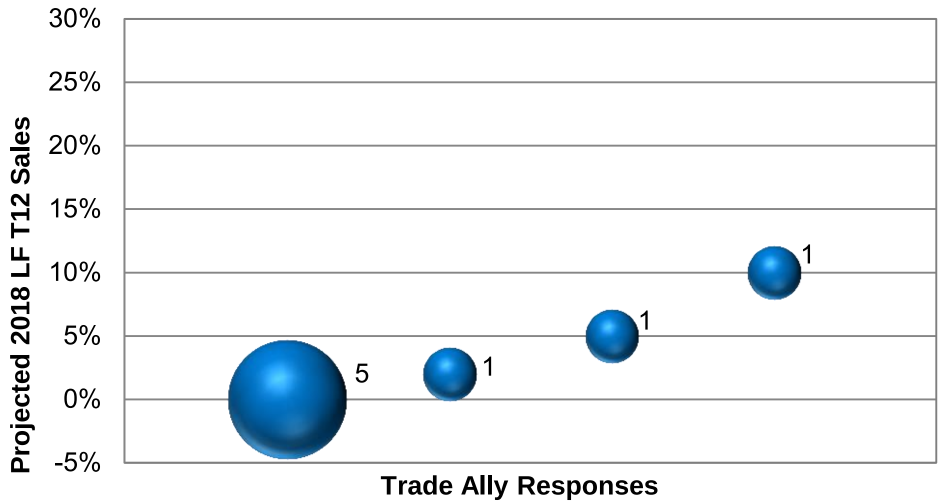
Figure 4-8 Are Trade Allies Still Stocking Linear Fluorescent T12 Replacement Lamps



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 4-9)

Figure 4-9 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 4-10.

Figure 4-10 Comparison of Verified Energy Savings (kWh) and Realization Rates when Using T12 vs. T8 Baseline for Linear Fluorescent Retrofits

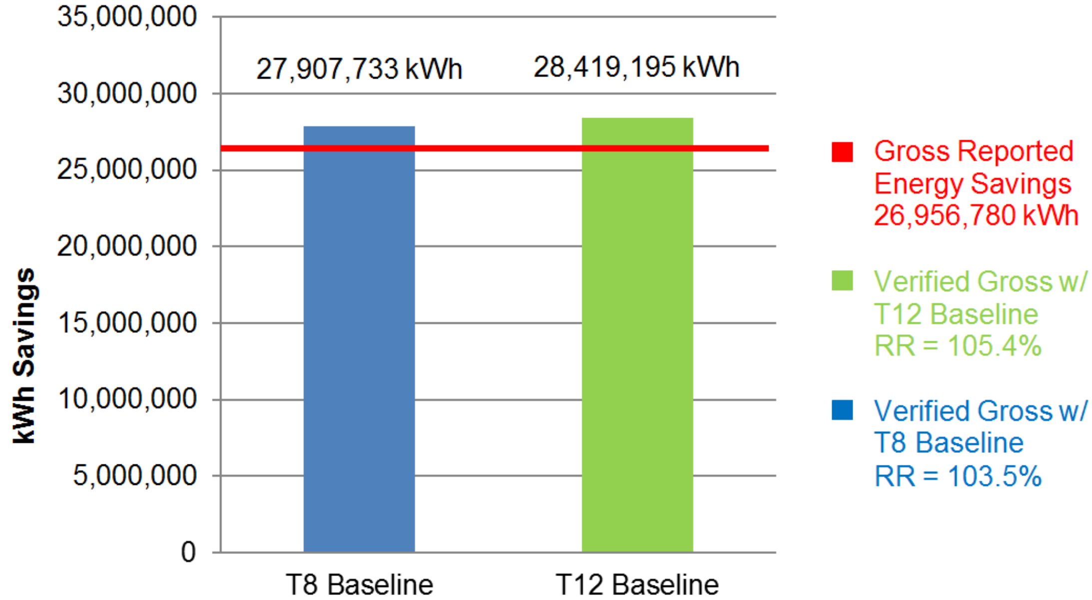


Figure 4-10 indicated that the overall impact on verified energy savings at the program level is very small regardless of whether a T12 or a T8 baseline is used for linear fluorescent fixture retrofits. Verified energy savings would reduce by approximately 511,462 kWh or 1.8%. Due to the relative minimal 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.[6] The survey was designed based on established methodologies outlined in the Pennsylvania Evaluation Framework.[7]

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	=	*program-level net-to-gross ratio*
FR_p	=	*program-level free-ridership ratio*
SO_p	=	*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. If the respondent answered they

[6] https://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf, Section 3.2.

[7] http://www.puc.state.pa.us/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework082516.pdf, Appendix B.

would have done exactly the same project without the program, they are asked if they would have paid the additional amount they received in incentives to complete the project.

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

<table>
<tr><th>Program Aspect</th><th>Max Rating →
Influence Score</th></tr>
<tr><td>Incentive provided by Duke Energy</td><td rowspan="5">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</td></tr>
<tr><td>Interactions with Duke Energy</td></tr>
<tr><td>Duke Energy marketing materials</td></tr>
<tr><td>Previous experience with Duke Energy programs</td></tr>
<tr><td>Contractor or vendor recommendation</td></tr>
</table>

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}	=	*program-attributable spillover savings*
kWh_{gso}	=	*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 net-to-gross interviews with 61 customers who completed projects at 75 different locations in the DEP and DEC territories. Most customers (51 of 75 projects) reported they would have put off the project, 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 all 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.

Table 5-4 What Would You Have Done Had You Not Received an Incentive?

Response	DEC	DEP
Canceled or postponed the project	29	9
Done a smaller or less efficient project	11 Large reduction (1) Moderate reduction (6) Small reduction (4)	2 Large reduction (0) Moderate reduction (2) Small reduction (0)
Done exactly the same project	21 Would have paid (21) Would not have paid (0)	3 Would have paid (3) Would not have paid (0)

When asked to rate the influence of the program on their decision to complete the energy-efficiency project, nearly 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. Customers who had previously participated a Duke Energy program rated that experience as particularly influential.

The resulting free-ridership, spillover, and net-to-gross ratios 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	DEC	DEP	Combined[8]
Net of Free-ridership	78.9%	70.8%	78.5%
Program-influenced Spillover	0.4%	0.0%	0.4%
Net-to-Gross	**79.2%**	**70.8%**	**78.8%**

The evaluation team notes that the DEP results are based on a small number of completed interviews. While the DEC results are estimated to be accurate ±4.5% with 90% confidence, the DEP results have a much wider confidence interval of ±16%. The combined results have a confidence interval of ±4.5%. This reflects that the DEP result is only based on 14 observations and there is notable variation in the individual responses. Because the evaluation team did not originally plan to produce a precise result for each territory individually, we did not stratify our survey sample or target a certain level of response from each territory. We recommend that Duke Energy should use the combined result for DEP since we believe it is more reflective of program operations.

The overall result of 78.8 percent net-to-gross reflects that the program was a primary influence in customers’ energy savings actions. The evaluation team offers some observations on the

[8] The combined results are weighted using the same kWh-based weights used for DEC and DEP results, since this accounts for individual project sizes as well as the relative size of the programs across the two jurisdictions.

drivers of the free-ridership that does exist, though many of these observations are qualitative since they are based on a small number of observations.

- Controls (BAS), HVAC Units, LEDs, and Compressors had higher than average free-ridership, while Chillers, Manufacturing Equipment, and Occupancy Sensors were lower than average. The result of 25% free-ridership for LEDs is the only result with a sufficient number of responses (60) to be a meaningful result, the other measures range from one to eight responses.
- Responses to the second wave of the survey resulted in much higher net-to-gross (94%, n=18) than those from the first wave (76%, n=57).
- There were no full free-riders, or customers with 100% freeridership scores, in the DEC territory, but there were several in the DEP territory.

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. Because the program is delivered the same between the two territories, we report combined activites and results for DEC and DEP together for the process evaluation. 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. Table 6-1 summarizes the process evaluation data collection activities.

Table 6-1 Summary of Process Evaluation Data Collection Activities

Target Group	Completes
Staff	2 In-depth interviews
Participants	81 Telephone survey (65 unique participants)[9]
Contractors	24 In-depth interviews

6.1.1 Program Staff Interviews and Database Review

Two 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

[9] 65 DEC participant projects (52 unique survey respondents); 16 DEP participant projects (13 unique survey respondents)

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.

The evaluation team selected implementation contractors associated with customer projects from the tracking database provided by Duke Energy. Discussion topics in the interviews included program awareness among customers, program guidelines and processes, interactions with customers, and suggestions for improving the program. Interviews were completed with 24 of 59 program contractors who participated in the program. The interviews were completed in February and March 2018 and the average interview length was 26 minutes. The average number of telephone attempts for cases that were not completed was 4.5. Table 6-2 outlines the contractor response rate for the evaluation.

Table 6-2 Contractor Response Rate

Disposition	Contractor Count
Starting Sample	**59**
Does not recall participating	1
No knowledgeable respondent	5
Refusal	4
Bad phone number	1
Attempted but not completed	24
Completes	**24**
Response Rate (Complete/Starting Sample)	**40.6%**

6.1.3 Participant Surveys

Collecting survey data from program participants provides data suitable for quantitative analyses of participant characteristics and satisfaction with key aspects of the program. The evaluation team conducted a telephone survey with program participants, defined by customers who received a rebate through Duke Energy's NR Custom program between January 2016 and December 2017. Surveys were conducted with program participants in two waves; the first wave was in October 2017 and the second wave was in March 2018. 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 completed for 81 of the 118 projects completed through the program (52 DEC and 13 DEP unique respondents).

Table 6-3 outlines the participant response rate of the evaluation.

Table 6-3 Participant Response Rate

Disposition	DEC	DEP	Overall
Starting Sample	**89**	**29**	**118**
Does not recall participating	2	0	2
Refusal	4	5	5
Incompletes (partial surveys)	0	1	1
Wrong number	2	0	2
Not completed	16	11	27
Completes	**65**	**16**	**81**
Response Rate (Complete/Starting Sample)	**73.0%**	**55.2%**	**68.6%**

Wave 1 calling started October 5, 2017 and ended October 26, 2017

Wave 2 calling started March 14, 2018 and ended March 23, 2018

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 the information obtained from the interviews was used to design the interview guides and surveys for program participants and contractors. Information from staff interviews are included 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. For evaluation purposes, some necessary information was 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 incorrect. Understanding which customers received a Custom incentive is critical in evaluating progress towards program goals and conducting an independent review of program participants.

The evaluation team recommends that post installation ECM quantities be tracked in the participation tracking database and incentive calculation worksheets so as to improve the evaluability of the program. . The evaluation team encountered several lighting projects where the ECM quantity was indicated to be “1”, but was known to be multiple based upon review of other project documentation, invoices, and/or application forms. The evaluation team determined that this was an internal policy for non one-for-one retrofits or in cases where measure-level savings represented a mix of post installation fixture wattages. This issue created a challenge when it came to determining what the program used for baseline watts per fixture in ex ante energy savings estimates. The evaluation team understands why this approach is used by the program team, but feels that accurately tracking post installation ECM quantities within the tracking database would make per fixture energy savings more transparent.

In conducting the process evaluation telephone efforts, some contact information associated with some participants was also out of date. Some level of personnel turnover at companies is expected, resulting in having contact information for people who no longer work for listed companies. Also, in trying to reach contractors, the evaluation team had more success on records where contractors provided a phone number for a cellphone. When office numbers were provided, many calls went straight to voicemail with very few messages returned. Contractors tend to work outside the office so the ability to reach them on their cell is key to gaining their feedback and having the ability to schedule a call during a convenient time.

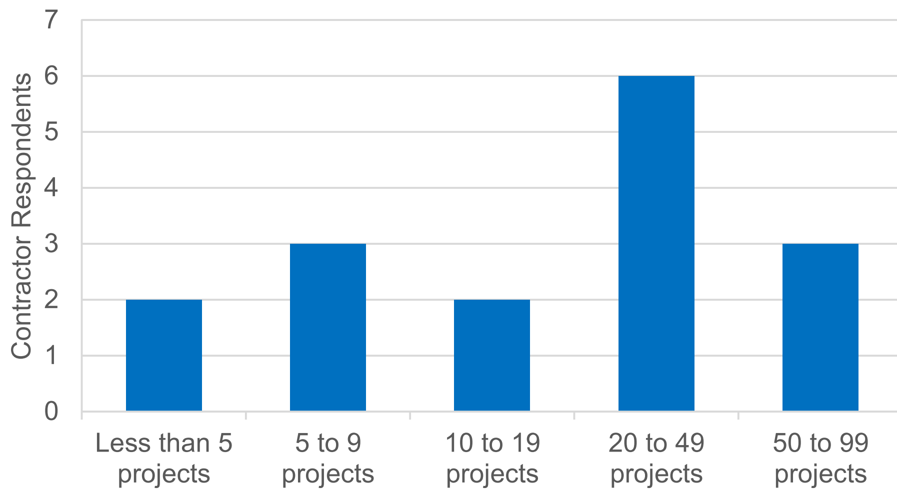
The evaluation team recommends that Duke pursue and obtain alternate site contact names, phone numbers, and email addresses from program participants to better ensure a line of communication is maintained between the contract information and the program records once a project is completed.

6.2.2 Contractors

The evaluation team interviewed 24 contractors who were involved in the installation of participating customer's projects during the evaluation period. Most of the interviewed contractors were companies that mainly provided lighting retrofit services (22 respondents). The remaining contractor respondents serve other end uses such as HVAC equipment and compressors. The amount of time these contractors have been involved in the program varied with two contractors indicating they have participated in Duke Energy's programs for one to two years, eight contractors indicating they have been involved between three to five years, and eleven have been involved for more than five years. Three 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 over 50 with most indicating between 20 and 50 projects. 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.

Figure 6-1 Number of Total Completed Projects



6.2.2.1 Communication

Duke Energy has a dedicated trade ally outreach team who travel and conduct in-person meetings. Trade allies can sign up and become an approved trade ally and be mentioned on Duke Energy's website. Most contractors reported that communication with Duke Energy program staff was effective and that staff was available when they had any questions about the program or application. Eleven contractor respondents indicated they have received trainings and information from Duke Energy about the NR Custom program in the form of one-on-one informational meetings, lunch and learns at the company, or webinars. Five contractors were not sure if they received a training, and the remaining nine reported not receiving a training. Few of the latter contractors indicated that they were able to gather the necessary information about the program from Duke Energy through the website or emails. Three contractors stated that additional trainings/information could be provided regarding savings estimations, non-lighting equipment, and new services provided by Duke Energy. Some specific comments included the following:

> *"The application seemed to be geared towards lighting, compressors are a small segment of the rebate process. A guide of everything that would be applicable to the program [not just related to compressors and dryers but if there is something else like vacuums] would be helpful."*

> *"...especially training with building automation would be beneficial. It's hard to know what path to achieve to save the customer money. It's hard to figure out if I have a viable custom incentive project."*

6.2.2.2 Customer Interaction

Many contractors felt they were at least partially responsible for customer awareness, especially in explaining the difference between custom and prescriptive and the application process. Fourteen contractor respondents felt that their customers were not aware of the program prior to telling them about it. Many of these contractors indicated, however, that the customers were aware of the availability of rebates through Duke Energy but did not specifically know about the Smart$aver programs or the custom incentives offering. Three contractors felt that few of their customers were aware of the program, and six other contractors reported that at least half of their customers knew about it. The remaining respondent could not comment on program awareness because he was not involved in sales.

When asked about the impact of the program on their recommendations of high efficiency equipment, 15 contractor respondents reported that they always recommend high efficiency equipment since that is the nature of their business (e.g. LED lighting, retrofits), and 3 contractor respondents indicated that they recommend high efficiency equipment over 90 percent of the time. Although most of the contractors also reported that their recommendations before and after the program have not changed, one contractor indicated that his recommendations of high efficiency equipment increased from 50 to 75 percent after learning about the program. One contractor, who indicated they always recommend high efficient equipment, added that "*once the rebates came into play we definitely started educating our customers and advising them to purchase high efficiency equipment*." The remaining respondents did not know or were not able to answer the question.

Contractors were asked to estimate the frequency in which their customers planned to purchase high efficiency equipment before and after learning about the program. Ten contractor respondents indicated that customer plans to purchase high efficiency equipment increased on average from 40 to 80 percent after learning about the program. Two contractors reported that customers' plans were the same before and after learning about the program with one contractor indicating they only sell high efficiency products. Some of the remaining respondents did not provide a percentage but indicated that the program helps sell more high efficiency equipment.

When talking with contractors, 6 of 24 respondents indicated that customers do not have any concerns about the program. From the remaining respondents, 15 contractors mentioned a variety of customer concerns about participating, as outlined in the table below. Uncertainty about the preapproval process was the frequently cited concern; it includes thinking that the preapproval process is going to be too long, or that the company is obliged to move forward with the project after getting preapproved. Three contractors felt there was some customers confusion about the differences between custom and prescriptive, specifically, the steps required in the application process, and the quality of the qualified equipment. Three contractors mentioned concern about the incentives not being as high as estimated and another contractor reported a concern about receiving incentive at all. Two contractors indicated that customers are sometimes skeptical and need reassurance from Duke Energy about the program and a confirmation that the contractor is a program trade ally. The remaining contractors reported that customers are sometimes not sure if the equipment qualifies, or if they can keep the old equipment.

Table 6-4 Contractor Reported Customer Concerns About the Program

Concern	Respondents
Uncertainty about the preapproval process	7
Unsure about the difference between custom and prescriptive	3
Unsure if the incentive will be as high as estimated	3
Skeptical about the program offerings	2
Unsure if they will receive the incentive	1
Unsure if the equipment qualifies	1
Unsure if they can keep the old equipment (in case it is still functional)	1
Respondents	**15**

Source: Question 7
Don't know responses are excluded.

Eight of the 24 contractor respondents indicated that they use the program as a sales tool and that the program is helpful in selling energy efficient equipment. Many contractor respondents reported that the main reason some customers do not move forward with projects is financial in nature such as lack of funds or high costs (10 respondents). This was followed by reallocation of funds due to an emergency (2 respondents), project not meeting payback or ROI criteria (1 respondent), the prescriptive option being cheaper (1 respondent), and a timing issue (1 respondent). One contractor explained that they sometimes did not vet the customer well enough to assess their ability to move forward with the project before offering a potential custom incentive. Some specific comments included the following:

> *"Normally it's just because [the customers] decided not to complete the project in general. Whether the funds were not available or the project was not approved at the customer side for financial reasons."*

> *"Nothing to do with Duke, it's more where [the customers] need to be from a payback stand point, from corporate."*

> *"Something came up or some catastrophic thing happened, which made [the customer] reallocate the funds, or the customer realized that cost of opting in was too much to justify the reward."*

6.2.2.3 Application Process

Thirteen contractor respondents indicated that they received a request for additional information after submitting their initial application for preapproval. Typical requests were related to missing documents such as electricity bills (7 respondents), clarification about calculations and energy model assumptions (4 respondents), additional documentation about the equipment such as specification sheets (3 respondents), or updated W9 forms (2 respondents).

Based on contractor respondent feedback, the preapproval process takes on average 2.8 weeks for lighting projects and longer, 6 to 12 weeks, for non-lighting projects. Most contractors seemed satisfied with the duration, however, when asked if there were any suggestions to improve the program, seven contractor respondents had improvement suggestions specific to the application. Five contractor respondents requested shortening the preapproval process while four contractor respondents recommended streamlining the application process. Streamlining suggestions including simplifying the calculation requirements and paperwork by providing engineering services to reduce the burden on the contractors, or by tailoring it to non-lighting equipment (e.g. compressors). Some specific comments included the following:

> *"Every time, I have to submit duplicate documents. I understand the need for it but I would think that certain things could be kept on file. When I send an email, it would be with 11 or 13 attachments. A lot of stuff to send in."*

> *"Take out the need for a full-blown engineering solution so that a sales person like me could do [the application] without the need for an engineer. That's the difficulty there. If Duke would provide the engineering service, that would be helpful."*

> *"The pre-approval process is confusing for some customers, you get an estimated offer and it is turned into an actual offer. Sometimes it didn't come back a match penny for penny. A quicker turnaround time and explanation as why the incentive amount has changed would be helpful."*

Email applications have been used almost exclusively for the past three years. Although starting in 2016, an online application portal was launched. All but four contractors were aware of the online application portal, and 13 indicated they have used the portal and found it very useful. The contractor respondents who were aware of the online portal but have not used it (5 respondents) mentioned that they prefer to use paper and/or to have a tangible document to show to the customer. No matter the method, most contractors reported they submit the application for their customers.

6.2.2.4 Calculators

As part of the application process, and to receive incentives through the NR 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. Sixteen respondents mentioned using Duke Energy provided tools while seven mentioned they only use their own/other tools (Table 6-5).

Table 6-5 Calculators Used by Contractors

Calculators Used	Respondents
Custom-to-go only	9
Own calculators only	7
Custom-to-go and own calculators	2
Classic Custom only	2
Classic Custom and own calculators	2
Custom-to-go, Classic Custom and own calculators	1
Respondents	**23**

Source: Question 24
Don't know responses are excluded.

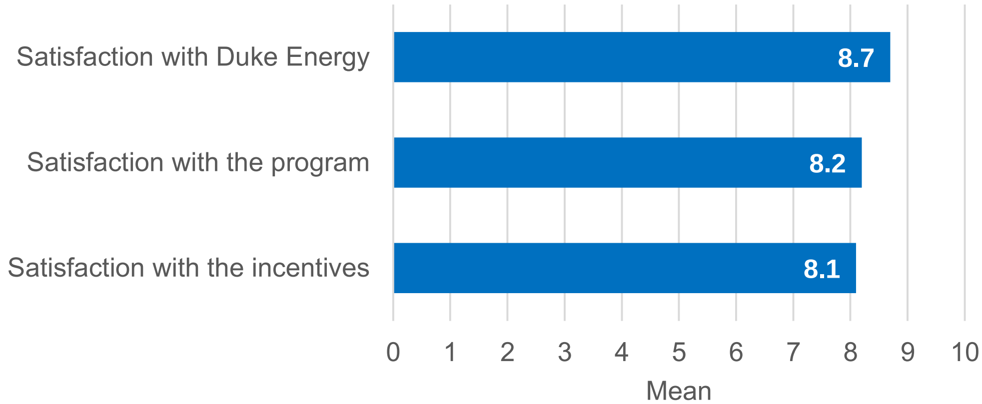
Contractor respondents who used Duke provided calculators were asked to rate their usefulness on a 0 to 10 scale where 0 was 'not at all useful' and 10 was 'very useful.' Both calculators were rated as being useful with mean scores of 9.0 and 8.3 for Custom-to-go and Classic Custom, respectively. While overall the usefulness of the calculators was high, those contractors who complete non-lighting projects rated the usefulness lower or use their own calculators.

Respondents who did not use the calculators provided by Duke reported using their own calculators because they are trained to use them, or their calculators are customized to their company or are more advanced.

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 Duke Energy 8.7 and their satisfaction with the program 8.2. Using the same scale, contractors were also asked to rate their satisfaction with the incentives provided through the NR Custom program. Contractors were generally satisfied with the incentives, as shown in Figure 6-2.

Figure 6-2 Contractor Satisfaction with Program Components



Source: Questions 13, 16, 17
Don't know responses are excluded.

Most contractor respondents felt the incentives was the most influential in customers' decision to purchase high-efficiency equipment; on average a rating of 8 on a 0 to 10 scale where 0 was 'not at all influential' and 10 was 'very influential.' Other factors that play a role in customers deciding to purchase high-efficiency equipment mentioned by the contractors included planning and financing (3 respondents), reliability of the equipment (2 respondents), energy and long term monetary savings (2 respondents), and increased capacity (1 respondent).

As far as improvements to the program, nine contractor respondents indicated no changes were needed. Most of the remaining contractor respondents (7 of 12) had suggestions related to the application process, as described above. Other responses varied between increasing the incentives to make the custom program more attractive to customers (e.g., to encourage controls offerings such as motion sensors) (3 respondents), increasing transparency in relation to savings estimations or changes in the final incentives amount received by the customer (2 respondents), moving more lighting equipment to prescriptive (1 respondent), and keeping contractors informed about program changes (e.g., new W9 form) (1 respondent).

Table 6-6 Contractor Suggestions for Program Improvements

Suggestion	Overall
Shorten preapproval time	5
Streamline the application process	4
Increase the incentives	3
Increase transparency	2
Move more lighting equipment to prescriptive	1
Keep contractors informed about program changes	1
Respondents	**12**

Source: Question Q31
Don't know responses are excluded.

Some specific comments included the following:

> *"The only thing that comes to mind is the value of potential incentives for controls offerings to encourage folks to utilize controls more frequently, for example motion sensors. That's the single biggest thing. Also, the incentive could be more generous."*
>
> *"The only thing they could do is make it more easier to explain to our customers and for us to estimate the savings and ROI upfront."*
>
> *"Shorten preapproval time… the actual incentive amounts should be higher. Custom projects tend to cost the customers more money so anything you can do to make the incentive amount more attractive to the customer."*

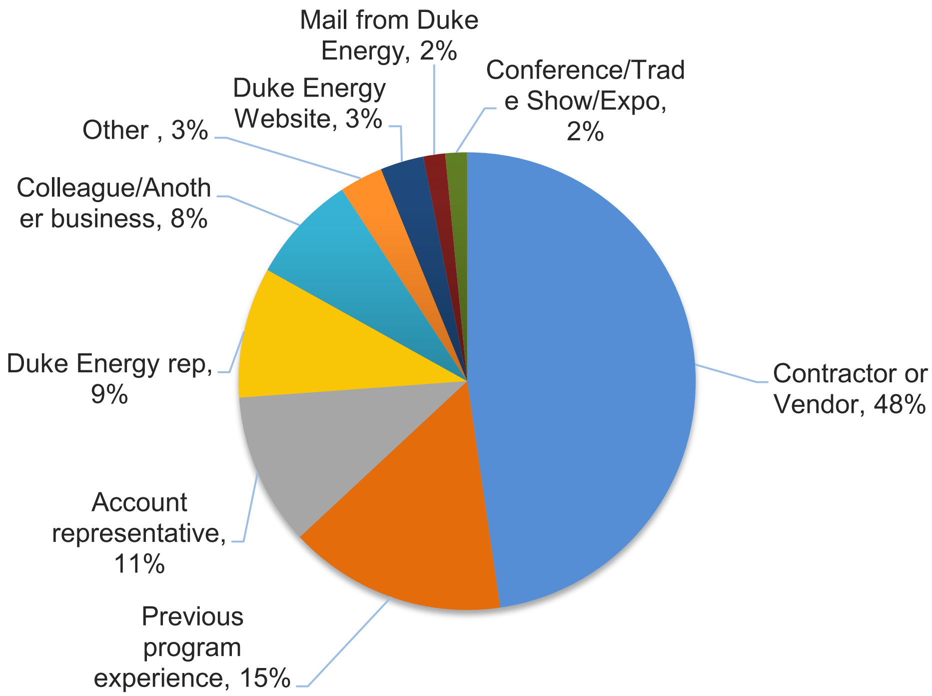
6.2.3 Participants

Surveys were conducted with program participants, or customers who received a rebate through the NR Custom program. This section provides detailed findings from 65 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. Starting in 2016, contractor outreach representatives marketed 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 among participant respondents were their contractor or vendor (48 percent), previous experience with the program (15 percent), and their account representative (11 percent). Figure 6-3 shows breakdown of the awareness sources among customer respondents. Sources of awareness were similar between the two territories.

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, the majority of 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 interviewed 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 Incentive program, the incentives, energy savings, and the monetary savings were most frequently mentioned by participants.

Table 6-7 Reasons for Participating in Smart $aver Custom Incentive Program

Reason	DEC	DEP	Overall
Duke Energy rebate/incentive	22	4	40%
The energy savings	15	4	29%
The monetary savings	14	5	29%
Ability to get a better product cheaper	7	2	14%
Needed new equipment	3	2	8%
ROI/payback	5	0	8%
Other	5	0	8%
Respondents	**52**	**13**	**65**

Source: Question Q6
Don't know responses are excluded.

6.2.3.2 Application Process

According to program staff, the review process takes about four to six weeks. Staff mentioned they have worked to improve the turnaround, which is now around 20 days. While Duke staff felt the review process could be improved, program participants were 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 for each aspect of the application 8.7 or higher for participants (using a 0 to 10 scale where 0 is 'very dissatisfied' and 10 is 'very satisfied'). Only one participant respondent (from DEC) rated their satisfaction low for an aspect of the application process (less than 4) and this was due to the complexity of the application.

Table 6-8 Satisfaction with Application Process

	DEC		DEP		Overall	
Application Aspect	Mean	Respondents	Mean	Respondents	Mean	Respondents
Process to fill out and submit your application	8.9	45	9.5	12	9.0	57
Staff time it took to submit the application	8.7	49	8.8	13	8.7	62
Duke Energy's processing and preapproval of your application	9.1	51	9.5	13	9.2	64

Source: Questions Q8, Q9, Q10
Don't know responses are excluded.

About half of participant 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 of the 19 respondents who recalled, most noted that it was additional equipment specifications (11 respondents), or building/address specifications (5 respondents).

As far as who was involved in completing the application, over half of participant respondents (57 percent) indicated their contractor filled out the NR Custom program application. Someone within the organization was the second most common way the application was completed (25 percent), followed by a combination of the contractor and someone within the organization (18 percent). These responses were similar across the two territories although the contractor was slightly more likely to be involved in the DEP territory.

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. While contractors were the most common method used to calculate energy savings, one-third of respondents reported using the tools Duke Energy provided (Table 6-9). This is similar to the feedback received from contractors where 16 of the 23 contractors indicated they used Duke tools to calculate savings.

Table 6-9 Calculators Used by Participants

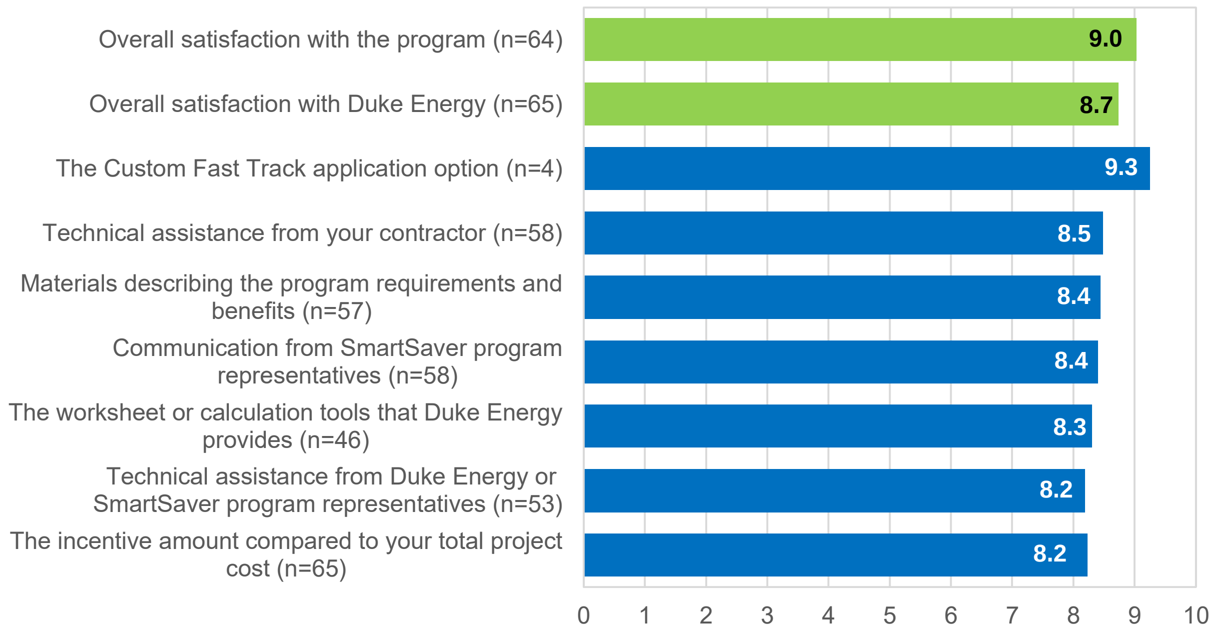
Calculators Used	DEC	DEP	Overall
Contractor calculated only	37%	25%	34%
Own methods only	27%	42%	30%
Custom-to-go only	29%	25%	28%
Custom-to-go and own methods	4%	0%	3%
Own methods and contractor	2%	8%	3%
Custom-to-go and contractor	2%	0%	2%
Respondents	**49**	**12**	**61**

Source: Question Q12
Don't know responses are excluded.

6.2.3.4 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, 9.0 overall, and rated Duke Energy highly as their service provider, 8.7 overall. 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 8.2 or higher.

Figure 6-4 Program Participant Satisfaction and Value of Program Aspects

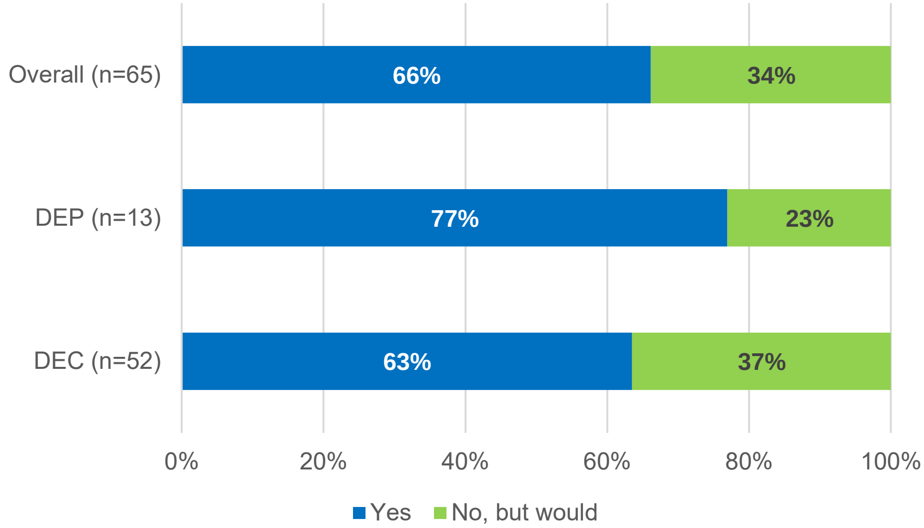


Source: Question SAT5, SAT11, SAT13
Don't know responses are excluded.

As far as the program aspect that is most valuable to their organization, about half of the participant respondents indicated the incentive compared to their total project cost, which correlates with the contractor responses (19 of 45 respondents). This was followed by the technical assistance they received from their contractor (13 of 45 respondents).

As another gauge of satisfaction, customers were asked if they have recommended the program to others. As shown in the figure below, most participants reported that they had already recommended the program. If provided the opportunity, the remaining respondents said they would recommend the program. Furthermore, all respondents but one indicated they would participate in the program again. The one respondent who did not indicate he would participate in the program again was not sure (did not know) and provided no indication of dissatisfaction throughout the survey.

Figure 6-5 Have You Recommended the Program to Others?



Source: Questions SAT8, SAT9

The primary reason respondents reported rating the program highly (providing a rating of an 8 or higher) was the ease of the process. This was followed by the availability of the incentive/monetary savings, and the energy savings they expect to achieve.

Table 6-10 Reasons for Rating the Program Highly

Reason	DEC	DEP	Overall
Ease of the process	21	3	24
Incentive/Monetary savings	14	8	22
Energy savings	7	3	10
Duke service	3	2	5
Contractor service	1	0	1
Respondents	**45**	**12**	**57**

Source: Question SAT12o
Don't know responses are excluded.

Seven participant respondents rated their satisfaction less than an 8. While some had to do with the application process, other responses varied. Below are specific comments respondents provided along with how they rated their overall satisfaction with the program in parentheses.

> *"Some parts of it were easy, did exactly what they said, and other parts were harder to get done, some of the application process. People who don't know about lighting like we do would not be able to do those applications".* (5)

> *"I'd like to be more informed about what's going on. I'm a person who likes someone to give me a call instead of shooting an email at me."* (5)

> *"Well because it was almost not worth the trouble of going through the application process for an incentive of $27. It took me hours."* (6)

> *"Some of the time it's a lot of work. For some of the products they understand they offer significant incentives, and for technology they don't understand they don't offer much incentive. You can see that in the incentives they offer."* (7)

> *"There were difficulties getting status updates during the application process. There seemed to be a long time for approval."* (7)

> *"Give me more."* (7)

> *"On the plus side for receiving the incentive, and on the negative having to opt in or opt out."* (7)

When asked what they would change about the NR Custom program, over half of participant respondents (33 of 64) indicated they would not change anything. Of the remaining respondents, 13 respondents mentioned the incentive. Specifically, 12 respondents asked for higher incentives and 1 respondent asked not to reduce the incentives. Other suggestions included simplifying the application especially in relation to the language used and the calculations needed (5 respondents), extending the deadlines for pre- and post-approval especially for large projects (4 respondents), updating or extending the list of eligible equipment (3 respondents), increasing awareness about the program (3 respondents), and decreasing the initial processing time (3 respondents).

Table 6-11 Recommended Program Changes

Reason	DEC	DEP	Overall
Nothing	25	8	33
Increase rebate amount	11	2	13
Simplify application	4	1	5
Extend deadlines	3	1	4
Updating or extending the equipment list	2	1	3
Increase awareness	2	1	3
Decrease the preapproval time	2	1	3
Other	2	0	2
Remove the preapproval requirement	0	1	1
Make the website more user friendly	1	0	1

Reason	DEC	DEP	Overall
Streamlining the process	1	0	1
Interaction with staff & contractor	1	0	1
Improve payment process	1	0	1
Respondents	**51**	**13**	**64**

Source: Question SAT1
Don't know responses are excluded.

Some specific comments included the following:

> *"Clearer and more up-to-date list of appliances that qualify for the program."*

> *"More interaction between Duke and the third party especially during initial approval and application."*

> *"They reduced the incentive in 2018. Because of that, we are going to evaluate how we approach our lighting."*

> *"More publicity. We would not have known about it without our vendor, Batteries Plus. More advertising to businesses."*

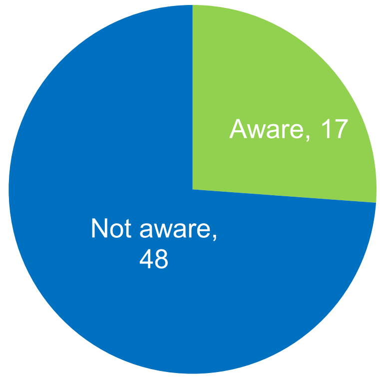
6.2.3.5 Fast Track

Duke Energy offers a fast track option 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.

When customers were asked about their awareness and interest in the offering, over one-quarter (17 of 65 participant respondents) were aware of the Fast Track offering.[10] Awareness was similar between DEC and DEP respondents. Four DEC respondents have utilized the Fast Track offering, two participants found out from their contractors, one participant from their account representative, and one participant from their business energy advisor.

[10] Fourteen contractor respondents reported being aware of the Fast Track option. An additional five contractor respondents did not know it was offered by Duke Energy.

Figure 6-6 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 of respondents (32 of 55 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. For those who were not willing to pay the fee, six participants explained that the extra fee would reduce the return on investment or increase the costs. Other respondents indicated reasons such as not having projects that would require needing an expedited process or under tight deadlines (5 respondent), or delaying the project or planning ahead to avoid having to pay a fee (4 respondents). Four other participant respondents reported that they cannot afford to pay that money or get approval for it. Other respondent mentioned that the fee "*defeats the purpose*," or that they would have to *"find something else."*

While the fee may be a barrier, the meetings may not be. Over two-thirds of respondents (43 of 58 respondents) would be willing to participate in an entrance meeting and respond to requests about the project specifications in a timely manner. Fifteen participant 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'). Nine respondents rated the value a 0 (not at all valuable), 17 respondents rated the value a 5, and 9 respondents provided a rating of 10 (very valuable). Other respondents were sprinkled in between, resulting in mixed feedback on the value of the service.

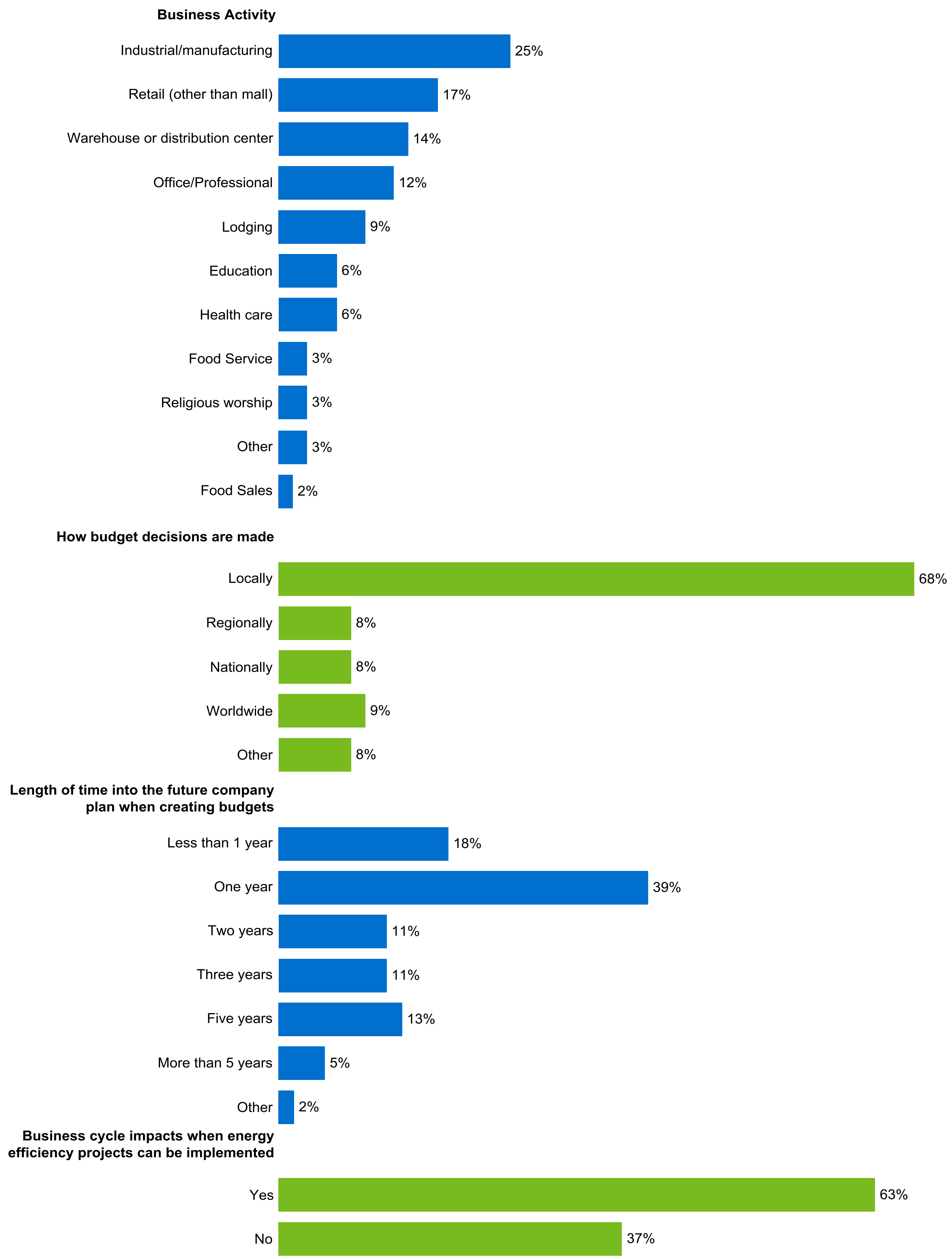
6.2.3.6 Participating Customer Characteristics

Facility types varied across participant respondents' locations. The most frequently mentioned types of businesses were industrial/manufacturing (25 percent), followed by retail (17 percent), warehouse or distribution center (14 percent) and office building (12 percent). The facility types are consistent with how the program was marketed, which initially targeted larger industrial customers. Historically, there have been a lot of large customers that would normally participate in a custom program, but now more of the large customers are opting out, which will narrow the number of customers eligible for the program.[11]

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 (68 percent). Most respondents tended to plan one year (39 percent) or less than 1 year (18 percent) into the future when creating budget and financial plans. The figure below shows the participant business characteristics.

[11] The opt in/out requirements are different between DEC and DEP. DEC is a one year opt in period for the calendar year and customers have a window where they are able to opt in and opt out. DEP you can opt in at any time. As soon as a customer receives their incentive, they opt in for 3 years.

Figure 6-7 Smart $aver Custom Incentive Program Participant Characteristics



Source: Questions C1, C2, C3, C4
Don't know responses are excluded.

7 Conclusions and Recommendations

7.1 Impact Evaluation

Conclusion 1: The evaluation team's analysis resulted in a 105.4% realization rate (energy) for the DEC NR Custom Program and 105.7% for the DEP NR Custom Program. The strong realization rates indicate 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.

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 for customers was 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 two-thirds of contractors and one-third of participant respondents indicated they have used Duke's tools to calculate savings. Contractors who used Duke Energy's provided tools rated their usefulness high. That said, contractors who install non-lighting equipment were more likely to use their own calculators or rated the usefulness of Duke's calculators low.

Recommendation 2a: 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.
Recommendation 2b: Consider reviewing the calculators for non-lighting equipment to ensure they perform as expected and do not require lighting-specific information.

Conclusion 3: Program participants were generally satisfied with the review process. Most contractors were also satisfied with the process. However, five contractors felt the preapproval process could be improved. Specifically, three indicated that the non-lighting preapproval process can take significantly longer than lighting preapproval. As different technologies come into the market, it will be important to ensure customers are getting feedback in a timely manner.

Recommendation 3: Monitor the time it takes to review applications for preapproval to ensure the time does not exceed six weeks.

Conclusion 4: Most participant respondents reported high satisfaction with the application process, although five respondents indicated the program could benefit from simplifying the application. A few contractors also recommended the application is geared towards lighting projects, leading to some confusion in what information is needed.

Recommendation 4: Streamline the application paperwork to minimize customer burden and collect only the information relevant to specific equipment types.

Appendix A Summary Forms

Duke Energy Carolinas 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 Carolinas (DEC) 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)	*Carolinas*	*Lighting*	*59,695,834*
Evaluation Period	*Jan 1, 2016 – Dec 31, 2017*		
Annual kWh Net Savings	*95,479,738*	*Non-lighting*	*35,783,904*
Coincident kW Net Impact - Summer	*15,054*		
Coincident kW Net Impact - Winter	*14,829*		
Net-to-Gross Ratio	*79.2%*		
Process Evaluation	*Yes*		
Previous Evaluation(s)	*N/A*		

Evaluation Methodology

mpact Evaluation Activities

- *59 On-site Measurement & Verification*

Impact Evaluation Findings

- *Energy Realization Rate: 105.4%*
- *Summer Demand Realization Rate: 115.9%*
- *Winter Demand Realization Rate: 123.9%*
- *Net-to-gross: 79.2%*

Process Evaluation Activities (DEC & DEP Combined)

- *Program Staff; 2 interviews with program staff*
- *Trade Allies; 24 in-depth interviews*
- *Participants; 81 telephone surveys*

Process Evaluation Findings

- *Primary source of program awareness is 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 are useful to contractors*
- *Contractors value the program and use incentives to encourage customers to purchase high efficiency equipment*
- *Program application and processes are geared toward lighting projects leading to some confusion*

Duke Energy Progress 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 Progress (DEP) 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)	Progress	Lighting	5,336,890
Evaluation Period	Jan 1, 2016 – Dec 31, 2017		
Annual kWh Net Savings	13,444,668	Non-lighting	8,107,778
Coincident kW Net Impact - Summer	1,498		
Coincident kW Net Impact - Winter	1,954		
Net-to-Gross Ratio	78.8 combined		
Process Evaluation	Yes		
Previous Evaluation(s)	N/A		

Evaluation Methodology

Impact Evaluation Activities

- *33 for DEP and 59 for DEC On-site Measurement & Verification*

Impact Evaluation Findings

- *Energy Realization Rate: 105.7%*
- *Summer Demand Realization Rate: 99.5%*
- *Winter Demand Realization Rate: 122.7%*
- *Net-to-gross: 78.8 combined%*

Process Evaluation Activities (DEC & DEP Combined)

- *Program Staff; 2 interviews with program staff*
- *Trade Allies; 24 in-depth interviews*
- *Participants; 81 telephone surveys*

Process Evaluation Findings

- *Primary source of program awareness is 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 are useful to contractors*
- *Contractors value the program and use incentives to encourage customers to purchase high efficiency equipment*
- *Program application and processes are geared toward lighting projects leading to*

Appendix B Survey Instruments

Duke Energy Nonresidential Custom Carolinas 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

YEAR The year the measure was completed and paid

PREMISE_ADDR 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
NC North Carolina
SC South Carolina

TOTAL_KWH

PROGRESS

0 States

1 Progress case

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 who decided to participate in <UTILITY>'s SmartSaver Custom Incentive program?

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 / 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	Duke Energy representative (other than an account rep)	
10	Previous program experience / participation	
11	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

Q7a [ASK IF Q7=1,3] Did you submit your application by hard copy application or electronically?

01 Hard copy
02 Electronically
03 Other (specify)
88 Don't know
99 Refused

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=1,2,3 OR Q9=1,2,3 OR Q10=1,2,3] 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
02 No
88 Don't know

Q13O [ASK IF Q13=1] What additional information was requested?

[IF DON'T KNOW OR DOES NOT RECALL PROBE: Do you recall if it was information about your building, the equipment installed or the prior equipment?)

[RECORD VERBATIM]

Q14 Was your project under pressure to be completed in a short amount of time?

01 Yes
02 No

Q15 Did you work with a Duke Energy-provided Energy Advisor as part of this project?

01 Yes
02 No
88 Don't know

Q16 [ASK IF Q15 = 1] Using a scale of 0 to 10, where 0 is "very dissatisfied" and 10 is "very satisfied", how satisfied are you with the Energy Advisor?

___ [RECORD RESPONSE]

88 Don't know
99 Refused

Equipment Questions

E1 Was the [MEASURE] equipment 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] equipment 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] equipment?

____ 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 [DO NOT READ] Don't know
99 [DO NOT READ] 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 [ASK 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?

TL2_months ___ Months
TL2_years ___ 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] 1-999
888 Don't know
999 Refused

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]
77 Not applicable
88 Don't know
99 Refused

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

FT10 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 SAT5
88	Don't know	SKIP TO SAT5

FT1 Did you participate in the Smart $Saver Custom Fast Track option?
[IF NEEDED: "There is typically a several hundred dollars fee for the accelerated review."]

01	Yes	
02	No	SKIP TO SAT5
88	Don't know	SKIP TO SAT5

FT2 How did you hear about the SmartSaver Custom Fast Track 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 in the future 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 FT1=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]
88 Don't know
99 Refused

SAT14 [ASK IF SAT13=0,1,2,3] Why do you say that?

[RECORD VERBATIM]

C_FT11_SKIP [IF FT1=1 SKIP TO C1]

FT11 [IF FT10 = 1, ELSE SKIP TO FT13] How did you become aware of the Smart $aver Custom Fast Track offering?

01 Account representative
02 Business Energy Advisor
03 Contractor / Vendor
04 Duke Energy website
05 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 [SKIP IF MULTCHK=02] That completes the survey, thank you very much for your time.

CP Completed

INT98 That completes the survey, thank you very much for your time.

CM Completed

Duke Energy Carolinas Smart$aver Custom Incentive Program
Participating Trade Ally Interview Guide

This document serves as a guide for interviews with companies that provided services to Smart$aver Custom Incentive program participants.

Background for respondent: We are working with Duke Energy to evaluate their Smart$aver Custom Incentive program in the Carolinas. 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. Your responses to these questions will be confidential and will not be associated with you or your company when we prepare our report for Duke Energy.
I would like to record this call so I can review it later and make sure I capture your responses accurately. Is that OK?

Trade Ally Background

1 What is your role at <company>? What services does your company provide to your customers?

2 How long has <company> been participating in the Duke Energy Smart$aver Custom Incentive program? About how many projects would you say you have completed since then?

Program Interaction

3 How did your company first get involved with the Smart$aver Custom Incentive program?

4 Who do you interact with at Duke Energy in connection with the Custom program?

5 What information or training has Duke Energy provided as part of the Custom program? Is the information/training sufficient? Is there anything additional Duke Energy could provide?

6 Do your customers tend to already know about the Custom program, or do you introduce it to them? Do you use the program as a sales tool?

7 What types of concerns do customers have about the program, if any? Is there anything Duke Energy could provide to address these concerns?

Attribution

8 Approximately how many projects have you completed through the Smart$aver Custom Incentive program in 2017?

__ [RECORD # OF PROJECTS]

9 In what percent of your sales situations did you recommend high-efficiency equipment *before* you learned about the Smart$aver Custom Incentive program?

___ [RECORD 0-100%]

10 And in what percent of your sales situation do you recommend high-efficiency equipment now that you have worked with the Smart$aver Custom Incentive program?

___ [RECORD 0-100%]

11 In what percent of your sales situations did the customer plan to purchase high-efficiency equipment *before* you told them about the Smart$aver Custom Incentive program?

___ [RECORD 0-100%]

12 And in what percent of your sales situation did the customer purchase high-efficiency equipment *after* you told them about the Smart$aver Custom Incentive program?

___ [RECORD 0-100%]

13 Using a similar 0 to 10 scale, this time with 0 being "not at all satisfied" and 10 being "very satisfied" how satisfied are you with the Smart$aver Custom Incentive program?

__ [RECORD 0-10]

14 Using a scale from 0 to 10 where 0 is "not at all influential" and 10 is "very influential", how influential was the Smart$aver Custom Incentive program in customers deciding to purchase high-efficiency equipment?

__ [RECORD 0-10]

15 [if not already discussed] Can you talk a little bit about your typical sales process? Do you provide customers with multiple equipment options? How do these options differ? (Probe if they are all high efficiency options, combination of high efficiency and standard efficiency, etc.)

16 Again, using a 0 to 10 scale, with 0 being "not at all satisfied" and 10 being "very satisfied", how satisfied are you with the incentives provided through the Smart$aver Custom Incentive program?

__ [RECORD 0-10]

17 Using the same scale, how satisfied are you with Duke Energy overall?

__ [RECORD 0-10]

17.a Why did you give Duke Energy that rating?

18 What percent of the projects in 2017 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%]

19 [IF Q18>0] Why do you or your customers not request an incentive for these energy efficiency projects? If you requested an incentive but did not receive one, why was that?

T12 Lamp Questions (for Lighting contractors)

Next I have a few questions about lighting systems.

20 Of your linear fluorescent lighting system sales in 2017, what percent were T12s?

___ [RECORD 0-100%]

21 Are you still stocking and selling linear fluorescent T12 lighting systems and replacement lamps?
(Capture any additional contractor comments in TL2 (e.g., yes, but…))

22 [if still stocking T12s] Thinking of your 2018 sales of linear fluorescent lighting system sales, what percent will be T12s?

___ [RECORD 0-100%]

Program Participation

I have just a few more questions for you.

23 Are you familiar with any changes that Duke Energy made to the Custom program in 2016 or 2017? (If needed: for example, changes to the application, calculations, or pilot offerings?) How did you learn about these changes? Did Duke Energy communicate these changes clearly enough? How useful were these offerings? What are customers' reactions to these offerings?

24 Do you utilize Duke Energy's classic custom or custom-to-go calculators to estimate savings, do you use your own calculators or do you use a combination of each? If used any of Duke's calculators, ask how useful is the calculator was in estimating energy savings (using a scale from 0 to 10 where 0 is "not at all useful" and 10 is "very useful")? If not used, why haven't you used Duke's calculators? Probe for which calculator they use (lighting, HVAC, etc.). In what situations do you use one calculator over another? Would you find it valuable to have a combined calculator for both custom and prescriptive?

25 Do you complete applications for your customers, or do they complete the applications? Do you complete the applications online or paper? Why do you complete using that method? Do you have any feedback on the application process?

26 Have you received requests for more information after submitting an application? Were any of these requests difficult to respond to? Is there anything Duke Energy could do to help you anticipate these requests before submitting the application?

27 On average, roughly how long is the pre-approval process from the time you submit the application to approval?

28 Were you aware there was on online application portal to submit the application online? If aware, have you used this method? If used the online portal, how was the process? (Did you like it?) If not used, is there anything preventing you from using this method?

29 Why do some customers not move forward with projects through the program? Are there enrollment processes that could be simplified to encourage customers to complete projects? What program aspects are most influential in their decision?

30 From your perspective, what is the most valuable part of the Smart$aver Custom Incentive program? Why do you say that?

31 From your perspective, what part of the Smart$aver Custom Incentive program needs the most work? Why? What could Duke Energy do to improve this?

32 Do you have any other feedback that you would like to share with Duke Energy about this program?

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EM&V Report for the EnergyWise Home Demand Response Program

Summer PY2018

Prepared for:

Duke Energy Progress

November 30, 2018

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NAVIGANT

EM&V Report for the EnergyWise Home Demand Response Program

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Included as Separate Documents:

Appendix A: Output Summary

Filename: “*DEP EWise PY2018 Summer Mini Analysis Appendix A 2018-11-27.xlsx*”
Description: Includes summary results and snapback calculation.

Appendix B: EnergyWise Home Ex-Ante Tool for Duke Energy Progress Territory

Filename: *“DEP EWise Summer 2018 Appendix B Summer Ex Ante Tool v04 2018-11-27.xlsx”*
Description: Spreadsheet tool for estimating DR impacts of various cycling strategies (including full shed).

NAVIGANT

EM&V Report for the EnergyWise Home Demand Response Program

EVALUATION SUMMARY

The EnergyWise Home (EnergyWise) demand response (DR) program offers Duke Energy Progress (DEP) residential customers the opportunity to earn credits on their electricity bill by allowing DEP to remotely control air conditioners (A/C) in the summer months (available system wide) and space- and water-heating equipment in winter (Western region customers only) during times of seasonal peak consumption. This report covers the evaluation, measurement, and verification (EM&V) activities for the summer of 2018.

At the time of the single event called by Duke Energy during the summer 2018, there were 174,348 participants with a total of 223,312 A/C units enrolled in the program.

The test event took place between 5:00 PM and 5:30 PM on August 30, 2018. Participants were cycled at 100% during the 30-minute event. The average temperature experienced by participating households during this event was approximately 92.6 degrees Fahrenheit. **Navigant has estimated that the average impact per participant was 1.67 kW, with an aggregate program total impact of 291 MW.**

Evaluation Methods

Since Navigant's first evaluation of the EnergyWise program in 2011, Navigant has evaluated impacts using one of two approaches: a logger analysis or a "mini" analysis. For a logger analysis (for example the recently completed evaluation of the EnergyWise program for the winter of 2017/2018), data loggers are deployed to a representative sample of participant homes and regression analysis is used to estimate event impacts and project program capability. For a "mini" analysis, Navigant applies the regression-estimated DR coefficients (parameters) from the most recent metering study to the temperature values actually observed during the evaluation period events. This delivers the equivalent of an ex ante impact, or prediction, based on previously estimated impact/temperature relationships.

For PY2018, no logger analysis was carried out, but Navigant determined that the standard mini-analysis approach was also inappropriate. The most recent program year in which regression analysis had been applied to a 100% cycling event (like that called in the summer of 2018) was 2011. Given the length of time since that evaluation, Navigant believed that it would be imprudent to use the parameters estimate in PY2011.

Rather, Navigant first estimated a baseline average A/C demand at the event temperatures using the PY2016 summer logger data, and then applied the estimated percentage reduction from 2011 for the 100% cycling event deployed that year. We then further applied a reduction to account for device operability[1] (operability data were not collected or used in PY2011). In summary: the baseline is derived from PY2016 data, and the relative (percentage) impact of curtailment is derived from the 100% cycling event for which regression-estimated impacts are available (from 2011), slightly adjusted to account for the summer 2016 operability rate.

[1] Note that operability – whether a switch is physically operational when observed in person by a technician – is quite different from responsiveness (whether an operable switch responds to Duke's curtailment signal for any given event). Navigant's approach here implicitly assumes the same responsiveness rate for 100% cycling events as estimated for the 100% cycling event deployed in 2011. See report body for more details.

Evaluated Impacts

The principal EM&V findings regarding the PY2018 summer event demand impacts are as follows:

- **Full load shed of A/C units delivered an average impact of 1.67 kW per household.** The total estimated program impact of the 174,348 participating households was 291 MW.
- **The average snapback** impact during the first full hour beginning 15 minutes after the end of the event was 0.42 kW.
- **The impact of the 100% cycling event was higher in 2018 than in 2011, due to a shift in the participant baseline.** The estimated impact of the one-hour event in 2011 was 1.28 kW. The 2018 impact is higher than the 2011 impact for three reasons:
    - *The event was hotter.* The average event temperature in 2011 was 90 degrees, in 2018, 92.5 degrees.
    - *The event was later*. In 2011 the event lasted from 3:30 PM to 4:30 PM, in 2018 from 5:00 PM to 5:30PM, when A/C demand (all else equal) tends to be higher.
    - *The baseline is higher.*[2] The 2016 participant baseline demand is higher at every temperature value than that of 2011. Navigant believes that this may reflect a change in overall program participant characteristics (in 2011, there were fewer than 65,000 participating households, in 2018 there were nearly triple that number).

[2] Applying the PY2018 approach to the variable values from 2011 (timing and temperature of event) yields an average event impact of approximately 1.4 kW, an approximately 10% increase in the baseline from 2011 to 2018.

1. INTRODUCTION

The EnergyWise program provides residential customers the opportunity to earn credits on their electricity bill by allowing DEP to remotely control air conditioning (in the summer) and water heater and heat pump auxiliary heating strips (in the winter – Western region customers only) during times of seasonal peak consumption. This report covers the EM&V activities for the summer of 2018.

EM&V is a term adopted by DEP and refers generally to the assessment and quantification of the energy and peak demand impacts of an energy efficiency or DR program. For DR, estimating reductions in peak demand is the primary objective, as energy impacts are generally negligible. EM&V also can encompass an evaluation of program processes and customer feedback typically conducted through participant surveys. The summer PY2018 EM&V cycle did not include a process evaluation.

1.1 Objectives of the Evaluation

This report is intended to verify program impacts per the requirements established by the North Carolina Utilities Commission and the Public Service Commission of South Carolina. Since no data loggers were deployed to participating homes in the summer of PY2018, the principal objective of the evaluation is to apply the outputs from the data collected for the PY2016 and PY2011 logger studies to weather and participation data observed in the summer of 2018 to estimate the impact of direct load control on residential demand in the summer of 2018.

1.2 Program Overview

The EnergyWise program was developed in response to DEP's determination that a curtailable load program would be a valuable resource for the company, and that it would provide an opportunity to engage directly with customers to help reduce costly seasonal peak demand. The program seeks to attract DR resources by providing incentives to residential customers to allow DEP to remotely control the most important driver of summer peak demand typically found in the home: central air conditioning.

The program offers an annual bill credit of $25 (per appliance type controlled) to customers that choose to allow DEP to control their central air conditioners (summer only), electric auxiliary heat strips and/or water heaters (winter only).

Eligibility. To be eligible for participation in the summer component of the EnergyWise program, a household must meet the following criteria:

- Participants must occupy the residence where the controls are installed. Renters must complete a Tenant Authorization Form and the landlord/property owner must approve.
- Residential electricity service must be in the name of the participant.
- Participants must be in an area that can receive the EnergyWise Home paging signal.
- Participation also requires that participants have electric central air conditioning or a centrally ducted heat pump.

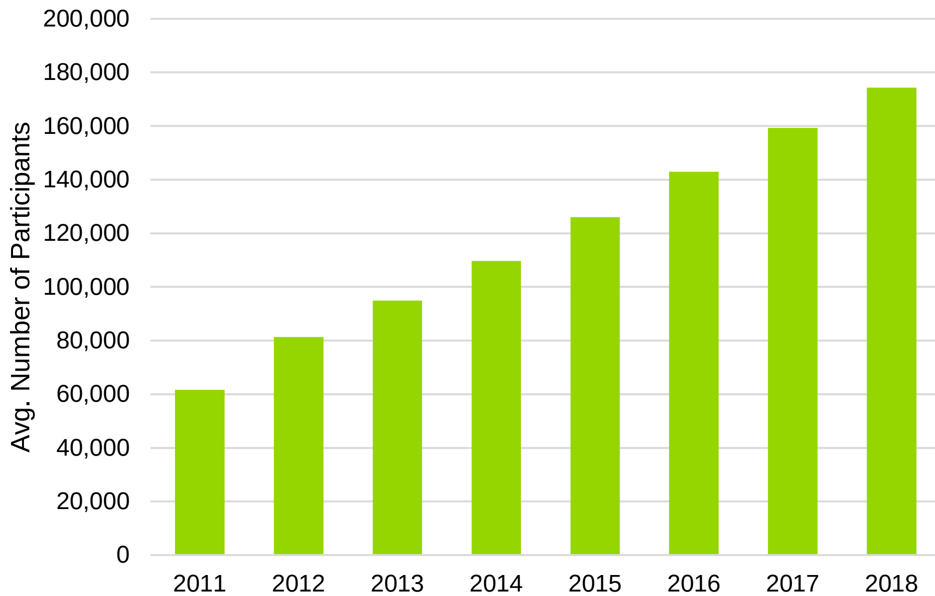
Incentives. Each participant receives a $25 yearly bill credit upon joining the summer program, and then an additional $25 bill credit every 12 months they remain on the program.

Marketing. DEP is responsible for all marketing of the EnergyWise program. Participant enrollments are generated through a mix of direct mail, bill inserts, email, outbound calling, and door-to-door canvassing.

1.3 Reported Program Participation

This section reports the overall program participation for the summer EnergyWise program in the summer of PY2018. In total, approximately 174,348 individual customers participated in the 100% full shed test event on August 30. Since 2011, program growth has been stable and consistent at approximately 15,000 incremental participants joining per year (see Figure 1).

Figure 1: Historical EnergyWise Summer Participation



Source: DEP

Altogether the 174,348 participants have a total of nearly 223,312 central air-conditioning units enrolled, or approximately 1.28 per participant. This ratio has not changed meaningfully over time – in the first year Navigant evaluated this program there were approximately 1.3 enrolled central air conditioners enrolled for each participant – a statistically identical value to that in PY2018.

2. EVALUATION METHODS

This section of the EM&V report describes the approach used to estimate the DR and snapback impacts of the EnergyWise program for PY2018.

Since Navigant's first evaluation of the EnergyWise program in 2011, Navigant has evaluated impacts using one of two approaches: a logger analysis or a "mini" analysis.

- For **a logger analysis** (for example the recently completed evaluation of the EnergyWise program for the winter of 2017/2018), data loggers are deployed to a representative sample of participant homes and regression analysis is used to estimate event impacts and project program capability.
- For **a "mini" analysis**, Navigant applies the regression-estimated DR coefficients (parameters) to the actually observed temperature values. This delivers the equivalent of an ex ante impact, or prediction, based on previously estimated impact/temperature relationships.

For PY2018, no logger analysis was carried out, but Navigant determined that the standard mini-analysis approach was also inappropriate. The most recent program year in which regression analysis had been applied to a 100% cycling event (like that called in the summer of 2018) was 2011. Given the length of time since that evaluation, Navigant believed that it would be imprudent to use the parameters estimate in PY2011.

Rather, Navigant proceeded in the following fashion (each step of which is described in greater detail in the sub-section of the same name below:

- **Baseline Estimation:** Navigant used the logger data from PY2016 – the most recently collected summer A/C logger data – to estimate the relationship between A/C demand, temperature, and time of day. These estimated values deliver a baseline on the event day.
- **Demand Response Impact Estimation:** To quantify the impact, Navigant applied the percentage DR impact estimated in PY2011 for the only 100% cycling event that Navigant has had the opportunity to evaluate using logger data.
- **Snapback Impact Estimation:** Snapback impacts are estimated using the same approach deployed in prior non-logger-data evaluation year, as a function of: total energy "taken back" (as a percentage of energy saved), and the demand pattern of snapback in the period following the event.

2.1 Baseline Estimation

Navigant estimated the relationship between average participant demand and temperature using the regression specification below, applied to the PY2016 logger data:

$$y_{k,t} = \alpha_k + \beta_1 qhour_t CDH70_{k,t} + \varepsilon_{k,t}$$

Where:

$y_{k,t}$ = The average AC demand of household *k* in a quarter hour of sample *t*.

α_k	=	The individual-level fixed effect.
$qh_{i,t}$	=	A dummy variable equal to 1 when the quarter hour of sample *t* falls in the *i*-th hour of the day. For example, if quarter hour *t* fell in the first quarter hour of the day then $qh_{1,t}$ would equal 1 and $qh_{2,t}$ to $qh_{96,t}$ would all be equal to 0.
$CDH70_{k,t}$	=	The cooling degree quarter-hours observed by household *k* in quarter hour of sample *t*.

This regression was estimated using the PY2016 EM&V participants' logger data from non-event weekdays on which the average temperature observed by participants between 3pm and 6pm was greater than 90 degrees Fahrenheit. Altogether 17 days met these inclusion criteria.[3]

The parameters estimated in the regression above ($\widehat{\alpha_k}$, and $\widehat{\beta_1}$) are applied to the cooling degree hours of interest to deliver an estimate of participant baseline A/C demand at that temperature.

Note that the regression equation specified above is relatively simple – for example it does not control explicitly for heat build-up[4], humidity, the day of the week or other factors. This is an explicit modeling decision made in order to facilitate the use of model outputs in an ex-ante impact estimation tool that Navigant has developed for Duke Energy. The inclusion of additional variables and interactions (e.g., humidity, moving averages, etc.) would require considerably more complex inputs for that tool, substantially reducing its usefulness as a quick reference, without meaningfully improving its predictive accuracy (given the model uncertainty).

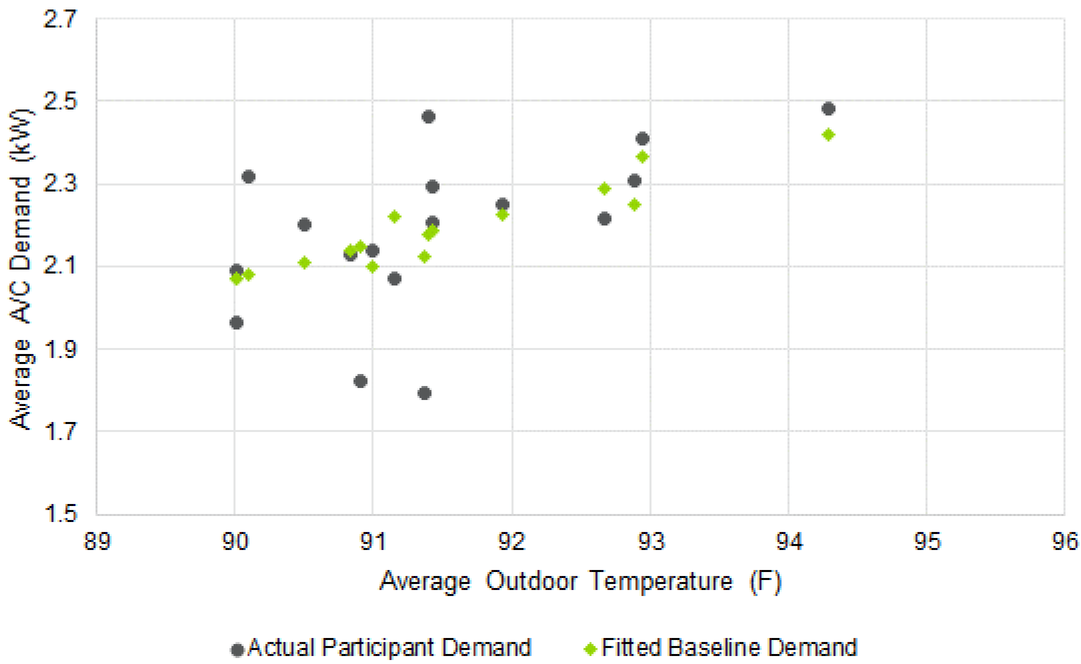
Following estimation of the regression model, Navigant generated fitted values for all observations included in the regression. A fitted value is simply what the model predicts the value of the left-hand side variable should be, given the variable values included on the right-hand side. The differences between the fitted and actual values are the residuals.

Figure 2 compares the average predicted baselines between 3pm and 6pm during the days included in the regression data set with the actual average A/C demand observed in the same period. Each marker in the plot below reflects a different daily average temperature/demand pair, with the green diamond markers representing the fitted values and the grey circles representing the actuals.

[3] Note that not all participant data were included for each day. For example, data for the Group 1 participants were included on July 14, 2016, but not Group 2 data, as Group 2 was curtailed on this date, but Group 1 was not. For more details regarding the group-split of EM&V participants, please refer to the PY2016 Summer evaluation report of the EnergyWise program.

[4] Heat build-up is at least partially controlled for implicitly in that temperature time-series are highly auto-correlated

Figure 2: Demonstration of Baseline In-Sample Accuracy



Source: Navigant logger data and analysis.

Two things are immediately clear:

- **There is no apparent bias:** actuals appear as likely to be higher as they are to be lower than the fitted values.
- **Accuracy improves at higher temperatures:** the average distance between predicted and actual demand values is much smaller at the higher temperatures (i.e., 92 degrees and above) than at lower temperatures (i.e., 90 to 92 degrees)

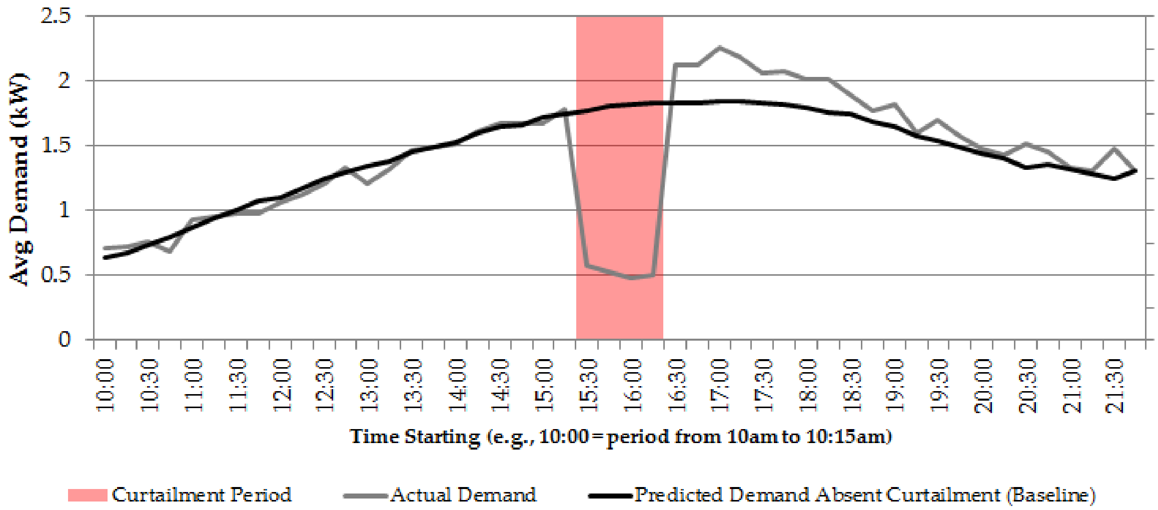
To generate the baseline used for this evaluation, Navigant applied the average event period temperatures to the regression-estimated parameters. This delivers an estimate of average per-participant demand during the two quarter-hours of the event on 2018-08-30.

2.2 Demand Response Impact Estimation

Navigant applied two factors to the baseline to obtain an estimated impact:

- **DR impact.** In PY2011, Navigant estimated that the average DR impact during the hour-long 100% cycling event that year was 71% of baseline demand (see Figure 3, below)
- **Operability Adjustment.** In PY2016, Navigant tracked device operability (quite different from device responsiveness – see below). Altogether, Navigant technicians found that approximately 3% switches inspected during logger deployment were entirely non-functional. Therefore a 3% adjustment (decrement) is applied to estimated impacts to account for population operability.

Figure 3: PY2011 100% Cycling Event Load Profile and Baseline



Source: Navigant logger data and analysis.

A standard output of Navigant's logger data analyses of the EnergyWise home program is a "responsiveness rate". This is an estimate of what proportion of switches appear to have been non-responsive to the Duke curtailment signal for any given event.[5] This is a parallel analysis to Navigant's impact analysis and has no effect on those values (i.e., the actuals shown in Figure 3 include responsive, non-responsive, and not-in-use A/C units). Implicitly then, Navigant's estimated impact for PY2018 assumes the same non-responsiveness as occurred during the 2011-08-25 100% cycling event.[6]

Navigant did consider an alternate approach (which can be implemented in the Appendix B spreadsheet with the selection of the appropriate toggle) in which the baseline is reduced only by the operability factor and the average non-responsive rate estimated in a prior year. This approach (though it delivers a higher impact) was rejected based on Navigant's observation that the difference between load remaining after 100% curtailment (i.e., the distance between the grey line and the x-axis in Figure 4) is larger than can be explained entirely by the historically estimated responsiveness.

2.3 Snapback Impact Estimation

Snapback is defined as the increase in demand observed in the period following a DR event. During a DR event A/C cycling limits the run time of the A/C compressor. This results in the indoor temperature rising above the thermostat set-point. When cycling ceases, the compressor needs to run for longer than it normally would in order to restore the indoor temperature to the thermostat set-point.

Snapback is calculated as a function of:

---

[5] More specifically, it is a measure of what proportion of participating A/C units had no observable reduction in demand in the first hour of an event, beginning fifteen minute after the start of the event. For more details, refer to the summer 2016 evaluation report.

[6] The specific values were: 13% of devices in use but non-responsive, 11% of devices not in use. These are in line with the non-responsiveness rates of the other events that summer, and in other years – i.e., between 10% and 15%.

- **Post-Event Snapback Pattern.** The magnitude of snapback in each quarter hour of the snapback period relative to the average quarter-hourly demand reduction in the curtailment period. This pattern is drawn from the estimated snapback impacts of the 100% cycling event deployed in PY2011.
- **Energy Take-Back.** The proportion of the energy (kWh) consumption reduction in the curtailment period that is “taken back” during the snapback period. This is also drawn from the 2011 evaluation.

The mechanics of the snapback approach are clearly laid out in the Appendix A workbook (see the “Snapback Calculation” tab).

3. IMPACT FINDINGS

This section provides the estimated demand reduction and snapback impacts for the EnergyWise program for the summer 2018. Section 2 details how these impacts were estimated. Impacts are based on the results of the weather observed during the PY2018 event, the baseline temperature/demand relationships estimated using the PY2016 logger data, and the relative DR impacts estimated for 100% cycling as part of the PY2011 evaluation.

The estimated DR impact by quarter-hour of event is shown in Table 1.

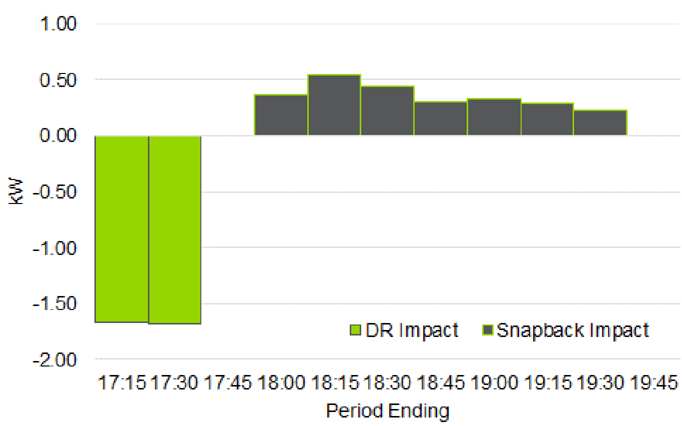
Table 1. Average Demand Reduction Impact by Quarter Hour

Quarter-Hour of Event	Time Starting	Time Ending	Average DR Impact Per Participant (kW)	Relative Precision (90% Confidence)[7]	Total Program DR Impact (MW)
1	17:00	17:15	1.66	8.0%	289
2	17:15	17:30	1.68	7.9%	292
Average of All Quarter-Hours	**17:00**	**17:30**	**1.67**	**7.8%**	**291**

Source: Navigant Analysis, PY2018 weather, PY2016 modeling results, and PY2011 estimated impacts

Quarter-hour by quarter-hour results are shown graphically in Figure 4. In Figure 4, DR impacts are represented as a negative number (i.e., demand reduction) and snapback as a positive (i.e., an increase in demand). Note that due to ramping, there is still a lingering DR impact in the first quarter-hour of the snap-back period (i.e., the negative value of the first gray column in the figure below). The average snapback impact during the first full hour beginning 15 minutes after the end of the event was 0.42 kW.

Figure 4. Demand Response and Snapback Impacts – 2018-08-30



Source: Navigant Analysis, PY2018 weather, PY2016 modeling results, and PY2011 estimated impacts

[7] Confidence intervals estimated here are based on the confidence interval surrounding the estimated *baseline* (based on PY2016 data) rather than an estimated impact. Because no actual events were observed, there is no estimated uncertainty associated with the impacts, only with the baseline. Although this approach is deemed acceptable by many state-wide groups (see for example Section 6.2.3 of the PA Act 129 Evaluation Framework), it will tend to overstate precision.

DR impacts for this event are substantially higher than the 1.28 kW impact estimated for the PY2011 100% cycling event. This is due to three factors:

- *The event was hotter.* The average event temperature in 2011 was 90 degrees, in 2018, 92.5 degrees.
- *The event was later*. In 2011 the event lasted from 3:30 PM to 4:30 PM, in 2018 from 5:00 PM to 5:30PM, when A/C demand (all else equal) tends to be higher.
- *The baseline is higher.*[8] The 2016 participant baseline demand is higher at every temperature value than that of 2011. Navigant believes that this may reflect a change in overall program participant characteristics (in 2011, there were fewer than 65,000 participating households, in 2018 there were nearly triple that number).

[8] Applying the PY2018 approach (i.e., the Appendix B workbook) to the variable values from 2011 (timing and temperature of event) yields an average event impact of approximately 1.4 kW, an approximately 10% increase in the baseline from 2011 to 2018.

4. SUMMARY FORM

EnergyWise Home
Summer PY2018
Completed EMV Fact Sheet

Description of Program

Duke Energy's EnergyWise program is a DR program offered to residential customers in the DEP territory.

EnergyWise is a direct load control program. Participants receive an incentive to allow Duke Energy to control their air conditioners (in the summer), their heat pump auxiliary heat strips (in the winter), or their electric water heaters (winter or summer). Only participants in the Western region are curtailed in the winter.

This report evaluates the impact of the program in the summer of 2018. Only a single event was called, on August 30, 2018.

Date:	2018-11-30
Region:	DEP
Evaluation Period	Summer 2018
DR Event Impact per Participant (kW)	
Central Air Conditioner	1.67
DR Event Program Impact (MW)	
Central Air Conditioner	291
Net-to-Gross Ratio	1

Evaluation Methods

Navigant estimated DR impacts for central air conditioners by estimating an average participant baseline demand, and applying the percentage impact for 100% cycling estimated as part of the 2011 evaluation (the only time a 100% cycling event has been evaluated with logger data).

The participant baseline to which the 2011 percentage impact was applied was estimated using relationships estimated from non-event-day logger data collected as part of the PY2016 summer evaluation. These estimated relationships were applied to PY2018 event temperature values to deliver the estimated baseline.

Impact Evaluation Details

- **Full load shed of A/C units delivered an average impact of 1.67 kW per household.** The total estimated program impact of the 174,348 participating households was 291 MW.
- **The impact of the 100% cycling event was higher in 2018 than in 2011, due to a shift in the participant baseline.** The estimated impact of the one-hour event in 2011 was 1.28 kW. The 2018 impact is higher than the 2011 impact for three reasons:
    - *The event was hotter.* The average event temperature in 2011 was 90 degrees, in 2018, 92.5 degrees.
    - *The event was later*. In 2011 the event lasted from 3:30 PM to 4:30 PM, in 2018 from 5:00 PM to 5:30PM, when A/C demand (all else equal) tends to be higher.
    - *The baseline is higher.*[1] The 2016 participant baseline demand is higher at every temperature value than that of 2011. Navigant believes that this may reflect a change in overall program participant characteristics (in 2011, there were fewer than 65,000 participating households, in 2018 there were nearly triple that number).

5. CONCLUSION

The principal EM&V findings regarding the summer event demand impacts for PY2018 are as follows:

- **Full load shed of A/C units delivered an average impact of 1.67 kW per household.** The total estimated program impact of the 174,348 participating households was 291 MW.
- **The average snapback** impact during the first full hour beginning 15 minutes after the end of the event was 0.42 kW.
- **The impact of the 100% cycling event was higher in 2018 than in 2011, due to a shift in the participant baseline.** The estimated impact of the one-hour event in 2011 was 1.28 kW. The 2018 impact is higher than the 2011 impact for three reasons:
    - o *The event was hotter.* The average event temperature in 2011 was 90 degrees, in 2018, 92.5 degrees.
    - o *The event was later*. In 2011 the event lasted from 3:30 PM to 4:30 PM, in 2018 from 5:00 PM to 5:30PM, when A/C demand (all else equal) tends to be higher.
    - o *The baseline is higher.*[9] The 2016 participant baseline demand is higher at every temperature value than that of 2011. Navigant believes that this may reflect a change in overall program participant characteristics (in 2011, there were fewer than 65,000 participating households, in 2018 there were nearly triple that number).

[9] Applying the PY2018 approach to the variable values from 2011 (timing and temperature of event) yields an average event impact of approximately 1.4 kW, an approximately 10% increase in the baseline from 2011 to 2018.

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Energy Efficiency Education in Schools Program Year 2017 – 2018 Evaluation Report

Submitted to Duke Energy Carolinas and Progress in partnership with Research into Action

March 20th, 2019

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1 Executive Summary

1.1 Program Summary

The Energy Efficiency Education in Schools Program is a Duke Energy Carolinas (DEC) and Duke Energy Progress (DEP) 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 DEC and DEP 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 July 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 DEC and DEP NTC programs. 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 DEC Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (kWh)	201.0	135.0%	271.3	0.94	254.1
Summer Demand (kW)	0.054	61.7%	0.034		0.031
Winter Demand (kW)	N/A	N/A	0.048		0.045

*Values may appear inaccurate due to rounding errors

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

Measurement	Reported	Realization Rate	Gross Verified*	Net-to-Gross Ratio	Net Verified*
Energy (kWh)	4,655,361	135.0%	6,283,232	0.94	5,884,250
Summer Demand (kW)	1260.7	61.7%	777.7		723.5
Winter Demand (kW)	N/A	N/A	1,113.4		1,036.4

* Values may appear inaccurate due to rounding errors

Table 1-3 and Table 1-4 present the summarized findings of the DEP impact evaluation.

Table 1-3: 2017-2018 DEP Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified*	Net-to-Gross Ratio	Net Verified*
Energy (kWh)	276.4	124.3%	343.5	0.92	317.5
Summer Demand (kW)	0.079	52.5%	0.041		0.038
Winter Demand (kW)	N/A	N/A	0.064		0.059

* Values may appear inaccurate due to rounding errors

Table 1-4: 2017-2018 DEP Program Level Savings

Measurement	Reported	Realization Rate	Gross Verified*	Net-to-Gross Ratio	Net Verified*
Energy (kWh)	2,494,510	124.3%	3,055,293	0.92	2,865,616
Summer Demand (kW)	711.0	52.5%	373.1		343.0
Winter Demand (kW)	N/A	N/A	581.0		534.1

* Values may appear inaccurate due to rounding errors

Figure 1-1 and Figure 1-2 provide the verified energy saving share by measure for DEC and DEP, respectively.

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

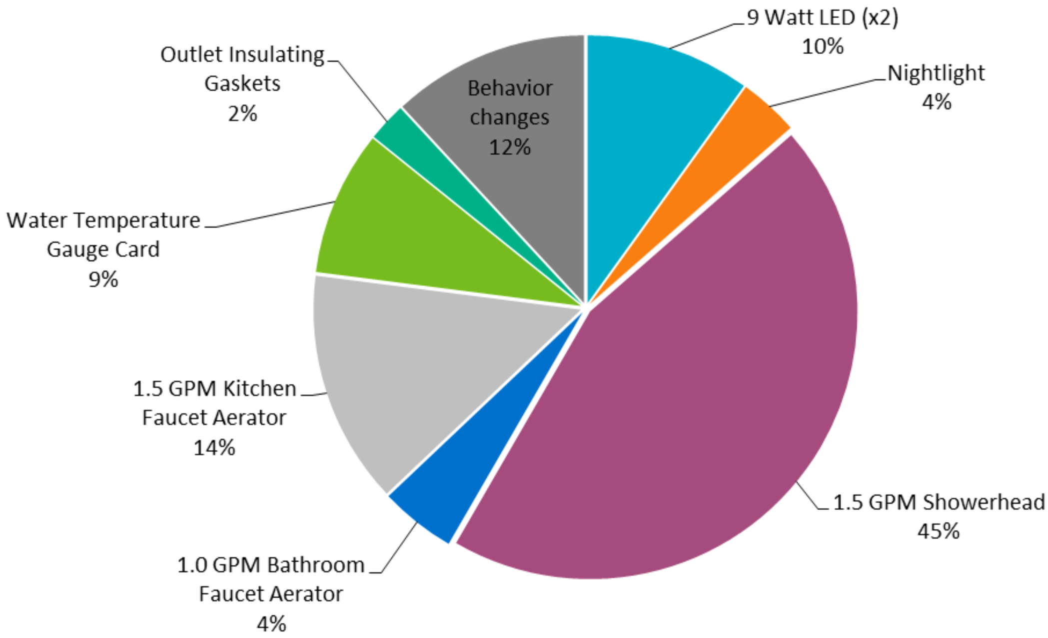


Figure 1-2: 2017-2018 DEP NTC Gross Verified Energy Savings

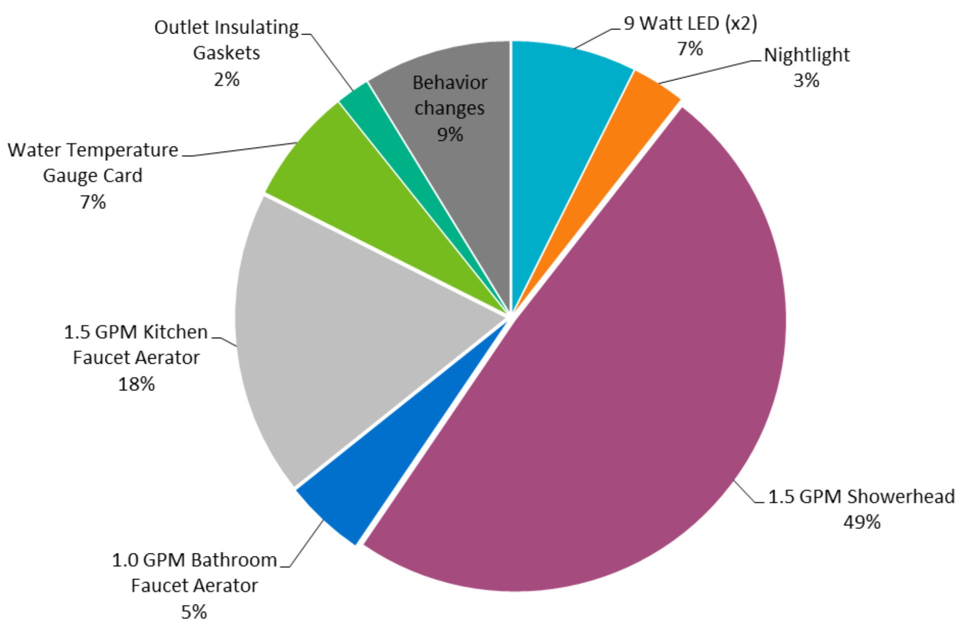


Table 1-5 and Table 1-6 provide gross verified energy and demand savings by measure and net to gross ratio details for DEC and DEP, respectively.

Table 1-5: DEC NTC Program Year 2017-2018 Verified Impacts by Measure

Measure	Gross Energy Savings per unit (kWh)	Gross Summer Demand per unit (kW)	Gross Winter Demand per unit (kW)	Free Ridership	Spillover	Net to Gross Ratio
9 Watt LED*	27.0	0.005	0.002	0.16	0.09	0.93
Nightlight	9.8	0.000	0.000			
1.5 GPM Showerhead	121.6	0.010	0.027			
1.0 GPM Bathroom Faucet Aerator	12.4	0.002	0.003			
1.5 GPM Kitchen Faucet Aerator	38.2	0.005	0.008			
Water Temperature Gauge Card	23.7	0.003	0.005			
Outlet Insulating Gaskets	6.3	0.008	0.000			
Behavioral Changes	32.3	0.001	0.002	-	-	1.00
Total Kit and Behavioral Impacts	**271.3**	**0.034**	**0.048**	**0.16**	**0.09**	**0.94**

*Reflects savings for two 9 watt LEDs bulbs

Table 1-6: DEP NTC Program Year 2017-2018 Verified Impacts by Measure

Measure	Gross Energy Savings per unit (kWh)	Gross Summer Demand per unit (kW)	Gross Winter Demand per unit (kW)	Free Ridership	Spillover	Net to Gross Ratio
9 Watt LED*	25.4	0.004	0.002	0.13	0.05	0.92
Nightlight	10.9	0.000	0.000			
1.5 GPM Showerhead	168.1	0.013	0.038			
1.0 GPM Bathroom Faucet Aerator	16.4	0.002	0.004			
1.5 GPM Kitchen Faucet Aerator	62.3	0.008	0.014			
Water Temperature Gauge Card	23.5	0.003	0.005			
Outlet Insulating Gaskets	6.8	0.009	0.000			
Behavioral Changes	30.1	0.001	0.001	-	-	1.00
Total Kit and Behavioral Impacts	**343.5**	**0.041**	**0.064**	**0.13**	**0.05**	**0.92**

*Reflects savings for two 9 watt LEDs bulbs

1.2.2 Process Evaluation

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

The evaluation team reviewed program documents and conducted phone (*n*=74 DEC and *n*=70 DEP) and web surveys (*n*=260 DEC and *n*=102 DEP) with student families that received a kit and teachers who attended the performance (*n*=44 DEC and *n*=29 DEP). The team also conducted in-depth interviews with utility staff, NTC staff, and ten teachers (five in DEC territory and five in DEP territory) who completed the web survey.

Program Successes

The 2017-2018 DEC and DEP NTC program evaluation's found successes in the following areas:

Teachers and parents are aware of Duke Energy sponsorship of the kits. Most parents (94% in DEC and 88% in DEP) and teachers (84% in DEC and 79% in DEP) knew that Duke Energy sponsored the kits. Parents became aware of Duke Energy sponsorship via the materials their children brought home (58% in DEC and 57% in DEP), or via engagement by their school or teacher (29% in DEC and 30% in DEP). DEC teachers most commonly became aware via communication from other teachers (14 of 37), whereas DEP teachers more commonly reported learning about Duke's sponsorship via marketing materials (8 of 23) and NTC staff (8 of 23).

Parents largely learned about Duke Energy kits from materials brought home by child. About three-quarters (75% in DEC and 72% in DEP) of parents learned about the kits from program engagement materials their children brought home. Lesser reported ways included school newsletters (17% in DEC and 11% in DEP) and emails from their children's teacher or school (14% in DEC and 13% in DEP).

Teachers were highly satisfied with the performance reporting that the performance was not missing important components, was age appropriate for most students, and engaged students. Nearly all stated they were "highly satisfied" (39 of 44 in DEC and 25 of 29 in DEP), most noted the performance was not missing important concepts (43 of 44 in DEC and 28 of 29 in DEP), and most noted the performance was age appropriate (40 of 44 in DEC and 27 of 29 in DEP). 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 almost all (42 of 44 in DEC and 28 of 29 in DEP) 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 1-3 and Figure 1-4).

Figure 1-3: DEC Kit Recipient Satisfaction with Installed Measures

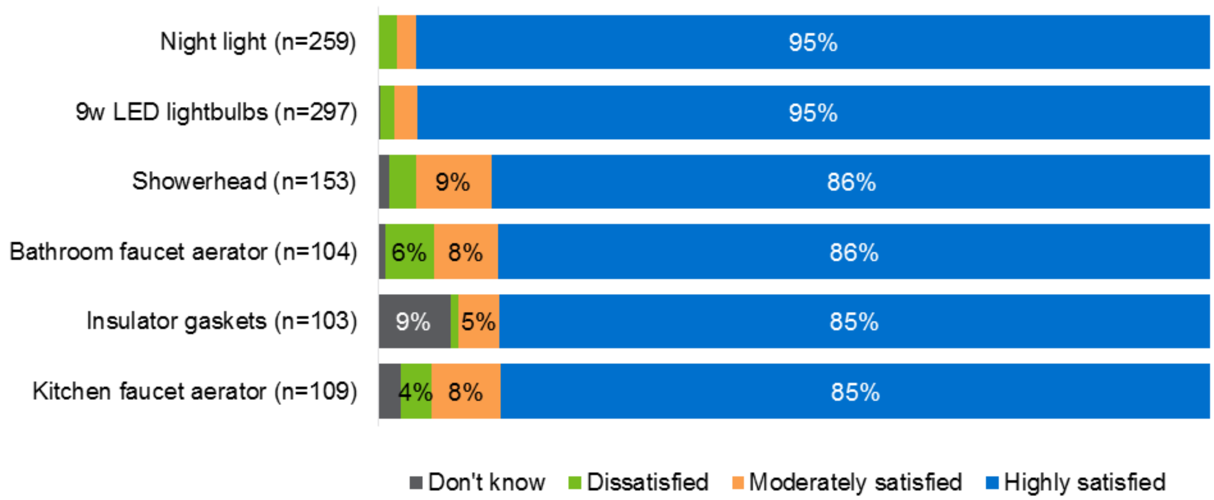
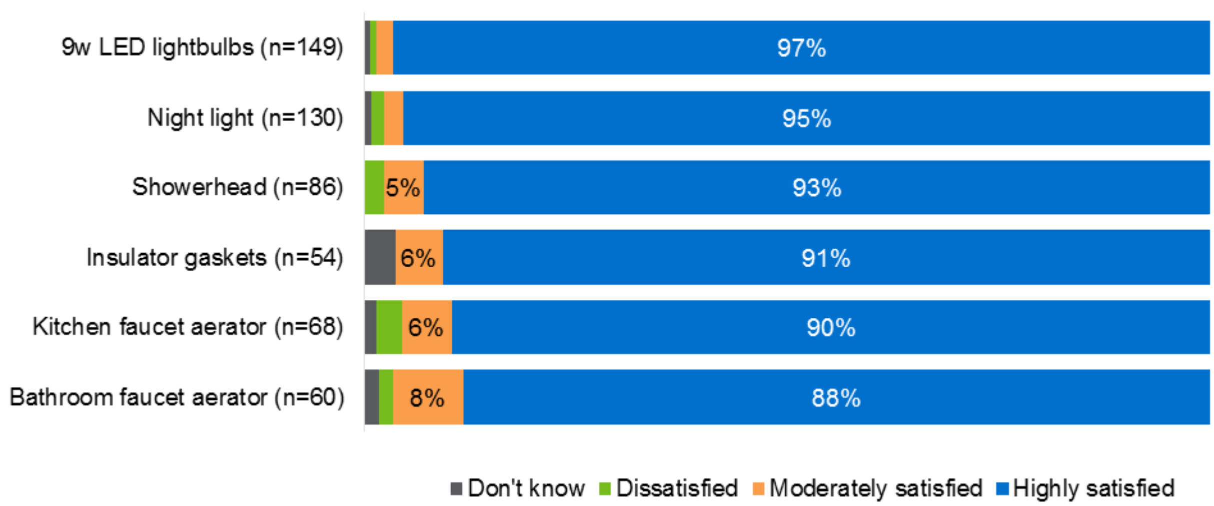


Figure 1-4: DEP Kit Recipient Satisfaction with Installed Measures



Many kit recipients value the educational information in the kit. About three-quarters of respondents (73% in DEC and 74% of DEP) 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. In both the DEC and DEP territories, about half of parents and half of children 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 and parents noted they had changed their thermostat settings.

Program Challenges

The 2017-2018 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 performance. Although about half of respondents in DEC territory (29 of 44) and DEP territory (12 of 29) reported receiving the educational materials, 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 "somewhat useful" at best. Additionally, use of online materials was limited.

There is variation in teacher efforts to encourage kit requests. All teachers encouraged their students to request kits, but they varied in the tenacity of their approach. Almost all reported vocally encouraging students (40 of 44 in DEC and 24 of 29 in DEP) and to request a kit, but far fewer reported taking additional actions (e.g., sending reminders to parents or awarding prizes to students who request kits).

There may be opportunities to get families to install more kit measures. Most parent respondents noted they installed at least one measure in the kit, but few install all measures. Most student families installed the LED lights and the nightlights, however far fewer installed the water saving measures or 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, and those who used them did so in a limited way.

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

Recommendation: Consider exploring ways to increase teacher receipt and use of materials, such as:

- Making sure teachers are aware that NTC aligns their materials with state science standards, and
- Requesting that teachers align energy-focused lesson plans with performance timing.

Conclusion 2: There is an opportunity to increase parental awareness of the kits and thus get more families to request and install kits. Currently, students bear the bulk of the burden of generating parental awareness of the kit opportunity. Although most teachers engage students on the kit request process, only about half engage parents. Parent surveys corroborate this lack of teacher to parent engagement on the kits; few parents mentioned their child's teacher or school as the source of awareness of the kit (instead, most parents learned about the kit from their child). Additionally, two-thirds of parents did not know kits were associated with a performance and instructional materials. Although about one-third of teachers follow-up with students to see if parents requested kits, there is great variation in how much emphasis teachers place on promoting the kits.

Further, the contests appear to have limited success in encouraging kit requests, as a) only one teacher mentioned using the contests to encourage kit requests, and b) the household- and school-level contests had particularly low influence on parent motivations to get a kit.

> **Recommendation:** Explore ways to increase parent awareness of and motivation for requesting the kits. For example: create a household-level contest that engages both students and their parents, so students are motivated to ask their parents to sign up and so parents are motivated to participate. For example, in addition to a cash prize drawing for parents, include a prize drawing aimed at students (e.g., toys, electronics, or other items valued by students) or a guaranteed incentive such as a coupon for pizza (e.g., Book It model).

Conclusion 3: The program influences families to save energy. Families save energy they would not have saved without receiving the kits. Nearly all respondents installed at least one kit measure, and few would have installed the kit measures if they had not received them for free from the program (as evidenced by low free-ridership rates). About one-fifth of parent respondents reported making additional energy saving improvements, and 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 in Duke Energy territories. 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 commonly 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 in the kit.

Conclusion 5: Energy savings could be increased by encouraging partipants to install LED lamps as soon as they are received and in higher usage areas. LED lamp in-service rates (ISR) measured just below 80% for both DEC and DEP. This included some participants who store the LED kit lamp until a similar lamp in the home burns-out. Continue to encourage participants to install the lamps as soon as the kit is received can increase LED lamp in-service rates and generate additional savings for the program.

Most kit lamps were installed in rooms with average (2 to 4 hour) daily lighting usage, while very few lamps were installed in high use locations such as kitchens or exterior fixtures (Table 1-7). Installation of lamps in high usage areas will results in higher energy savings.

Table 1-7: Lamp HOU Installation Rates

Daily Lamp Use*	DEC Installation Rate	DEP Installation Rate
Low (< 2 hours)	43%	44%
Average (2-4 hours)	36%	32%
High (> 4 hours)	21%	24%

*Based on the participant survey responses

Recommendations: Program should continue to encourage lamp installations as soon as possible informing them where their new lamps can save the most energy. Alternatively, consider swapping out one of the A-shape LEDs with a lamp, such as an LED PAR, that may be more applicable to higher use areas like the kitchen.

Conclusion 6: Water-related measures drive savings, but installation rates are low. Water measures contributed the majority of verified savings (DEC 74%, DEP 80%), yet fewer than half of all participants installed an aerator or showerhead (Table 1-8).

Table 1-8: Water Measure In-Service Rates

Measure	DEC ISR	DEP ISR
Kitchen Faucet Aerator	30%	40%
Bathroom Faucet Aerator	30%	34%
Showerhead	42%	50%

*Based on the participant survey responses

Recommendations: Review water savings measures' satisfaction and dislikes as well as elicit feedback from Save Energy and Water Kit Program to determine if there are ways to improve the ISR for water measures.

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 Carolinas (DEC) and Duke Energy Progress (DEP). 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, including a take-home form that students and parents can complete to receive an energy efficiency starter kit (kit) from Duke Energy; and 2) lesson plans associated with the content in the student workbooks. All workbooks, assignments and activities meet state curriculum requirements. The NTC performers encourage students to have their parents request the kits.

The program can achieve energy savings in two ways:

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

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

2.1.2 Energy Efficiency Kit Measures

Table 2-1 lists the kit's contents included in the evaluation scope (the kit includes additional educational items described in section 2.2.4 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 each utility 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: 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 their utility 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 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 ($2,500). The utilities use 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 Energy 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. Because some school districts may straddle a Duke territory and a non-Duke territory, the kit contents will differ if a family is a Duke utility (DEP or DEC) customer versus a non-Duke Energy customer (Table 2-2).[1]

Table 2-2: Measures Received by Customer Type

Measures	Duke Energy 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	✓	✓
9 Watt LEDs	✓	
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 September 2017 through May 2018, the program recorded a total of 23,161 kit recipients in DEC and 9,025 kit recipients in DEP. 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] Only Duke customers were surveyed for the evaluation

1) To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.
2) To help understand why those effects occurred and identify ways to improve the program.

2.3.1 Impact

As part of evaluation planning, the evaluation team outlined the following activities to assess the impacts of the DEC and DEP NTC programs:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings[2] 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 DEC and DEP service territory. It specifically documented teacher, student, and parent experiences by investigating: 1) teachers' assessments of the NTC performance, program materials, and curriculum in terms of quality of content, and ability to engage and motivate students to save energy; and 2) student families' responses to the energy efficiency kits and the extent to which the kits effectively motivate families to save energy.

The evaluation team assessed several elements of the program delivery and customer experience, including:

- **Awareness:**
  - How aware are teachers and student families of the DEC or DEP 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?

[2] 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.

- **Challenges and opportunities for improvement:**
  - Are there any inefficiencies or challenges associated with program delivery?
  - How engaged are teachers in implementing the curriculum and motivating student families to request program kits?
  - What are teachers' assessments of the NTC performance, program information, and curriculum?
- **Student family characteristics:**
  - What are the demographic characteristics of kit recipients?

2.4 Evaluation Overview

The evaluation team divided its approach into key tasks to meet the outlined goals:

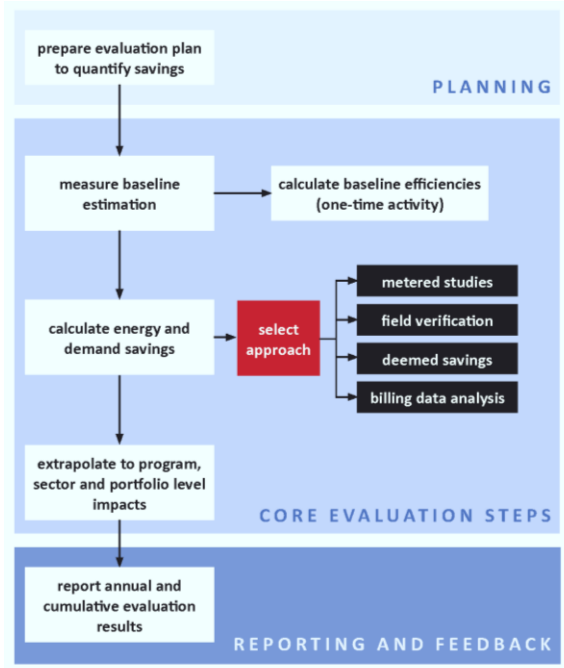
- **Task 1 –** Develop and manage evaluation work plan to describe the processes that will be followed to complete the evaluation tasks outlined in this project;
- **Task 2 –** Conduct a process review to determine how successfully the programs are being delivered to participants and to identify opportunities 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 applied 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. 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 evaluation team activities.

Table 2-3: DEC and DEP NTC Summary of Evaluation Activities

Target Group	Method	Duke Energy Carolinas (DEC)			Duke Energy Progress (DEP)		
		Population	Sample	C/P	Population	Sample	C/P
Impact Activities							
Participants	Phone/Web Survey	23,161	334	90/5	9,025	172	90/6
Process Activities							
Duke Energy Program Staff	Phone IDI	n/a	1	n/a	n/a	1	n/a
Implementer Staff: NTC	Phone IDI	n/a	1	n/a	n/a	1	n/a
Implementer Staff: R1	Phone IDI	n/a	1	n/a	n/a	1	n/a
Teachers who attended a NTC workshop	Web Survey	Unknown	44[a]	90/12	Unknown	29[b]	90/17
Participating teacher follow-up interviews	Phone IDI	Unknown	5	n/a	Unknown	5	n/a
Participants – student families who received a kit and are Duke customers	Phone/Web Survey	23,161	334	95/5	9,025	172	90/6

[a] 34 elementary teachers and 10 middle school teachers
[b] 19 elementary teachers and 10 middle school teachers

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 July 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 DEC and DEP participant databases.
- 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.

3.2 Database and Historical Evaluation Review

DEC and DEP 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 DEC and DEP were 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.

DEC and DEP provided ex-ante, or deemed, energy and summer demand savings values at the kit-level; however, they did not have measure-level ex-ante energy savings available nor winter demand savings at the kit-level. Because measure-level energy and demand savings and kit-level winter demand savings were not provided, realization rates could only be calculated at the kit-level for energy and summer demand savings.

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 a prior Energy Efficiency Education in Schools evaluation conducted in Duke Energy Carolinas. The benchmarking review illustrated variations in deemed savings among each source for each given measure, with much of the variation reflecting different baseline, household size, or water temperature assumptions. The evaluation team ultimately used assumptions outlined by the Mid-Atlantic and Pennsylvania TRMs (see section 3.4.4) to better capture region-specific assumptions such as water temperature.

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 23,161 participants for DEC and 9,025 participants for DEP within our defined evaluation period.

Based on the populations of 23,161 and 9,025 participants, the evaluation team established sub-sample frames for phone and web-based survey administration. As illustrated in Table 3-1 and Table 3-2 below, we completed a total of 334 DEC and 172 DEP surveys. This sample size resulted in an achieved confidence and precision of 90/4.5 and 90/6.2 for DEC and DEP, respectively.

Table 3-1: DEC NTC Impact Sampling

Survey Mode	Population*	Sampled Participants	Achieved Confidence/ Precisions**
Phone	7,953	74	90/4.5
Web-based	11,629	260	
Total	**19,582**	**334**	

*Sampling population excludes participants flagged as “do not contact”
**Based on full population of 23,161 participants

Table 3-2: DEP NTC Impact Sampling

Survey Mode	Population*	Sampled Participants	Achieved Confidence/ Precisions**
Phone	2,406	70	90/6.2
Web-based	4,037	102	
Total	**6,443**	**172**	

*Sampling population excludes participants flagged as “do not contact”
**Based on full population of 9,025 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 from the 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 eligible survey respondents are detailed in Table 3-4 and Table 3-5 for DEC and DEP, respectively.

Table 3-4: DEC NTC In-Service Rates

Measure	Distributed	Installed	Removed	ISR
9 Watt LEDs[1]	668	528	10	78%
Nightlight	334	259	8	75%
1.5 GPM Showerhead	334	153	13	42%
1.0 GPM Bathroom Faucet Aerator	334	104	4	30%
1.5 GPM Kitchen Faucet Aerator	334	109	10	30%
Water Temperature Gauge Card	334	57	2	16%
Outlet Insulating Gaskets[2]	4,008	620	2	15%

[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.

Table 3-5: DEP NTC In-Service Rates

Measure	Distributed	Installed	Removed	ISR
9 Watt LEDs[1]	344	266	1	77%
Nightlight	172	130	1	75%
1.5 GPM Showerhead	172	86	0	50%
1.0 GPM Bathroom Faucet Aerator	172	60	1	34%
1.5 GPM Kitchen Faucet Aerator	172	68	0	40%
Water Temperature Gauge Card	172	25	2	13%
Outlet Insulating Gaskets[2]	2,064	345	0	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 two 9W LEDs and an LED nightlight. Equation 3-1, Equation 3-2, and Equation 3-3 outline the algorithms utilized to estimate savings accrued by the lighting measures, with key parameters defined in Table 3-6.

Equation 3-1: LED Bulb Energy Savings

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

Equation 3-2: LED Nightlight Energy Savings

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

Equation 3-3: LED Bulb Demand Savings

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

Table 3-6: Inputs for Lighting Measures Savings Calculations

Input	Units	DEC Value	DEP Value	Source
$Watts_{BASE}$	Watts	LED: 27.7 Nightlight: 3.2	LED: 26.8 Nightlight: 3.6	LED: Federal minimum standards; Survey responses Nightlight: Survey responses
$Watts_{EE}$	Watts	LED: 9 Nightlight: 0.03		Equipment specifications
HOU	Hours	LED: 2.71 Nightlight: 12 / 24	LED: 2.69 Nightlight: 12 / 24	LED: Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018; Survey responses; Nightlight (HOU_{BASE} / HOU_{EE}): Pennsylvannia 2016 TRM
CF_{SUMMER}	N/A	LED: 0.1283 Nightlight: 0.0000		LED: Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018 Nightlight: Pennsylvannia 2016 TRM
CF_{WINTER}	N/A	LED: 0.1454 Nightlight: 0.0000		LED: Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018 Nightlight: Pennsylvannia 2016 TRM
IE_{kWh}	N/A	-6%		Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018
$IE_{kW\text{-}SUMMER}$	N/A	+27%		Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018
$IE_{kW\text{-}WINTER}$	N/A	-50%		Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018
ISR	N/A	LED: 78% Nightlight: 75%	LED: 77% Nightlight: 75%	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 (e.g., incandescent or CFL) 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 incandescents, a 13W baseline for CFLs, and a 9W baseline for LEDs. The final baseline wattage applied in the evaluation is a blended average of all the reported lamp technologies, which resulted in a lower wattage than would be assumed if we relied on the Uniform Methods Project least efficient baseline approach. Using a blended average baseline wattage based on the participant survey results more accurately captures the diversity of bulbs replaced by the program participants and provides greater confidence in our savings estimates. Nightlights, which are not affected by EISA, 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 on the 2018 Duke Energy Progress & Duke Energy Carolinas Energy Efficient Lighting & Retail LED Programs Evaluation Report, which estimated hours of use for 7 different room types. Based on installation locations from survey responses the evaluation estimated an average lighting hours of use of 2.71 for DEC and 2.69 for DEP.

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 3-7 and Table 3-8.

Table 3-7: DEC NTC Energy and Demand Savings, Lighting Measures

Kit Measure	Gross per bulb energy savings (kWh)	Gross per bulb summer demand savings (kW)	Gross per bulb winter demand savings (kW)
9W LED*	13.5	0.002	0.001
Nightlight	9.8	0.000	0.000

*Reflects savings per 9 watt LED bulb

Table 3-8: DEP NTC Energy and Demand Savings, Lighting Measures

Kit Measure	Gross per bulbenergy savings (kWh)	Gross per bulb demand savings (kW)	Gross per bulbwinter demand savings (kW)
9W LED*	12.7	0.002	0.001
Nightlight	10.9	0.000	0.000

*Reflects savings per 9 watt LED bulb

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 3-9.

Equation 3-4: Aerator Energy Savings

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

Equation 3-5: Showerhead Energy Savings

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

Equation 3-6: Water Heater Setback Energy Savings

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

Equation 3-7: Water Heating Measures Demand Savings

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

Table 3-9: Inputs for Water Heating Measures Savings Calculations

Input	Units	DEC Value	DEP Value	Source
ISR	N/A	Bath: 30% Kitchen: 30% Shower: 42% Setback: 16%	Bath: 34% Kitchen: 40% Shower: 50% Setback: 13%	Survey responses
ELEC	N/A	Bath: 76% Kitchen: 75% Shower: 73% Setback: 64%	Bath: 90% Kitchen: 92% Shower: 87% Setback: 78%	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		Mid-Atlantic 2018 TRM
$N_{persons}$	Persons	Bath: 3.8 Kitchen: 3.8 Shower: 3.8	Bath: 3.7 Kitchen: 3.7 Shower: 3.7	Survey responses
$N_{showers\text{-}day}$	Showers per Day	Shower: 0.6		Mid-Atlantic 2018 TRM
DF	N/A	Bath: 70% Kitchen: 50%		Mid-Atlantic 2018 TRM
ΔT	°F	Bath: 25.1 Kitchen: 32.1 Shower: 44.1 Setback: 15.0		Mid-Atlantic 2018 TRM
$\#_{faucets}$	Units	Bath: 2.28 Kitchen: 1.0 Shower: 1.8		Bathroom: 2013 RASS Data[1] Kitchen: Pennsylvania 2016 TRM Showerhead: 2015 Residential Energy Consumption Survey - South Atlantic Region
$ETDF_{SUMMER}$	N/A	Bath: 0.00013 Kitchen: 0.00013 Shower: 0.00008		Pennsylvania 2016 TRM; Ratio of calculated measure demand to energy savings
$ETDF_{WINTER}$	N/A	Bath: 0.00022 Kitchen: 0.00022 Shower: 0.00022		TVA 2017 TRM; Ratio of calculated measure demand to energy savings
RE	N/A	98%		Mid-Atlantic 2018 TRM
A_{tank}	Ft^2	24.99		Mid-Atlantic 2018 TRM
R_{tank}	°F·ft²·hr/BTU	8.0		Mid-Atlantic 2018 TRM
V_{HW}	GPD	7.3		Pennsylvania 2016 TRM
EF_{WH}	N/A	0.945		Mid-Atlantic 2018 TRM

[1] Duke Energy 2013 Residential Appliance Saturation Survey. North and South Carolina respondents.

The evaluation team determined that the 2018 Mid-Atlantic and 2016 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. Neither the Mid-Atlantic nor Pennsylvania TRM provide information on winter demand savings, therefore the evaluation team used assumptions from the 2017 Tennessee Valley Authority TRM to calculate winter demand 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 3-10 and Table 3-11.

Table 3-10: DEC NTC Gross Energy Savings, Water Heating Measures

Kit Measure	Gross per unit energy savings (kWh)	Gross per unit summer demand savings (kW)	Gross per unit winter demand savings (kW)
1.5 GPM Showerhead	121.6	0.010	0.027
1.0 GPM Bathroom Faucet Aerator	12.4	0.002	0.003
1.5 GPM Kitchen Faucet Aerator	38.2	0.005	0.008
Water Temperature Gauge Card	23.7	0.003	0.005

Table 3-11: DEP NTC Gross Energy Savings, Water Heating Measures

Kit Measure	Gross per unit energy savings (kWh)	Gross per unit summer demand savings (kW)	Gross per unit winter demand savings (kW)
1.5 GPM Showerhead	168.1	0.013	0.038
1.0 GPM Bathroom Faucet Aerator	16.4	0.002	0.004
1.5 GPM Kitchen Faucet Aerator	62.3	0.008	0.014
Water Temperature Gauge Card	23.5	0.003	0.005

3.4.5 Air Infiltration

Equation 3-8 and Equation 3-9 outline the algorithms utilized to estimate savings accrued by the outlet insulating gaskets. The parameters are defined in Table 3-12.

Equation 3-8: Air Infiltration Energy Savings

$$\Delta kWh = ISR \times gaskets \times \frac{\Delta CFM}{gasket} \times \frac{kWh}{CFM}$$

Equation 3-9: Air Infiltration Demand Savings

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

Table 3-12: Inputs for Air Infiltration Measures Savings Calculations

Input	Units	DEC Value	DEP Value	Source
ISR	N/A	17.4%	16.7%	Survey responses
Gaskets per kit	N/A	12		Duke Energy Kit Materials
∆CFM/gasket	CFM	0.23		2015 DEC Energy Efficiency Education Program Evaluation Final Report
kWh/CFM	kWh/CFM	14.64	14.46	2016 Duke Energy RASS Data[1], 2015 DEC Energy Efficiency Education Program Evaluation Final Report
$ETDF_{SUMMER}$	N/A	0.00127		Pennsylvania 2016 TRM; Ratio of calculated measure demand to energy savings
$ETDF_{WINTER}$	N/A	0.00005		TVA 2017 TRM; Ratio of calculated measure demand to energy savings

[1]Duke Energy 2016 Residential Appliance Saturation Survey. DEC and DEP respondents.

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 Carolinas service territory[3]. 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 DEC and DEP 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 3-13 and Table 3-14.

Table 3-13: DEC NTC Gross Energy Savings, Air Infiltration Measures

Kit Measure	Gross per kit energy savings (kWh)	Gross per kit summer demand savings (kW)	Gross per kit winter demand savings (kW)
Outlet Gaskets*	6.3	0.0081	0.0003

*Reflects savings for the 12 outlet gaskets per kit

[3] The Cadmus Group (2015). *Duke Energy Carolinas' Energy Efficiency Education for Schools Program Evaluation*. Retrieved December 18, 2018 from https://dms.psc.sc.gov/Attachments/Matter/ab859368-1ab3-44e5-ad5d-d6a9fb6ba2f5

Table 3-14: DEP NTC Gross Energy Savings, Air Infiltration Measures

Kit Measure	Gross per kit energy savings (kWh)	Gross per kit summer demand savings (kW)	Gross per kit winter demand savings (kW)
Outlet Gaskets*	6.8	0.0086	0.0003

*Reflects savings for the 12 outlet gaskets per kit

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 3-15 and Table 3-16 for DEC and DEP, respectively.

Table 3-15: DEC Behavioral Savings In-Service Rates

Behavior	Child Adoption Rate	Parent Adoption Rate
Turn off lights	37%	10%
Turn off electronics	25%	16%
Take shorter showers	19%	16%
Turn off heat / CAC	N/A	5% / 12%
Change thermostat settings	N/A	22%
Use fans instead of CAC	N/A	15%

Table 3-16: DEP Behavioral Savings In-Service Rates

Behavior	Child Adoption Rate	Parent Adoption Rate
Turn off lights	32%	13%
Turn off electronics	27%	19%
Take shorter showers	16%	9%
Turn off heat / CAC	N/A	5% / 9%
Change thermostat settings	N/A	22%
Use fans instead of CAC	N/A	12%

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 3-17.

Table 3-17: Behavioral Savings Kit Influence Adjustment Factor

Influence Score	DEC Response Rate	DEP Response Rate
0	2.0%	3.2%
1	0.4%	0.0%
2	0.0%	0.8%
3	0.4%	1.6%
4	1.2%	0.0%
5	5.6%	5.6%
6	8.8%	2.4%
7	16.3%	16.8%
8	19.5%	13.6%
9	7.2%	8.0%
10	38.6%	51.3%
Weighted	**81%**	**83%**

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 245 out of 334 respondents read the provided literature and set the adjustment factor at 73% for DEC and 128 out of 172 respondents read the provided literature and set the adjustment factor at 74% for DEP.

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%[4]. This estimate is based on research which modeled the persistence of customers who received four quarterly Home Energy Reports after which treatment was ceased[5]. For this evaluation, we calculated the persistence rate as the ratio of the expected average behavioral savings per day (0.257 kWh DEC and 0.255 kWh DEP) to the decay coefficient (0.924 kWh DEC and 0.916 kWh DEP) 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 3-18 below provides the adjustment factors which are applied to the behavioral savings described in Section 3.4.6.2.

Table 3-18: Behavorial Savings Adjustment Factors

Adjustment Factor	DEC	DEP
In-service rate	Varies by measure	Varies by measure
Kit influence	81%	83%
Kit informational materials	73%	74%
Persistence	28%	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, Equation 3-2, and Equation 3-3) as illustrated in Equation 3-10 and Equation 3-11.

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[4] The persistence rate is calculated based on the ratio of the daily estimated savings impact (0.257 kWh DEC and 0.255 DEP) to the the daily rate of decay of savings (0.924 kWh DEC and 0.916 DEP). For both DEC and DEP this ratio is 28%.

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

Equation 3-10: 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 3-11: 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 analysis of 27.7 watts for DEC and 26.8 watts for DEP. 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 2018 DEP and DEC Energy Efficient Lighting and Retail LED Program Evaluation Report. 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	Basement	Outdoors	Don't Know
		3.23	**4.27**	**1.83**	**4.26**	**1.51**	**3.75**	**4.25**	**1.97**
Living Room	**3.23**	0.00	1.04	0.00	1.03	0.00	0.52	1.02	0.00
Dining Room	**4.27**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bedroom	**1.83**	1.40	2.44	0.00	2.43	0.00	1.92	2.42	0.14
Kitchen	**4.26**	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Bathroom	**1.51**	1.72	2.76	0.32	2.75	0.00	2.24	2.74	0.46
Basement	**3.75**	0.00	0.52	0.00	0.51	0.00	0.00	0.50	0.00
Outdoors	**4.25**	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00
Don't Know	**1.97**	1.26	2.30	0.00	2.29	0.00	1.78	2.28	0.00

The evaluation team calculated the likely reduction in daily runtime to be 0.61 hours, or 222 hours annually. The savings were calculated and adjusted based on this key assumption.

Energy savings were calculated at 5.8 kWh for DEC and 5.6 kWh for DEP (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 3-19 and Table 3-20.

Table 3-19: DEC Behavioral Savings Achieved by Turning off Lights (per home)

Input	Units	Value	Source
Watts	Watts	27.7	Federal minimum standards
$HOU_{Reduced}$	Hours	0.61	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018;
IE_{kWh}	N/A	-6%	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018;
Summer Energy to Demand Factor ($ETDF_{SUMMER}$)	N/A	0.00017	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018; Ratio of evaluated lighting measure demand to energy savings
Winter Energy to Demand Factor ($ETDF_{WINTER}$)	N/A	0.00008	Tennessee Valley Authority 2017 TRM; Ratio of evluated lighting measure demand to energy savings
Energy Savings	**kWh**	**5.8**	**Calculated from algorithm**
Summer Demand Savings	**kW**	**0.001**	**Calculated from algorithm**
Winter Demand Savings	**kW**	**0.0004**	**Calculated from algorithm**
Adjustment Factors			
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 37% Parent: 10%	81%	73%	28%
Savings from child behavior (Energy and Summer Demand):			**0.4 kWh; 0.0001 kW**
Savings from parent behavior (Energy and Summer Demand):			**0.1 kWh; 0.0000 kW**
Total Energy Savings:			**0.4 kWh**
Total Summer Demand Savings:			**0.0001 kW**
Total Winter Demand Savings:			**0.0000 kW**

*Totals may not sum to due to rounding

Table 3-20: DEP Behavioral Savings Achieved by Turning off Lights (per home)

Input	Units	Value	Source
Watts	Watts	26.8	Federal minimum standards
$HOU_{Reduced}$	Hours	0.61	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018
IE_{kWh}	N/A	-6%	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018
Summer Energy to Demand Factor ($ETDF_{SUMMER}$)	N/A	0.00018	Opinion Dynamics - Energy Efficient Lighting & Retail LED Programs for Duke Energy Progress and Carolinas, April 2018; Ratio of evaluated lighting measure demand to energy savings
Winter Energy to Demand Factor ($ETDF_{WINTER}$)	N/A	0.00008	Tennessee Valley Authority 2017 TRM; Ratio of evluated lighting measure demand to energy savings
Energy Savings	**kWh**	**5.6**	**Calculated from algorithm**
Summer Demand Savings	**kW**	**0.001**	**Calculated from algorithm**
Winter Demand Savings	**kW**	**0.0004**	**Calculated from algorithm**
Adjustment Factors			
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 32% Parent: 13%	83%	74%	28%
Savings from child behavior (Energy and Summer Demand):			**0.3 kWh; 0.0001 kW**
Savings from parent behavior (Energy and Summer Demand):			**0.1 kWh; 0.0000 kW**
Total Energy Savings:			**0.4 kWh**
Total Summer Demand Savings:			**0.0001 kW**
Total Winter Demand Savings:			**0.0000 kW**

*Totals may not sum to due to rounding

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 3-21) and used the average value as the calculated savings amount for this behavioral change.

Table 3-21: Smart Strip Savings

Source	Savings (kWh)
2016 Ameren Missouri Evaluation	54.0
Duke Energy Potential Study	74.5
Illinois 2018 TRM	55.0
Mid-Atlantic 2018 TRM	50.7
Pennsylvania 2016 TRM	61.1
Average	**59.0**

The demand savings were calculated from the energy savings using an assumed hours of use value of 6,351 and an assumed coincidence factor of 80%, both from the 2018 Mid-Atlantic TRM. Equation 3-12 and Equation 3-13 present the algorithms used to calculate energy and demand savings for the behavior change of turning off electronics.

Equation 3-12: Turn Off Electronics Energy Savings

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

Equation 3-13: Turn Off Electronics Demand Savings

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

Energy savings (before applying adjustment factors) were calculated at 59.0 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 3-22 and Table 3-35.

Table 3-22: DEC Behavioral Savings Achieved by Turning off Electronics

Input	Units	Value	Source
Summer Coincidence factor (CF)	N/A	0.8	Mid-Atlantic 2018 TRM
Winter Coincidence factor (CF)	N/A	0.8	Engineering Judgment
HOU	hours	6,351	Mid-Atlantic 2018 TRM
Energy Savings	**kWh**	**59.0**	**Average of TRMs and prior studies (see Table 3-21)**
Summer Demand Savings	**kW**	**0.007**	**Calculated from algorithm**
Winter Demand Savings	**kW**	**0.007**	**Calculated from algorithm**
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 25% Parent: 16%	81%	73%	28%
Savings from child behavior (Energy and Summer Demand):			**2.5 kWh; 0.0003 kW**
Savings from parent behavior (Energy and Summer Demand):			**1.6 kWh; 0.0002 kW**
Total Energy Savings:			**4.1 kWh**
Total Summer Demand Savings:			**0.0005 kW**
Total Winter Demand Savings:			**0.0005 kW**

*Totals may not sum to due to rounding

Table 3-23: DEP Behavioral Savings Achieved by Turning off Electronics

Input	Units	Value	Source
Summer Coincidence factor (CF)	N/A	0.8	Pennsylvania 2016 TRM
Winter Coincidence factor (CF)	N/A	0.8	Engineering Judgment
HOU	hours	6,351	Pennsylvania 2016 TRM
Energy Savings	**kWh**	**59.0**	**Average of TRMs and prior studies (see Table 3-21)**
Summer Demand Savings	**kW**	**0.007**	**Calculated from algorithm**
Winter Demand Savings	**kW**	**0.007**	**Calculated from algorithm**
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 27% Parent: 19%	83%	74%	28%
Savings from child behavior (Energy and Summer Demand):			**2.8 kWh; 0.0003 kW**
Savings from parent behavior (Energy and Summer Demand):			**1.9 kWh; 0.0002 kW**
Total Energy Savings:			**4.6 kWh**
Total Summer Demand Savings:			**0.0006 kW**
Total Winter Demand Savings:			**0.0000 kW**

*Totals may not sum to due to rounding

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[6] (summarized in left two columns of Table 3-24.

We set the target shower length equal to the typical length used in national energy efficiency evaluations (7.8 to 8.4 minutes[7]) 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 3-14 and Equation 3-15, respectively.

Equation 3-14: 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 3-15: Take Shorter Shower Demand Savings

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

Table 3-24: 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**

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

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

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 3-25 and Table 3-26.

Table 3-25: DEC Behavioral Savings Achieved by Taking Shorter Showers

Input	Units	Value	Source
GPM	GPM	1.96	Survey responses, Federal minimum standards
$T_{person/day}$	Minutes	3.47	Aquacraft 2011 Report
$N_{persons/day}$	Showers/Person/Day	0.6	Mid-Atlantic 2018 TRM
365	Days/Year	365	-
ΔT	°F	44.1	Mid-Atlantic 2018 TRM
ELEC	%	66.9	Duke Energy 2016 RASS Data (DEC Respondents)
RE	%	98	Mid-Atlantic 2018 TRM
Summer Energy to Demand Factor (ETDF)	N/A	0.000008	Ratio of evaluated showerhead measure demand to energy savings
Winter Energy to Demand Factor (ETDF)	N/A	0.00022	Ratio of evaluated showerhead measure demand to energy savings
Energy Savings	**kWh**	**109.3**	**Calculated**
Summer Demand Savings	**kW**	**0.009**	**Calculated**
Winter Demand Savings	**kW**	**0.025**	**Calculated**
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 19% Parent: 16%	81%	73%	28%
Savings from child behavior (Energy and Summer Demand):			**3.5 kWh; 0.0003 kW**
Savings from parent behavior (Energy and Summer Demand):			**2.8 kWh; 0.0002 kW**
Total Energy Savings:			**6.3 kWh**
Total Summer Demand Savings:			**0.0005 kW**
Total Winter Demand Savings:			**0.0014 kW**

*Totals may not sum to due to rounding

Table 3-26: DEP Behavioral Savings Achieved by Taking Shorter Showers

Input	Units	Value	Source
GPM	GPM	1.89	Survey responses, Federal minimum standards
$T_{person/day}$	Minutes	3.47	Aquacraft 2011 Report
$N_{persons/day}$	Showers/Person/Day	0.6	Mid-Atlantic 2018 TRM
365	Days/Year	365	-
ΔT	°F	44.1	Mid-Atlantic 2018 TRM
ELEC	%	74	Duke Energy 2016 RASS Data (DEP Respondents)
RE	%	98	Mid-Atlantic 2018 TRM
Summer Energy to Demand Factor (ETDF)	N/A	0.000008	Ratio of evaluated showerhead measure demand to energy savings
Winter Energy to Demand Factor (ETDF)	N/A	0.00022	Ratio of evaluated showerhead measure demand to energy savings
Energy Savings	**kWh**	**117.3**	**Calculated**
Summer Demand Savings	**kW**	**0.009**	**Calculated**
Winter Demand Savings	**kW**	**0.026**	**Calculated**
ISR	**Influence**	**Kit Info.**	**Persistence**
Child: 16% Parent: 9%	83%	74%	28%
Savings from child behavior (Energy and Summer Demand):			**3.1 kWh; 0.0003 kW**
Savings from parent behavior (Energy and Summer Demand):			**1.9 kWh; 0.0001 kW**
Total Energy Savings:			**5.0 kWh**
Total Summer Demand Savings:			**0.0004 kW**
Total Winter Demand Savings:			**0.0011 kW**

*Totals may not sum to due to rounding

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 3-16 and Equation 3-17 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 2018 Mid-Atlantic TRM and 2016 Pennsylvania.

Equation 3-16: Turn off CAC or use fan mode energy savings algorithm

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

Equation 3-17: 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 3-27). 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 North and South Carolina as provided in the US Energy Information Administration's 2009 Residential Energy Consumption Survey (RECS).

Table 3-27: Smart Thermostat Savings

Study Location	Cooling Savings	Heating Savings
Vectren Indiana[8]	13.9%	12.5%
NIPSCO[9]	16.1%	13.4%
National Grid[10]	10.0%	N/A
Median	**13.9%**	**13.0%**

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 3-28 and Table 3-30 for DEC and Table 3-29 and Table 3-31 for DEP.

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

[9] Evaluation of the 2013–2014 Programmable and Smart Thermostat Program for Northern Indiana Public Service Company. The Cadmus Group, January 2015

[10] Evaluation of 2013- 2014 Smart Thermostat Pilots: Home Energy Monitoring, Automatic Temperature Control, Demand Response. The Cadmus Group, July 2015

Table 3-28: DEC Behavioral Savings Achieved by Changing AC Use Patterns

Input	Units	Value	Source
Cooling Energy Use Intensity (EUI_{cool})	kWh/ft^2	1.4522	2009 RECS Data, North and South Carolina
Average Cooled Area ($Area_{cool}$)	ft^2	1,495	2009 RECS Data, North and South Carolina
T-stat $savings_{cool}$	%	13.9%	Multiple Smart Thermostat Studies as noted above
Energy Savings	**kWh**	**301.8**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
Turning off Air Conditioning when Not Home			
ISR	**Influence**	**Kit Info.**	**Persistence**
12%	81%	73%	28%
		Total Energy Savings:	**6.0 kWh**
		Total Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**
Using Fans Instead of Air Conditioning			
ISR	**Influence**	**Kit Info.**	**Persistence**
15%	81%	73%	28%
		Total Energy Savings:	**7.3 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

Table 3-29: DEP Behavioral Savings Achieved by Changing AC Use Patterns

Input	Units	Value	Source
Cooling Energy Use Intensity (EUI_{cool})	kWh/ft^2	1.4522	2009 RECS Data, North and South Carolina
Average Cooled Area ($Area_{cool}$)	ft^2	1,495	2009 RECS Data, North and South Carolina
T-stat $savings_{cool}$	%	13.9%	Multiple Smart Thermostat Studies as noted above
Energy Savings	**kWh**	**301.8**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
Turning off Air Conditioning when Not Home			
ISR	**Influence**	**Kit Info.**	**Persistence**
9%	83%	74%	28%
		Total Energy Savings:	**4.8 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**
Using Fans Instead of Air Conditioning			
ISR	**Influence**	**Kit Info.**	**Persistence**
12%	83%	74%	28%
		Total Energy Savings:	**6.0 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

Table 3-30: DEC Behavioral Savings Achieved by Changing Heating Use Patterns

Input	Units	Value	Source
Heating Energy Use Intensity	kWh/ft^2	1.1724	2009 RECS Data, North and South Carolina
Average Heated Area	ft^2	1,574	2009 RECS Data, North and South Carolina
Savings	%	13.0%	Multiple Smart Thermostat Studies as noted above
ELEC	%	63.1%	Duke Energy 2016 RASS Data (DEC Respondents)
Energy Savings	**kWh**	**150.7**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
ISR	**Influence**	**Kit Info.**	**Persistence**
5%	81%	73%	28%
		Total Energy Savings:	**1.2 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

Table 3-31: DEP Behavioral Savings Achieved by Changing Heating Use Patterns

Input	Units	Value	Source
Heating Energy Use Intensity	kWh/ft^2	1.1724	2009 RECS Data, North and South Carolina
Average Heated Area	ft^2	1,574	2009 RECS Data, North and South Carolina
Savings	%	13.0%	Multiple Smart Thermostat Studies as noted above
ELEC	%	74.8%	Duke Energy 2016 RASS Data (DEP Respondents)
Energy Savings	**kWh**	**178.9**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
ISR	**Influence**	**Kit Info.**	**Persistence**
5%	83%	74%	28%
		Total Energy Savings:	**1.4 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

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 3-18 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 2018 Mid-Atlantic TRM and 2016 Pennsylvania.

Equation 3-18: 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 3-32.

Table 3-32: Smart Thermostat Savings

Study Location	Cooling Savings	Heating Savings
Vectren Corporation[11]	N/A	5.0%
NIPSCO[12]	N/A	7.8%
Xcel Energy[13]	4.6%	N/A
Commonwealth Edison[14]	4.8%	6.7%
Median	**4.7%**	**6.7%**

The savings were calculated and adjusted based on these key assumptions as detailed in Table 3-33 and Table 3-34.

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

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

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

14 Commonwealth Edison Residential Smart Thermostats. Navigant Consulting, February 2016

Table 3-33: DEC Behavioral Savings Achieved by Changing Thermostat Settings

Input	Units	Value	Source
Heating Energy Use Intensity	kWh/ft^2	1.1724	2009 RECS Data, North and South Carolina
Average Heated Area	ft^2	1,574	2009 RECS Data, North and South Carolina
ELEC	%	63.1%	Duke Energy 2016 RASS Data (DEC Respondents)
Heating Savings	%	6.7%	Multiple Smart Thermostat Studies as noted above
Cooling Energy Use Intensity	kWh/ft^2	1.4522	2009 RECS Data, North and South Carolina
Average Cooled Area	ft^2	1,495	2009 RECS Data, North and South Carolina
Savings	%	4.7%	Multiple Smart Thermostat Studies as noted above
Energy Savings	**kWh**	**189.7**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
ISR	**Influence**	**Kit Info.**	**Persistence**
22%	81%	73%	28%
		Total Energy Savings:	**7.0 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

Table 3-34: DEP Behavioral Savings Achieved by Changing Thermostat Settings

Input	Units	Value	Source
Heating Energy Use Intensity	kWh/ft^2	1.1724	2009 RECS Data, North and South Carolina
Average Heated Area	ft^2	1,574	2009 RECS Data, North and South Carolina
ELEC	%	74.8%	Duke Energy 2016 RASS Data (DEP Respondents)
Heating Savings	%	6.7%	Multiple Smart Thermostat Studies as noted above
Cooling Energy Use Intensity	kWh/ft^2	1.4522	2009 RECS Data, North and South Carolina
Average Cooled Area	ft^2	1,495	2009 RECS Data, North and South Carolina
Savings	%	4.7%	Multiple Smart Thermostat Studies as noted above
Energy Savings	**kWh**	**205.7**	**Calculated**
Summer Demand Savings	**kW**	**0.000**	**Deemed**
Winter Demand Savings	**kW**	**0.000**	**Deemed**
ISR	**Influence**	**Kit Info.**	**Persistence**
22%	83%	74%	28%
		Total Energy Savings:	**7.8 kWh**
		Total Summer Demand Savings:	**0.000 kW**
		Total Winter Demand Savings:	**0.000 kW**

*Totals may not sum to due to rounding

Summary of behavioral impacts

Table 3-35 below presents the total energy savings derived from the behavioral component of the program.

Table 3-35: Energy savings from behavioral impacts

Behavior	DEC kWh savings	DEP kWh savings
Turn off lights	0.4	0.4
Turn off electronics	4.1	4.6
Take shorter showers	6.3	5.0
Turn off furnace	1.2	1.4
Turn off AC	6.0	4.8
Use fan mode	7.3	6.0
Adjust thermostat set points	7.0	7.8
Total	**32.3**	**30.1**

*Total may not sum to due to rounding

3.5 Billing Regression Analysis

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 using an approach commonly referred to as billing analysis. After a thorough investigation, we concluded that, absent a randomized control trial (RCT), billing analysis was unable to reliably detect energy savings resulting from participation in the program. When the percent change in household energy use is small, as it is with the NTC program education and kit, the only reliable way to estimate energy savings using billing analysis is through a randomized control trial using large treatment and control groups and pre- and post-enrollment billing data. The most critical component of a well-designed RCT is to guarantee there are no differences between the treatment and control groups, other than the treatment of the program. This is a critical step 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 differences 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

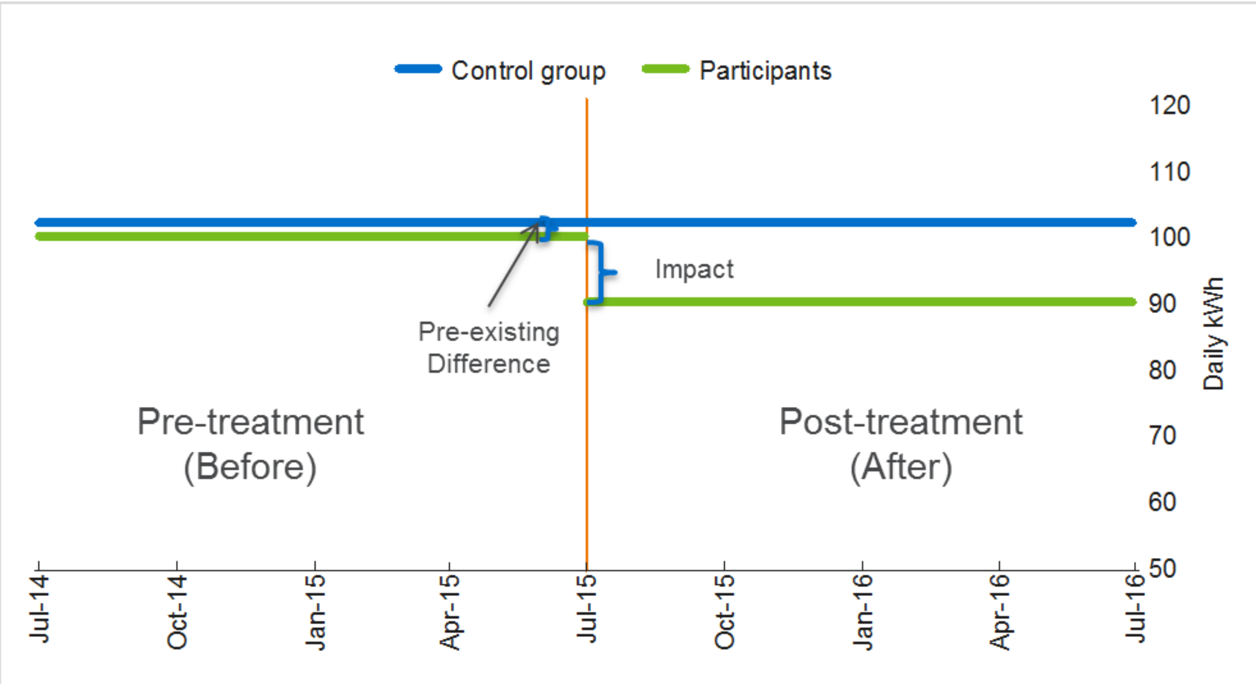
Any of these characteristics are likely to contribute to consumption responses or patterns that cannot be attributable to the program intervention. A well-designed RCT includes randomly selected customers in the treatment and control groups, thereby ensuring that the analysis avoids adverse effects of selection bias and/or lurking confounding variables. Due to these variables, RCTs are impracticable for opt-in programs. Thus, the evaluation team's recommendation is to rely on findings of the engineering analysis 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 program led to energy savings, it is necessary to systematically eliminate plausible alternative explanations for differences in electricity use patterns.

The basic framework for the analysis is illustrated in Figure 3-2 and relies on both a control group and pre- and post-enrollment billing data. The analysis is implemented via a difference-in-differences technique, which removes any pre-existing differences between the treatment and control groups. If the program's kit and behavioral changes lead to reductions in consumption, we should observe:

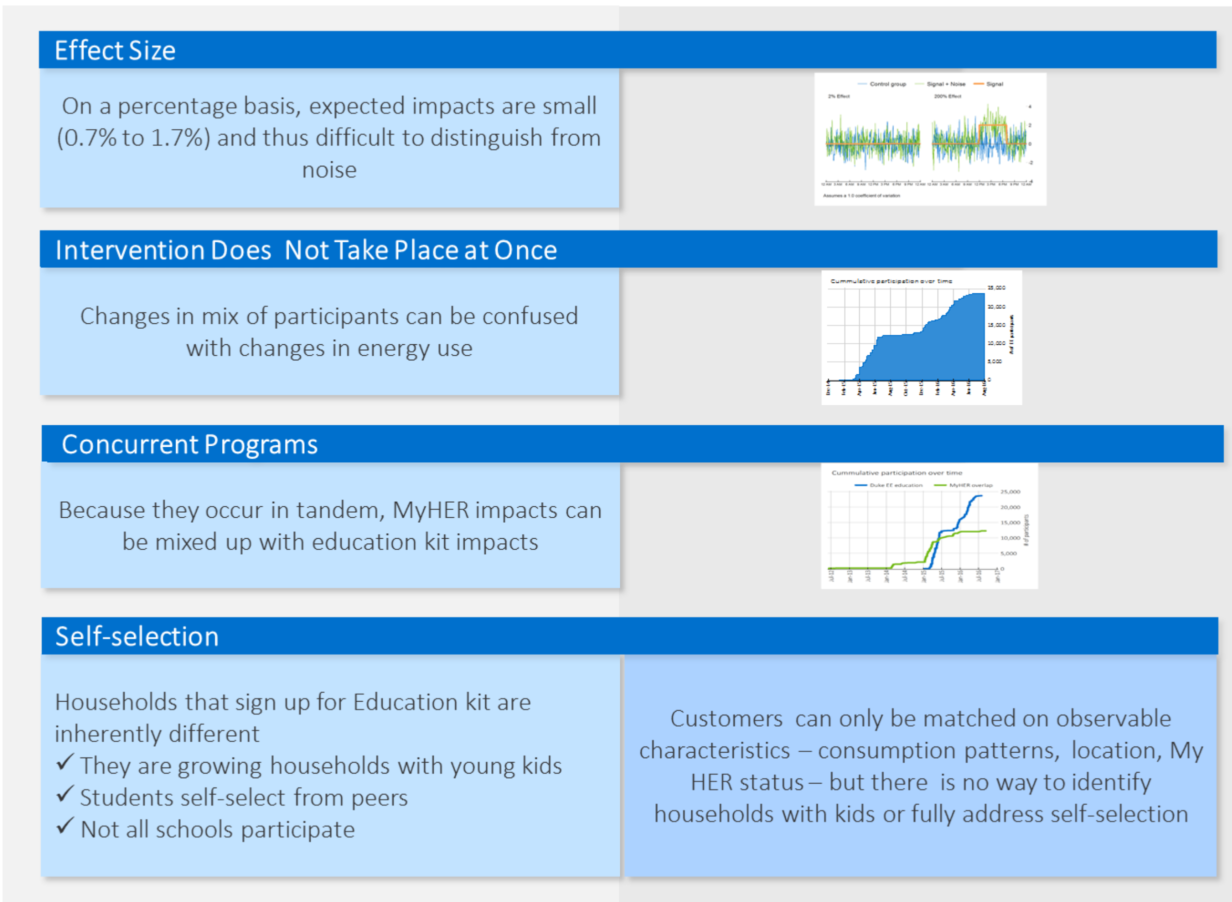
- A change in consumption for households that participated in the NTC program
- No similar change in consumption for the control group
- The timing of the change should coincide with the receipt of kits

Figure 3-2: Framework for Billing Analysis with Control Group, 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 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 a result, while the participant and comparison group may have had similar energy use patterns in the pre-treatment period, their energy use trajectories absent program participation were not necessarily the same 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 simulating fake enrollments prior to actual participation in the program and assessing if the models detected an effect when using data from the false "pre" period to estimate the counterfactual for the false "post" period. Because enrollment dates were 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 tests and each participant's enrollment date was simulated 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 fixed-effects pre-post panel regression model (using only treatment group data) and a difference-in-differences panel regression that made use of the matched comparison group.

Figure 3-4 shows the results from the pre-post placebo tests. Rather than produce zero impacts, the models estimated that the simulated enrollments 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 energy savings 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 1% to 1.5% when no intervention had taken place. Hence, neither method produced reliable energy savings estimates.

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

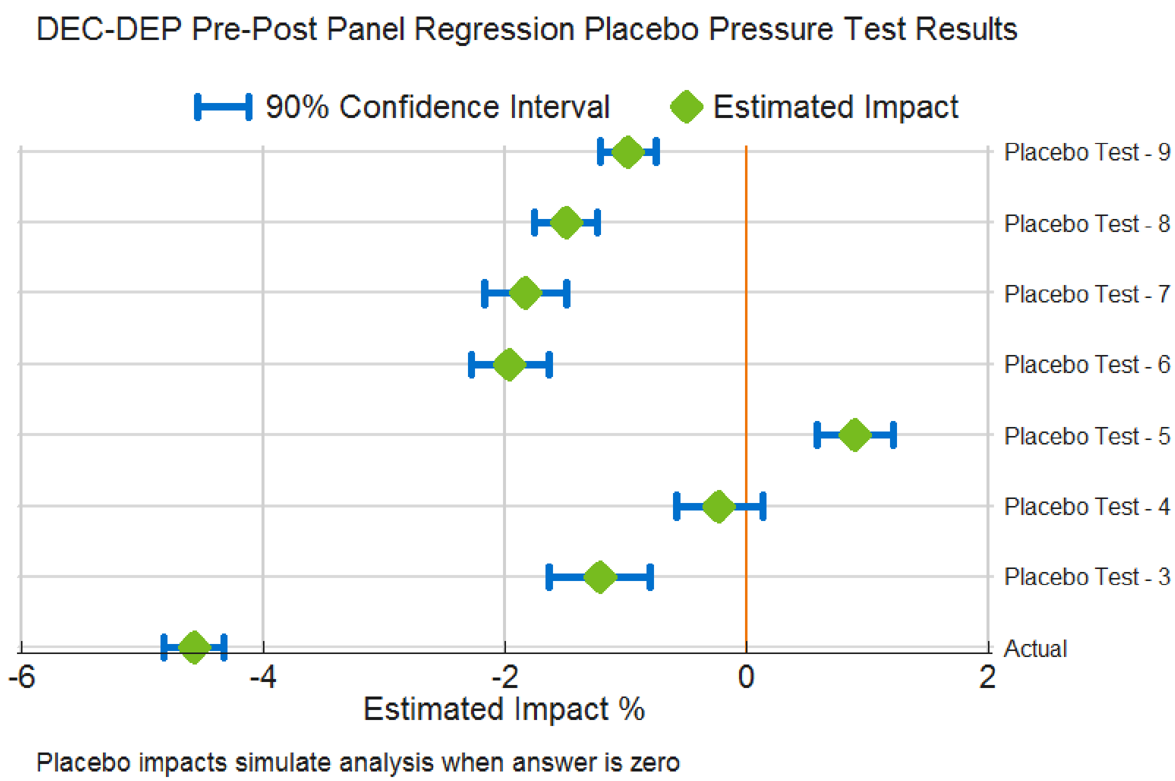
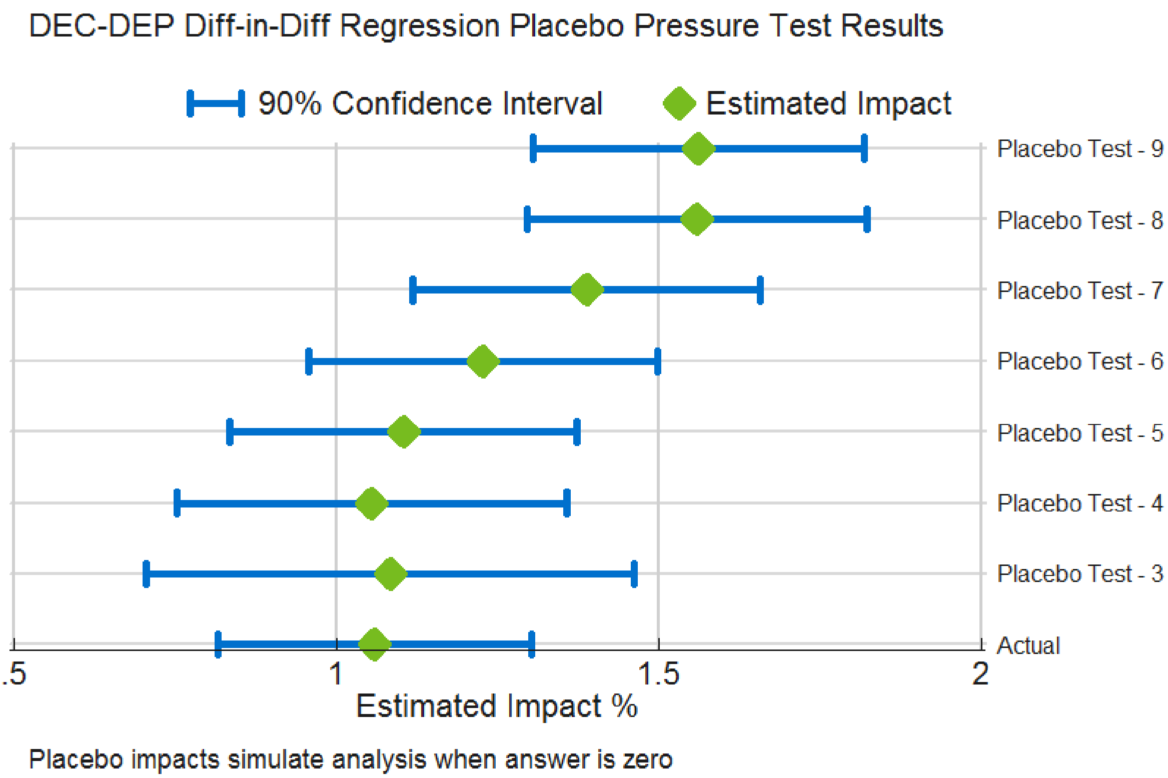


Figure 3-5: Placebo Pressure Test Results (Difference in Differences)



Appendix E 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 +/- 4.5% and +/-6.2% at the 90% confidence level for DEC and DEP, respectively (Table 3-36).

Table 3-36: Targeted and Achieved Confidence and Precision

Program	Targeted Confidence/Precision	Achieved Confidence/Precision
DEC NTC	90/10.0	90/4.5
DEP NTC	90/10.0	90/6.2

3.7 Results

DEC measure-level and kit-level energy savings values are detailed in Figure 3-6 and Table 3-37.

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

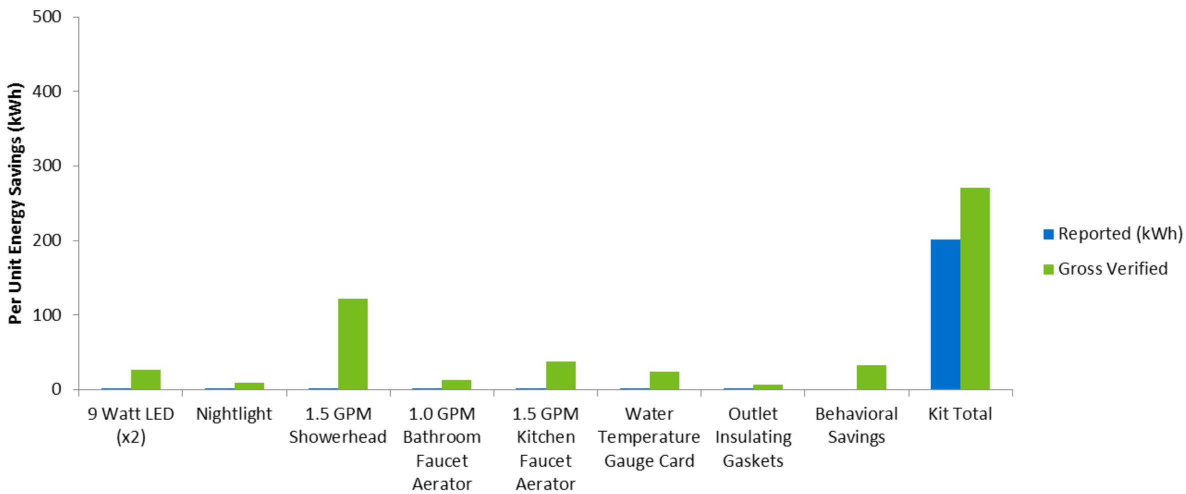


Table 3-37: DEC Measure-Level Reported and Verified Gross Energy Savings

Measure	Reported Gross Energy Savings, per unit (kWh)	Realization Rate	Verified Gross Energy Savings, per unit (kWh)	Total Verified Gross Energy Savings (kWh)
9 Watt LED*			27.0	624,555
Nightlight			9.8	226,717
Low-flow Showerhead			121.6	2,815,409
Low-flow Bathroom Aerator	N/A	N/A	12.4	287,880
Low-flow Kitchen Aerator			38.2	885,316
Water Heater Setback			23.7	549,490
Outlet Gaskets			6.3	146,847
Behavioral Changes			32.3	747,018
Total	**201.0**	**135.0%**	**271.3**	**6,283,232**

*Reflects savings for two 9 watt LEDs bulbs

DEP measure-level and kit-level energy savings values are detailed in and Figure 3-7 and Table 3-38.

Figure 3-7: 2017-2018 DEP NTC Gross Verified Energy Savings

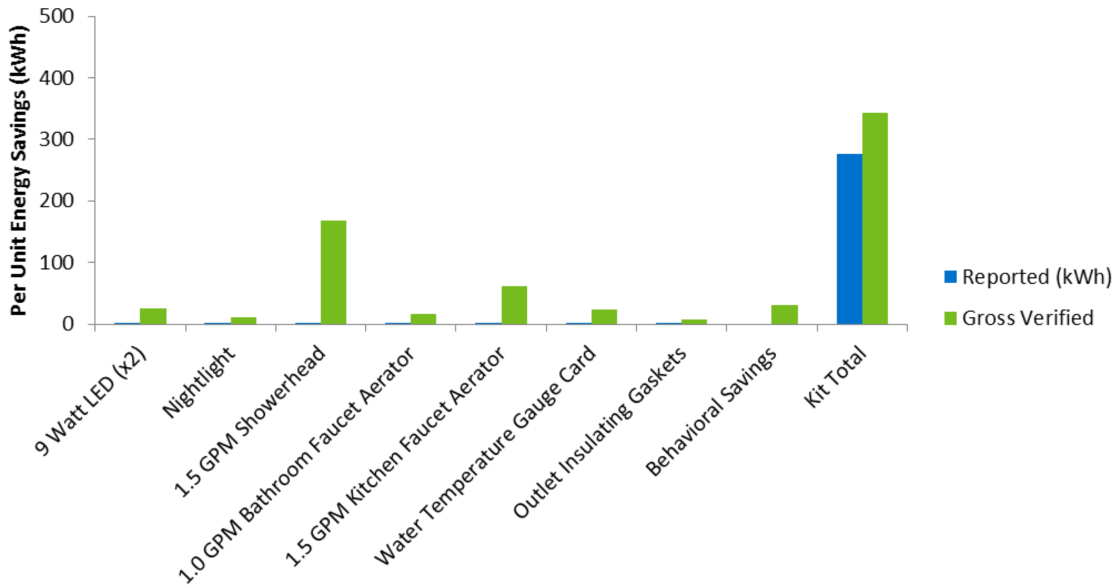


Table 3-38: DEP Measure-Level Reported and Verified Gross Energy Savings

Measure	Reported Gross Energy Savings, per unit (kWh)	Realization Rate	Verified Gross Energy Savings, per unit (kWh)	Total Verified Gross Energy Savings (kWh)
9 Watt LED*	N/A	N/A	25.4	229,261
Nightlight			10.9	98,409
Low-flow Showerhead			168.1	1,516,833
Low-flow Bathroom Aerator			16.4	148,343
Low-flow Kitchen Aerator			62.3	561,971
Water Heater Setback			23.5	212,411
Outlet Gaskets			6.8	61,268
Behavioral Changes			30.1	271,521
Total	**276.4**	**124.3%**	**343.5**	**3,100,016**

*Reflects savings for two 9 watt LEDs bulbs

Measure-level and kit-level summer demand savings are detailed in Table 3-39 and Table 3-40 for DEC and DEP, respectively.

Table 3-39: DEC Measure-Level Reported and Verified Summer Demand Gross Savings

Measure	Reported Gross Demand Savings, per unit (kW)	Realization Rate	Verified Gross Demand Savings, per unit (kW)	Total Verified Gross Demand Savings (kW)
9 Watt LED*	N/A	N/A	0.005	109.2
Nightlight			0.000	0.0
Low-flow Showerhead			0.010	225.6
Low-flow Bathroom Aerator			0.002	38.6
Low-flow Kitchen Aerator			0.005	118.6
Water Heater Setback			0.003	73.6
Outlet Gaskets			0.008	186.8
Behavioral Changes			0.001	25.3
Total	**0.054**	**61.7%**	**0.034**	**777.7**

*Reflects savings for two 9 watt LEDs bulbs

Table 3-40: DEP Measure-Level Reported and Verified Summer Demand Gross Savings

Measure	Reported Gross Demand Savings, per unit (kW)	Realization Rate	Verified Gross Demand Savings, per unit (kW)	Total Verified Gross Demand Savings (kW)
9 Watt LED*	N/A	N/A	0.004	40.4
Nightlight			0.000	0.0
Low-flow Showerhead			0.013	121.5
Low-flow Bathroom Aerator			0.002	19.9
Low-flow Kitchen Aerator			0.008	75.3
Water Heater Setback			0.003	28.5
Outlet Gaskets			0.009	77.9
Behavioral Changes			0.001	9.6
Total	**0.079**	**52.5%**	**0.041**	**373.1**

*Reflects savings for two 9 watt LEDs bulbs

Measure-level and kit-level winter demand savings are detailed in Table 3-41 and Table 3-42 for DEC and DEP, respectively.

Table 3-41: DEC Measure-Level Reported and Verified Winter Demand Gross Savings

Measure	Reported Gross Demand Savings, per unit (kW)	Realization Rate	Verified Gross Demand Savings, per unit (kW)	Total Verified Gross Demand Savings (kW)
9 Watt LED*	N/A	N/A	0.002	48.7
Nightlight			0.000	0.0
Low-flow Showerhead			0.027	631.9
Low-flow Bathroom Aerator			0.003	63.6
Low-flow Kitchen Aerator			0.008	195.5
Water Heater Setback			0.005	121.3
Outlet Gaskets			0.000	7.1
Behavioral Changes			0.002	45.2
Total	**N/A**	**N/A**	**0.048**	**1,113.4**

*Reflects savings for two 9 watt LEDs bulbs

Table 3-42: DEP Measure-Level Reported and Verified Winter Demand Gross Savings

Measure	Reported Gross Demand Savings, per unit (kW)	Realization Rate	Verified Gross Demand Savings, per unit (kW)	Total Verified Gross Demand Savings (kW)
9 Watt LED*	N/A	N/A	0.002	18.0
Nightlight			0.000	0.0
Low-flow Showerhead			0.038	340.4
Low-flow Bathroom Aerator			0.004	32.8
Low-flow Kitchen Aerator			0.014	124.1
Water Heater Setback			0.005	46.9
Outlet Gaskets			0.000	3.0
Behavioral Changes			0.002	15.7
Total	**N/A**	**N/A**	**0.064**	**581.0**

*Reflects savings for two 9 watt LEDs bulbs

The impact evaluation for the DEC 2017-2018 program resulted in a program energy realization rate of 135% and a demand realization rate of 62% as presented in Table 3-43.

Table 3-43: 2017-2018 DEC Energy Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified*
Energy (kWh)	201.0	135.0%	271.3
Demand (kW)	0.054	61.7%	0.034
Winter Demand (kW)	N/A	N/A	0.048

*Values may appear inaccurate due to rounding errors

The impact evaluation for the DEP 2017-2018 program resulted in a program energy realization rate of 124% and a demand realization rate of 52% as presented in Table 3-44.

Table 3-44: 2017-2018 DEP Energy Savings per Kit

Measurement	Reported	Realization Rate	Gross Verified*
Energy (kWh)	276.4	124.3%	343.5
Summer Demand (kW)	0.079	52.5%	0.041
Winter Demand (kW)	N/A	N/A	0.064

*Values may appear inaccurate due to rounding errors

Table 3-45 and Table 3-46 present the reported and verified energy and demand savings for the 2017-2018 program year for DEC and DEP, respectively.

Table 3-45: 2017-2018 DEC Program Level Savings

Measurement	Reported per Kit	Kits Distributed	Program Reported*	Realization Rate	Program Gross Verified*
Energy (kWh)	201.0	23,161	4,655,361	135.0%	6,283,232
Summer Demand (kW)	0.054		1,260.7*	61.7%	777.7
Winter Demand (kW)	N/A		N/A	N/A	1,113.4

*Values may appear inaccurate due to rounding errors

Table 3-46: 2017-2018 DEP Program Level Savings*

Measurement	Reported per Kit	Kits Distributed	Program Reported*	Realization Rate	Program Gross Verified*
Energy (kWh)	276.4	9,025	2,494,510	124.3%	3,100,016
Summer Demand (kW)	0.079		711.0*	52.5%	373.1
Winter Demand (kW)	N/A		N/A	N/A	581.0

*Values may appear inaccurate due to rounding errors

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).[15] 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, infiltration 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.

$$FR = FRC + FRI$$

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

4.1.1 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 Duke Energy 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 six 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:

- The fact that the items were free
- The fact that the items were sent to their home
- The chance to win cash prizes for their household and school
- Information in the kit about how the items would save energy
- Information that their child brought home from school
- Other information or advertisements from Duke Energy, including its website

Asking respondents to separately rate the influence of each of the six 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.

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.[16]

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.[17]
- 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 and Table 4-4 presents the end-use FR estimates.

[16] 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.

[17] 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: DEC End-Use-Level Free Ridership Scores

End-use	End-Use Free Ridership
Light bulbs	0.26
Water saving measures	0.15
Infiltration measures	0.12

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

End-use	End-Use Free Ridership
Light bulbs	
Water saving measures	0.12
Infiltration measures	0.08

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 and Table 4-4. Overall free ridership for the NTC kits is an estimated 16% for DEC and 13% for DEP.

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 2018 Mid-Atlantic TRM, 2016 Pennsylvania TRM, and outputs from this impact evaluation.

Lighting measures (namely, LEDs) were commonly reported spillover measures. Since Duke Energy offered discounted lighting at participating retailers through their Energy Efficient Lighting (EEL) program as well through their Online Savings Store (DEC only), we asked respondents to confirm they did not use Duke Energy's website to find or 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 find or purchase discounted lighting measures.

Participant measure spillover (PMSO) is calculated as follows:

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

Table 4-5 and Table 4-6 exhibits the PMSO by measure category.

Table 4-5: DEC PMSO, by Measure Category

Measure Category	Total kWh for Category	Percent Share of kWh
LEDs	6,345	82%
CFLs	486	6%
Appliances	768	10%
Windows	160	2%
AC Filters	3	<1%
Total	**7,743**	**100%**

Table 4-6: DEP PMSO, by Measure Category

Measure Category	Total kWh for Category	Percent Share of kWh
LEDs	2,421	87%
CFLs	19	1%
Appliances	236	8%
Windows	29	1%
Outlet Gaskets	79	3%
Total	**2,783**	**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 10% for DEC and 5% for DEP.

4.3 Net-to-Gross

Inserting the FR and SO estimates into the NTG formula (NTG = 1 – FR + SO) produces an NTG value of 0.94 for the DEC program (Table 4-7) and 0.92 for the DEP program (Table 4-8). The evaluation team applied the NTG ratios to verified gross savings to calculate NTC kit net savings.

Table 4-7: DEC Program Net-to-Gross Results

Free Ridership	Spillover	NTG
0.16	0.10	0.94

*Totals may not sum to due to rounding

Table 4-8: DEP Program Net-to-Gross Results

Free Ridership	Spillover	NTG
0.13	0.05	0.92

*Totals may not sum to due to rounding

5 DEC 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	44	Unknown	90/17
Participating teacher follow-up interviews	Phone in-depth interview	5	Unknown	N/A
Student families who received DEC kit and are customers of DEC	Phone/Web survey	334*	23,161	95/5

*260 web surveys and 74 phone surveys

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 44 teachers who attended NTC performances between September 7, 2017 and March 16, 2018. Of the 44 teacher respondents, 34 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 their experience. The evaluation team completed interviews with five of these teachers. Two taught at elementary schools (one first grade teacher and one second) and three taught at middle schools (two sixth grade teachers and one seventh grade teacher).

5.1.2 Survey of Student Families Who Received the DEC Kit

In April and May 2018, the evaluation team surveyed 334 families who received energy efficiency kits from DEC between August 2017 and May 2018 (Table 5-2). During that period, DEC distributed a total of 5,587 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 12,515 households, sending email survey invitations to 11,449 households and attempting to call 1,066 households for which program records provided an email address and/or a phone number. Ultimately, the data collection effort achieved a 2.7% response rate, providing a sample with 95/5 confidence/precision. Comparisons with census data demonstrate that the sample is largely representative of income level and ownership status for the region. Respondents reported greater educational attainment and larger-sized households than typical of the region.[18]

Table 5-2: DEC Student Family Survey Response Rates

Mode	Population Size	Sample Frame Size	Completed Surveys	Response Rate	Confidence/ Precision
Web-based	23,161	11,629	260	2.3%	95/5
Phone		7,953	74	6.9%	
Total		**19,582**	**334**	**2.7%**	

5.2 Process Evaluation Findings

5.2.1 Awareness of DEC Sponsorship of the Program

Teachers and student families were largely aware of DEC's sponsorship of the program. A majority of teachers (84%) reported they were aware of DEC's sponsorship. The 37 teachers who knew of DEC's sponsorship most often learned about it through another staff member at their school (14) or DEC marketing materials (6) (Table 5-3).

Table 5-3: How Teachers Learned of DEC's Sponsorship (Multiple Responses Allowed; n=37)

Source	Number of Teachers
Another staff person at school	14
The National Theatre for Children staff	12
Duke Energy marketing materials	6
The National Theatre for Children materials	6
Prior performance at school	5
Duke Energy staff	1
Don't recall	4

[18] Region comparisons come from 2016 American Community Survey (Census) 5-year period estimates data for the state of North Carolina and South Carolina.

Awareness of DEC sponsorship among student families was also high, with most (94%) stating they knew the kit was sponsored by Duke Energy. Over half (59%) 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 (29%) and communications from their child's teacher or school (29%).

About one-third (31%) of student family respondents said they knew about the energy-related classroom activities and NTC performance at their child's school. Of those, most (77%) said they found out about the NTC activities from their child or from a teacher or school administrator (28%).

5.2.2 Parent Awareness of DEC Kit Opportunity

Classroom materials sent home with students were the key source of awareness of kits for families, with most student families (71%) hearing about the opportunity to receive a Duke Energy kit via this medium. Other respondents learned about the kits from various communications from the school (Table 5-4).

Table 5-4: Sources of Parental Awareness of Kits (Multiple Responses Allowed; n=334)

Source of Kit Awareness	Percent
Classroom materials	71%
School newsletter	17%
Email from teacher/school	14%
School website or web portal	6%
Conversations with teacher	4%
Poster at school	4%
After hour event at school	2%
Other	13%

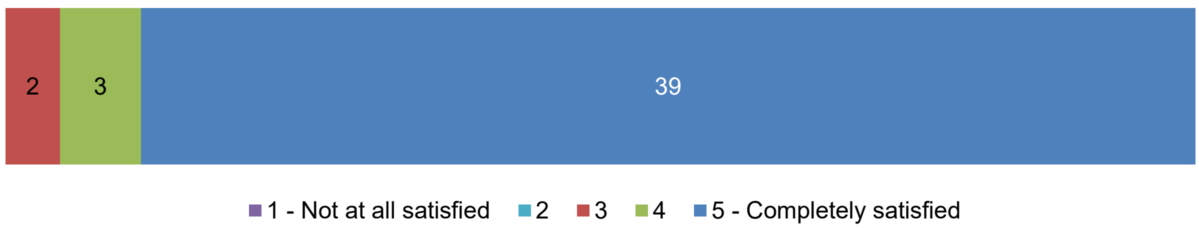
5.2.3 Teacher Experience with the Program

NTC Performance

Teachers were very 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 95% (42 of 44) 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 (Table 5-1).

Figure 5-1: Overall Teacher Satisfaction with NTC Performance (n=44)



More than 90% of the surveyed teachers (40 of 44) said the explanation of energy-related concepts was “about right” for most of their students. Of the other four, three teachers (two first grade teachers and one elementary teacher that teaches several grades) reported the material was too advanced, while one sixth grade teacher said the material was too basic for their students.

Regarding age appropriateness, the comments from the interviewed teachers echoed the findings from the online survey. All five interviewed teachers said the performance was age appropriate and kept their students’ attention.

The interviewed teachers commented on the quality of the performance, specifically that the performance was engaging, and one noted that the performance gave students tangible actions to save energy.

Two surveyed teachers offered suggestions for improving the performance:

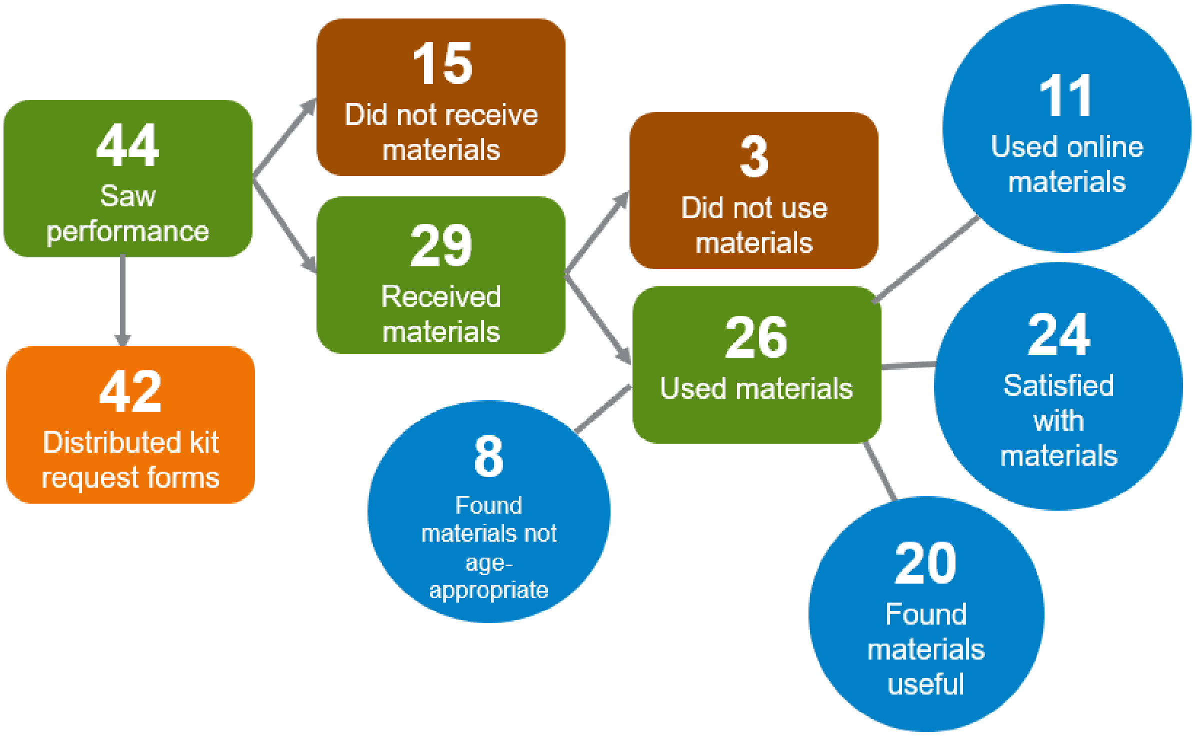
- Introduce vocabulary ahead of the performance. A first-grade teacher noted that having some key terms ahead of time would have allowed teachers to review them with students.
- Improve sound quality. A second-grade teacher noted that the it was hard to hear the performance in a large space. This teacher suggested the performers were not expecting have to perform in a large auditorium.

Curriculum and Instructional Materials

A notable percentage of teachers reported not receiving or using the curriculum materials, despite most reporting that they distributed kit request forms to their students (see Kit Request

Forms section below).[19] About two-thirds of teachers (29 of 44) reported receiving the curriculum and instructional materials, while fifteen said they did *not* receive the materials. Of the 29 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 state testing material took priority (Figure 5-2).

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



Twenty-six teachers reported use of the instructional materials and they reported 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 to moderate: Eight teachers characterized their use as "a little" and twelve used the materials "moderately." About 40% of respondents used the online aspect of the curriculum.
- Materials were useful: When asked to rate the usefulness of the materials, from 1 (not at all useful) to 5 (highly useful), most respondents rated the usefulness as a four (11) or five (9). The remaining six respondents scored the usefulness as a three.

[19] Kit request forms and curriculum materials are delivered to schools at the same time. The findings from this study are inconclusive as to whether teachers did not actually receive the instructional materials in the first place (for example: the school received them, but did not distribute them to the teachers), or if teachers did not remember receiving them due to a recency effect (in that, they did receive them but did not remember this event by the time of the survey, which seems particularly likely if the teacher did not distribute or use the materials despite receiving them).

- Materials were age-appropriate: Six reported the material was age-appropriate, while a 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: Fourteen reported the curriculum “completely” (5) or “mostly” (9) aligned with state science standards, seven stated it “somewhat” aligned, and four did not know if the materials aligned. One fifth grade teacher reported there were no state science standards.
- One teacher reported abstract concepts such as electricity can be difficult for children to understand.

The eight 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 their teaching priorities at that time (5 mentions) and concerns about the age appropriateness, with two kindergarten teachers saying the materials were too advanced and one sixth grade teacher reporting the materials were too basic.

No teacher specified any concepts the workbooks should have covered to make it more useful. Twenty-four of the 26 reported being satisfied with the materials (scored a “4” or “5” on a five-point scale) and two were neither satisfied or dissatisfied with the materials (scored a “3” on a five-point scale).

Two interviewed teachers said they used the curriculum materials. Of those, one used the workbooks in their classroom and one reported sending the materials home.

Kit Request Forms

As Figure 5-2 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, with more than one-third indicating they never received the instructional materials. Yet nearly all reported distributing kit request forms to students, which are delivered to the school at the same time as the instructional materials. This suggests that teachers viewed the materials as tangential to the kit request forms.

Ninety-five percent of surveyed teachers distributed the kit request forms to their students and almost 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 and all noted ways they encouraged students to receive the kit (Table 5-5).

Table 5-5: Actions Taken to Encourage Students to Receive Kit (Multiple Responses Allowed)

Actions	Teacher Survey Responses (n=44)	Interview Mentions (n=55)
Encouraged students to take action	43	5

Engaged students	*41*	*3*
Vocally encouraged students	40	2
Explain that school will get award	-	1
Posted MyEnergyKit.org poster	17	-
Engaged parents	*24*	*4*
Electronic reminders to parents (email, text)	18	3
Used classroom web portal	*12*	-
Spoke with parents in person	8	1
Used newsletter	2	-

About a third of surveyed teachers (32%) reported following up with students to find out whether their household requested a kit. Of those, teachers estimated between 5% to 65% of families ordered a kit, demonstrating an average of 22% of student families that requested a kit.[20]

5.2.4 Student Family Experience with the Program

Installation and Use Rates

Almost all (93%) participants used at least one measure in the kit, installing an average of three measures from their kit. Most kit recipients installed the lighting measures including LEDs (95%) and nightlights (83%); far fewer used the insulator gaskets and water related measures (ranging from 33% to 35%). Water related measures 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 (71%) said they installed both bulbs included in the kit and they typically replaced incandescent bulbs.

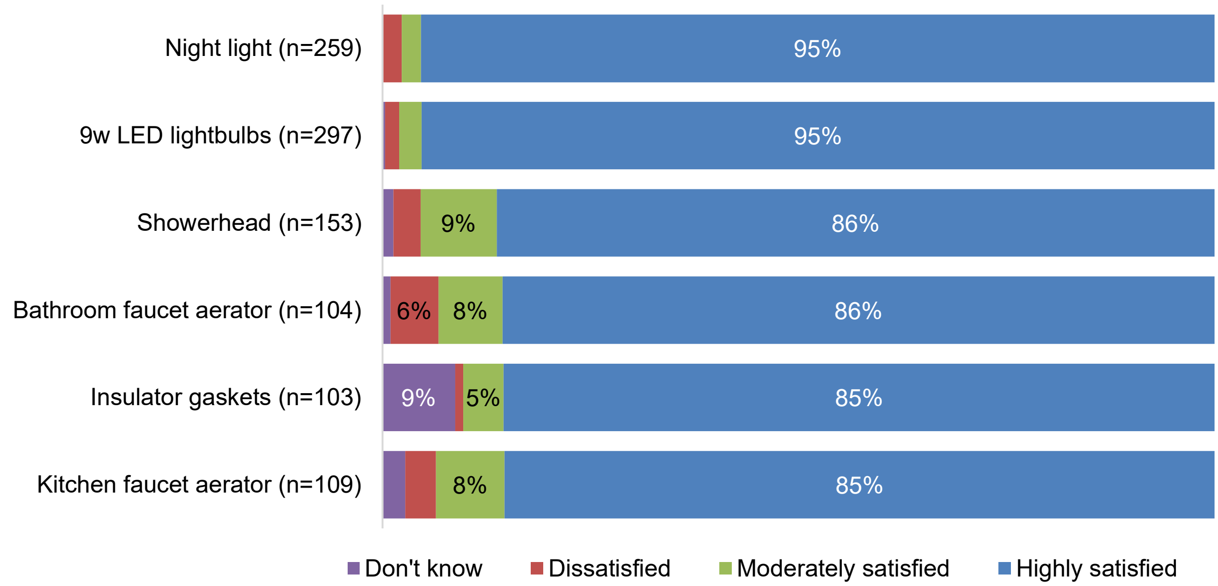
Of those who did not install all items in the kit, about a third (34%) said they do not plan to install any of the items they had not yet installed. Respondents said they would not install the remaining items because the currently installed item is still working, they already had an efficient measure installed, they tried it and it didn't fit, or they had not "gotten around to it."

Measure Satisfaction

Nearly all kit recipients reported high satisfaction with the items they installed from their kit (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 or that the measures did not fit properly.

[20] 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

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 (73%) respondents said they read the booklet, most of whom (82%) found it highly helpful.[21] Those not finding the booklet helpful stated they already knew the information presented in the booklet or they wanted additional energy saving tips and more detailed information included.

Additional Energy Saving Actions

Parents and children reported adopting new energy-saving actions since their involvement in the program. Over half of parents reported taking an energy-saving action (51%) and over half (51%) 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 (37%) or that they changed their thermostat settings (22%) (Table 5-6). More than three-quarters (81%) of respondents reporting new energy saving behaviors said the DEC-sponsored kit and materials were “highly influential” on their adoption of those behaviors.[22]

[21] 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-two percent of respondents who reported reading the booklet gave a rating of 7 or higher. 16% gave ratings of 5 or 6, and 2% gave ratings of 0 through 4.

[22] 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”). Eighty-one percent of respondents (or, 205 of 252) who reported behavior changes gave a rating of 7 or higher.

Table 5-6: New Behaviors Adopted by Parents and Children Since Receiving Kit (Multiple Responses Allowed; n=334)

New Behaviors Child Has Adopted	Parents	Children
Adopted new behaviors since receiving kit	51%	51%
Changed thermostat settings to use less energy	22%	-
Turn off electronics when not using them	16%	25%
Takes shorter shower	16%	19%
Using fans instead of air conditioning	15%	-
Turning off air conditioning when not home	12%	-
Turning off lights when not in a room	10%	37%
Turning water heater thermostat down	8%	-
Turning off furnace when not home	5%	-
Other reason	5%	2%
Refused	0%	1%

Receiving a kit may drive a desire to make additional energy efficiency improvements. Most student families reported a desire to receive more kit measures (90%), specifying interest in LEDs (78%), nightlights (58%), showerheads (24%), gasket insulators (15%), and bathroom and kitchen aerators (14%). Parents typically preferred requesting additional measures via the internet (74%) or pre-paid postcards (23%).

Many parent respondents reported they want to purchase additional energy saving products. More than half (58%) reported an interest in purchasing at least one of the products or services seen in Table 5-7.

Table 5-7: Parent Interest in Additional Products and Services (Multiple Responses Allowed; n=334)

Products and Services	Parents
New efficient lighting	40%
Air leak sealing	28%
Energy efficient appliances	23%
Connected or smart thermostats	19%
Energy efficient water heater	18%
Efficient heating or cooling equipment	16%
Efficient windows	16%
Adding insulation	16%
Sealing or insulating ducts	14%
Other	5%

The kit motivated some respondents to purchase energy efficient equipment or services (Table 5-8). More than one-quarter (28%) of respondents reported purchasing or installing additional energy efficiency measures since receiving their kit. Efficient light bulbs were the most commonly reported measure (mentioned by 67 respondents), with 59 respondents specifying LEDs and eight mentioning CFLs. Six respondents reported getting a Duke Energy rebate for their measure, four of whom said they received rebates for purchasing LEDs, one for CFLs, one for sealing air leaks, and another who received an incentive for their efficient heating or cooling equipment. Most (60 of 92) 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: Additional Energy Saving Measures Purchased (Multiple Responses Allowed; n=334)

	Count of Respondents Reporting Purchases After Receiving the Kit	Count Reporting Duke Rebates for Measure	Count Reporting High Program Influence on Purchase*
At least one measure	92	6	60
Bought LEDs	59	4	33
Bought energy efficient appliances	26	0	18
Sealed air leaks	18	1	8
Installed an energy efficient water heater	12	0	6
Added insulation	10	0	3
Sealed ducts	8	0	3
Bought CFLs	8	1	4
Other	8	0	3
Bought efficient heating or cooling equipment	7	1	4
Bought efficient windows	4	0	1
Moved into an ENERGY STAR home	2	0	1

*Respondents that rated the influence of the DEC program as 7 or higher on 10-point scale, where 0 was not at all influential and 10 was extremely influential.

6 DEP Process Evaluation

6.1 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 6-1).

Table 6-1: 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	29	Unknown	90/14
Participating teacher follow-up interviews	Phone in-depth interview	5	Unknown	N/A
Student families who received DEP kit and are customers of DEP	Phone/Web survey	172*	9,025	90/6

*102 web surveys and 70 phone surveys

6.1.1 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 29 teachers who attended NTC performances between September 18, 2018 and March 15, 2018. Of the 29 teacher respondents, 19 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 that had indicated interest in being interviewed about their experience. The evaluation team requested their participation in a follow-up in-depth interview (IDI) (n=5) 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 their experience. The evaluation team completed interviews with five of these teachers. Three taught at elementary schools (teaching kindergarten, fourth, and fifth grades, respectively) and two taught sixth grade at middle schools.

6.1.2 Survey of Student Families Who Received the DEP Kit

In April and May 2018, the evaluation team surveyed 172 families who received energy efficiency kits from DEP between September 2017 and May 2018. (Table 6-2). During that period, DEP distributed a total of 5,587 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 4,877 households, sending email survey invitations to 3,974 households and attempting to call 903 households for which program records provided an email address and/or a phone number. Ultimately, the data collection effort achieved a 3.5% response rate, providing a sample with 90/6 confidence/precision. Comparisons with census data demonstrate that the sample is largely representative of housing type, income level, and ownership status for the region. However, respondents reported greater educational attainment and more household members than typical for the region.[23]

Table 6-2: DEP Student Family Survey Response Rates

Mode	Population Size	Sample Frame Size	Completed Surveys	Response Rate	Confidence/ Precision
Web-based	9,025	3,974	102	2.6%	90/6
Phone		903	70	7.8%	
Total		**4,877**	**172**	**3.5%**	

6.2 Process Evaluation Findings

The subsequent sections discuss the key process evaluation findings, beginning with a review sponsorship awareness.

6.2.1 Awareness of DEP Sponsorship of the Program

Teachers and student families were mostly aware of DEP's sponsorship of the program. A majority of teachers (84%) reported they were aware of DEP's sponsorship. The 23 teachers who knew of DEP's sponsorship most often learned about it through Duke materials (8 mentions) or NTC staff (8 mentions) (Table 6-3).

23 Region comparisons come from 2016 American Community Survey (Census) 5-year period estimates data for the states of North Carolina and South Carolina.

Table 6-3: How Teachers Learned of DEP's Sponsorship (Multiple Responses Allowed; n=23)

Source	Number of Teachers
Duke Energy marketing materials	8
The National Theatre for Children staff	8
Another staff person at school	7
The National Theatre for Children materials	7
Duke Energy staff	1

Awareness among student families was high, with 88% of respondents stating they knew the kit was sponsored by Duke Energy. Over half (57%) 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 communications from their child's teacher or school (30%) and informational material included in the kit (27%).

Only about one-quarter (24%) of respondents said they knew about the energy-related classroom activities and NTC performance at their child's school. Of those, most said they found out about the NTC activities from their child (67%) and/or from a teacher or school administrator (41%).

6.2.2 Parent Awareness of DEP Kit Opportunity

Classroom materials sent home with students were the key source of awareness of kits for families, with most student families (69%) hearing about the opportunity to receive a Duke Energy kit via this medium. Other respondents learned about the kits from various communications from the school (Table 6-4).

Table 6-4: Sources of Parental Awareness of Kits (Multiple Responses Allowed; n=172)

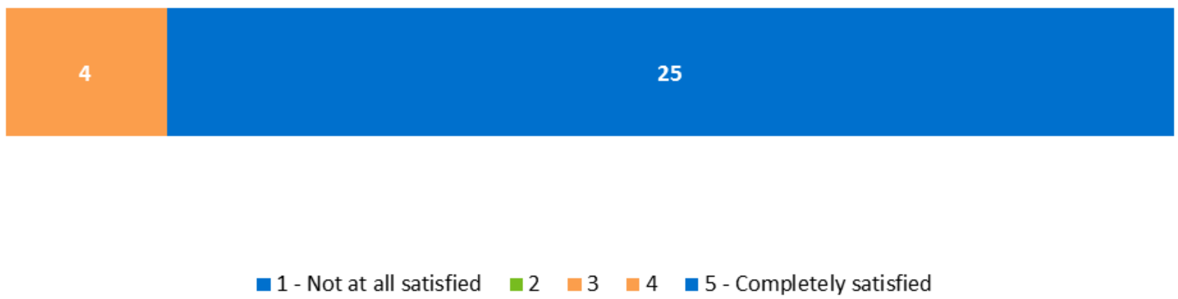
Kit Awareness	Percent
Classroom materials	69%
Email from teacher/school	13%
School newsletter	11%
School website or web portal	6%
Conversations with teacher	5%
Poster at school	3%
After hour event at school	1%
Other	18%

6.2.3 Teacher Experience with the Program

NTC Performance

Teachers were very 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 (Figure 6-1).

Figure 6-1: Overall Teacher Satisfaction with NTC Performance (n=29)



More than 90% of the surveyed teachers (27 of 29) said the explanation of energy-related concepts was "about right" for most of their students. The two remaining, one second grade teacher and one middle school teacher (who teaches grades 5 through 8), indicated the materials were "somewhat too advanced" for most students. Comments from the interviewed teachers echoed the findings from the online survey. Four of the five interviewed teachers – two elementary and two middle school teachers – said the performance was age appropriate and kept their students' attention. By comparison, a kindergarten teacher reported that the material in the performance may have been better suited for older elementary students but indicated the performance still engaged the kindergarteners.

Five teachers commented on the quality of the performance, specifically that the performance was engaging, and the performers were humorous. One sixth grade teacher particularly liked that the performance was easy to understand and the other sixth grade teacher liked that the performance reinforced what they were covering in their classroom.

Only one of the surveyed teachers offered any improvements for the performance, suggesting that the NTC performance could include a list of advantages and disadvantages for renewable energy compared to nonrenewable energy.

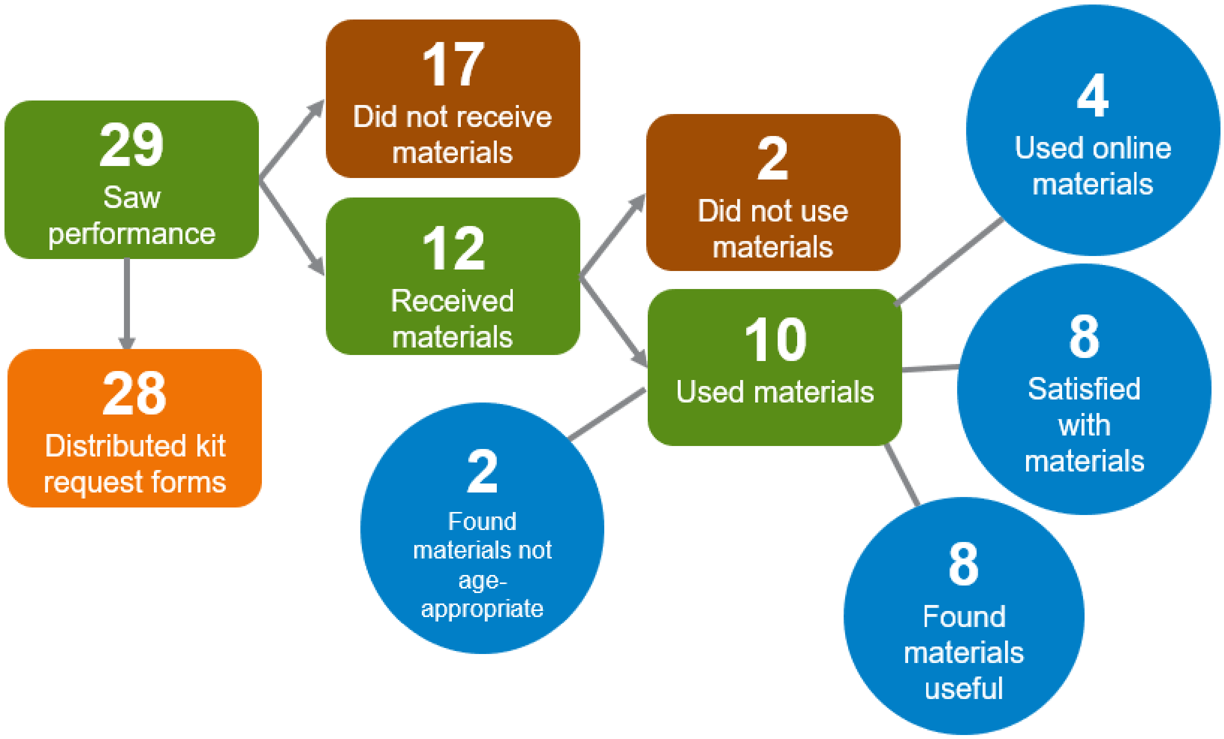
Curriculum and Instructional Materials

A notable percentage of teachers reported not receiving or using the curriculum materials. [24] About forty percent of teachers (12 of 29) reported receiving the curriculum and instructional

[24] Kit request forms and curriculum materials are delivered to schools at the same time. The findings from this study are inconclusive as to whether teachers did not actually receive the instructional materials in the first place (for example: the school received them, but did not distribute them to the teachers), or if teachers did not remember receiving them due to a recency effect (in that, they did receive them but did not remember this event by the time of the survey, which seems particularly likely if the teacher did not distribute or use the materials despite receiving them).

materials, while 17 said they did not receive the materials. Of the 12 who reported receiving the materials, two reported not using them "at all" because they did not have time to use them and integrate them into their existing curriculums (Figure 6-2).

Figure 6-2: DEP Teachers Use of Forms and Instructional Materials



The 10 teachers reporting use of the instructional materials made the following observations:

- Use of materials was limited: Two teachers characterized their use as "a little", and four used the materials "moderately" and four used them "a lot." Four respondents reported using the online aspect of the curriculum.
- Materials were useful: When asked to rate the usefulness of the materials, from 1 (not at all useful) to 5 (highly useful), two provided a score of three, five scored them a four, and three scored them the highest rating - five, extremely useful.
- Materials were age-appropriate: Seven reported the material was age-appropriate, while a kindergarten and a fifth-grade teacher reported the material was somewhat too advanced. One respondent did not know.
- Most respondents said the material aligned with state science standards: Seven reported the curriculum "completely" (1) or "mostly" (6) aligned with state science standards, and one said it "somewhat" aligned. Two did not know if the materials aligned with the standards.
- No teacher reported any specific concepts or topics children had trouble understanding.

The two teachers reporting "a little" use of the instructional materials explained their rationale for limited use of the material. One mentioned that the material was not part of their curriculum at the time and another teacher noted that they only received one workbook but “tons of materials telling the kids about the kit.”

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

Two of the five interviewed teachers said they used the curriculum materials. One of these respondents used the materials when teaching about the carbon cycle and another respondent noted using the materials when teaching about electricity.

Kit Request Forms

Figure 6-2 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, with more than half indicating they never received the instructional materials. Yet nearly all reported distributing kit request forms to students, which are delivered to the school at the same time as the instructional materials. This suggests that teachers viewed the materials as tangential to the kit request forms.

Nearly all surveyed teachers distributed the kit request forms to their students and all took actions to encourage or promote the kits to their students.[25] 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 6-5).

Table 6-5: Actions Taken to Encourage Students to Receive Kit (Multiple Responses Allowed)

Actions	Teacher Survey Responses (n=29)	Interview Mentions (n=5)
Encouraged students to take action	29	5
Engaged students	*26*	*4*
Vocally encouraged students	*24*	*4*
Awarded prizes to students that request kit	*1*	-
Posted MyEnergyKit.org poster	*13*	-
Assisted students with online application for kit	-	*1*
Engaged parents	*15*	*2*
Electronic reminders to parents (email, text)	*11*	*2*

[25] Note that one teacher respondent said they did not distribute kit request forms yet reported encouraging students to get a kit. Possible explanations for this discrepancy include that a different teacher distributed the forms, the teacher promoted online redemption instead, the respondent did not understand the question about distributing kit request forms, or the respondent accidentally selected the wrong response option.

Actions	Teacher Survey Responses (n=29)	Interview Mentions (n=5)
Spoke with parents in person	*5*	-
Used classroom web portal	*3*	-
Had school or principal send reminders	-	*1*
Used newsletter	*1*	-

About half (15 of 29) of surveyed teachers reported following up with students to find out whether their household requested a kit. Of those, 14 could estimate what percentage of student sent the forms to Duke Energy. Eleven estimated less than half of their families sent away for a kit and the remaining three reported more than half sent for a kit; on average, teachers reported that 34% of their students sent for a kit.[26]

6.2.4 Student Family Experience with the Program

Installation and Use Rates

Almost all participants used at least one measure in the kit, but installation of the measures varies by type. Ninety-three 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 energy efficient LEDs (93%) and night lights (81%); far fewer installed the water related measures (38% to 54%) and insulator gaskets (34%). The majority of those installing light bulbs (69%) said they installed both included in the kit bulbs and they typically replaced incandescent bulbs.

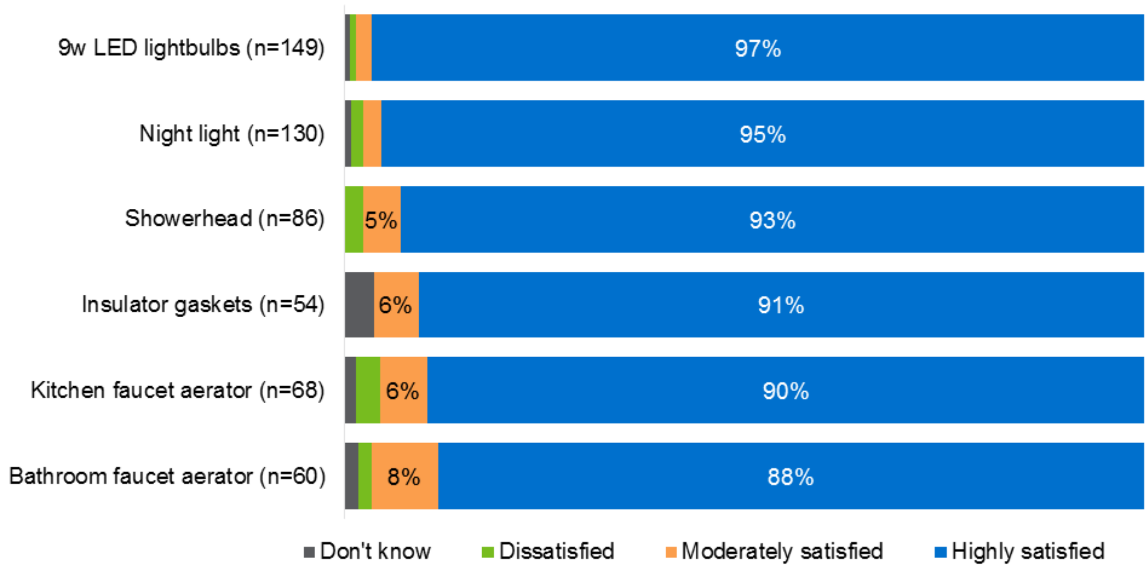
Of those who did not install all items in the kit, one-third said they do not plan to install any of the items they had not yet installed. Respondents said they would not install the remaining items because the currently installed item is still working, they already had an efficient measure installed, they had not “gotten around to it”, or they tried it and it didn’t fit or didn’t work as intended.

Measure Satisfaction

Nearly all kit recipients reported high satisfaction with the items they installed from their kit (Figure 6-3). 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.

[26] 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 6-3: 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

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 (74%) respondents said they read the booklet, most of whom (86%) found it highly helpful.[27] The other respondents rated the booklet as moderately helpful (11%) or not very helpful (2%). Those not finding the booklet helpful stated they already knew the information presented in the booklet and they were already doing what was recommended in their homes.

Additional Energy Saving Actions

Parents and children reported adopting new energy-saving actions since their involvement in the program. Around half of parents reported taking an energy-saving action (48%) and half 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 (32%), and parents reported changing thermostat settings (22%) (Table 6-6). The majority (86%) of respondents reporting new energy saving behaviors said the DEP-sponsored kit and materials were "highly influential" in their adoption of those behaviors.[28]

[27] 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 six percent of respondents who reported reading the booklet gave a rating of 7 or higher. 11% gave ratings of 5 or 6, and 2% gave ratings of 0 through 4.

[28] 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.

Table 6-6: New Behaviors Adopted by Parents and Children Since Receiving Kit (Multiple Responses Allowed; n=172)

New Behaviors Child Has Adopted	Parents	Children
Adopted new behaviors since receiving kit	48%	50%
Changed thermostat settings to use less energy	22%	-
Turn off electronics when not using them	19%	27%
Turn off lights when not in a room	13%	32%
Using fans instead of air conditioning	12%	-
Turning off air conditioning when not home	9%	-
Taking shorter showers	9%	16%
Turning water heater thermostat down	8%	-
Other	6%	6%
Turning off furnace when not home	5%	-
Refused	0%	1%

Receiving a kit may drive a desire to make additional energy efficiency improvements. Most student families reported a desire to receive more kit measures (89%), specifying interest in LEDs (82%), nightlights (60%), showerheads (27%), gasket insulators (19%), bathroom aerators (18%), and kitchen aerators (16%). Parents typically preferred requesting additional measures via internet (61%) or pre-paid postcards (29%).

Many respondents reported they want to purchase additional energy saving products. Two-thirds of respondents reported an interest in purchasing at least one of the products or services in (Table 6-7).

Table 6-7: Parent Interest in Additional Products and Services (Multiple Responses Allowed; n=172)

Products and Services	Parents
New efficient lighting	51%
Energy efficient appliances	28%
Efficient windows	17%
Air leak sealing	17%
Adding insulation	15%
Efficient heating or cooling equipment	14%
Connected or smart thermostats	13%
Energy efficient water heater	11%
Sealing or insulating ducts	9%
Other	9%

The kits also motivated some student families to purchase energy efficient equipment or services. More than a quarter (26%) of respondents reported purchasing or installing additional energy efficiency measures since receiving their kit. Efficient light bulbs were the most commonly reported measure (mentioned by 30 respondents), with 29 respondents specifying LEDs and one mentioning CFLs. Four respondents reported getting a Duke Energy rebate for their measure, two of whom said they received rebates for purchasing an energy efficient appliance, one who reported receiving a rebate for LEDs, and another who received an incentive for an unspecified measure. Most (31 of 45) respondents said the Duke Energy schools program was at least partially influential on their decision to purchase and install additional energy saving measures (Table 6-8)

Table 6-8: Additional Energy Saving Measures Purchased (Multiple Responses Allowed; n=172)

	Count of Respondents Reporting Purchases After Receiving the Kit	Count Reporting Duke Rebates for Measure	Count Reporting High Program Influence on Purchase*
At least one measure	45	4	31
Bought LEDs	29	1	19
Sealed air leaks	10	0	8
Bought energy efficient appliances	8	2	5
Added insulation	8	0	4
Other	8	1	3
Bought efficient heating or cooling equipment	4	0	0
Sealed ducts	3	0	3
Bought efficient windows	2	0	0
Moved into an ENERGY STAR home	2	0	2
Installed an energy efficient water heater	1	0	1
Bought CFLs	1	0	1

7 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, and those who used them did so in a limited way.

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

> **Recommendation:** Consider exploring ways to increase teacher receipt and use of materials, such as:
>
> - Making sure teachers are aware that NTC aligns their materials with state science standards, and
> - Requesting that teachers align energy-focused lesson plans with performance timing

Conclusion 2: There is an opportunity to increase parental awareness of the kits and thus get more families to request and install kits. Currently, students bear the bulk of the burden of generating parental awareness of the kit opportunity. Although most teachers engage students on the kit request process, only about half engage parents. Parent surveys corroborate this lack of teacher to parent engagement on the kits; few parents mentioned their child's teacher or school as the source of awareness of the kit (instead, most parents learned about the kit from their child). Additionally, two-thirds of parents did not know kits were associated with a performance and instructional materials. Although about one-third of teachers follow-up with students to see if parents requested kits, there is great variation in how much emphasis teachers place on promoting the kits.

Further, the contests appear to have limited success in encouraging kit requests, as a) only one teacher mentioned using the contests to encourage kit requests, and b) the household- and school-level contests had particularly low influence on parent motivations to get a kit.

> **Recommendation:** Explore ways to increase parent awareness of and motivation for requesting the kits. For example: create a household-level contest that engages both students and their parents, so students are motivated to ask their parents to sign up and so parents are motivated to participate. For example, in addition to a cash prize drawing for parents, include a prize drawing aimed at students (e.g., toys, electronics, or other items

valued by students) or a guaranteed incentive such as a coupon for pizza (e.g., Book It model).

Conclusion 3: The program influences families to save energy. Families save energy they would not have saved without receiving the kits. Nearly all respondents installed at least one kit measure, and few would have installed the kit measures if they had not received them for free from the program (as evidenced by low free-ridership rates). About one-fifth of parent respondents reported making additional energy saving improvements, and 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 in Duke Energy territories. 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 commonly single family homeowners

Recommendations: Investigate the possibility of leveraging kits to promote other Duke Energy efficiency programs, such as targeting these households for direct mail campaigns or including information on Smart $aver in the kit.

Conclusion 5: Energy savings could be increased by encouraging partipants to install LED lamps in higher usage areas. LED lamp in-service rates (ISR) measured just below 80% for both DEC and DEP. This included some participants who store the LED kit lamp until a similar lamp in the home burns-out. Continue to encouraging participants to install the lamps as soon as the kit is received can increase LED lamp in-service rates and generate additional savings for the program.

Most kit lamps were installed in rooms with average (2 to 4 hour) dialy daily lighting usage, while very few lamps were installed in high use locations such as kitchens or exterior fixtures. Installation of lamps in high usage areas will results in higher energy savings (Table 7-1).

Table 7-1: Lamp HOU Installation Rates

Daily Lamp Use*	DEC Installation Rate	DEP Installation Rate
Low (< 2 hours)	43%	44%
Average (2-4 hours)	36%	32%

Daily Lamp Use*	DEC Installation Rate	DEP Installation Rate
High (> 4 hours)	21%	24%

*Based on the participant survey responses

Recommendations: Program should continue to encourage lamp installations as soon as possible informing them where their new lamps can save the most energy. Alternatively, consider swapping out one of the A-shape LEDs with a lamp, such as an LED PAR, that may be more applicable to higher use areas like the kitchen

Conclusion 6: Water-related measures drive savings, but installation rates are low. Water measures contributed the majority of verified savings (DEC 74%, DEP 80%), yet fewer than half of all participants installed an aerator or showerhead (Table 7-2).

Table 7-2: Water Measure In-Service Rates

Measure	DEC ISR	DEP ISR
Kitchen Faucet Aerator	30%	40%
Bathroom Faucet Aerator	30%	34%
Showerhead	42%	50%

*Based on the participant survey responses

Recommendations: Review water savings measures' satisfaction and dislikes as well as elicit feedback from Save Energy and Water Kit Program to determine if there are ways to improve the ISR for water measures.

Appendix A Summary Forms

DEC 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 (NTC) 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 DEC and 2) lesson plans associated with the content in the student workbooks.

Date	October 15, 2018
Region(s)	North and South Carolina
Evaluation Period	August 1, 2017 – July 31, 2018
Annual Gross kWh Savings	6,283,232 kWh
Per Kit kWh Savings	271.3 kWh per kit
Annual Gross Summer kW Savings	777.7 kW
Annual Gross Winter kW Savings	1,113.4 kW
Net-to-Gross Ratio	0.94
Process Evaluation	Yes
Previous Evaluation(s)	Yes

Evaluation Methodology

Impact Evaluation Activities

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

Impact Evaluation Findings

- *Realization rate = 135% for energy impacts; 61% for demand impacts*
- *Net-to-gross ratio = 0.94*

Process Evaluation Activities

- *334 telephone/web surveys with student families and analysis of 8 unique measures.*
- *44 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 Duke Energy sponsorship of the kits*
- *Parents largely learning abut 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*
- *Teachers are not using materials as much as previous years*

DEP 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 (NTC) 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 DEP and 2) lesson plans associated with the content in the student workbooks.

Date	August 30, 2018
Region(s)	North and South Carolina
Evaluation Period	August 1, 2017 – May 31, 2018
Annual Gross kWh Savings	3,100,016 kWh
Per Kit kWh Savings	343.5 kWh per kit
Annual Gross Summer kW Savings	373.1 kW
Annual Gross Winter kW Savings	581.0 kW
Net-to-Gross Ratio	0.92
Process Evaluation	Yes
Previous Evaluation(s)	Yes

Evaluation Methodology

Impact Evaluation Activities

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

Impact Evaluation Findings

- *Realization rate = 124% for energy impacts; 52% for demand impacts*
- *Net-to-gross ratio = 0.92*

Process Evaluation Activities

- *172 telephone/web surveys with student families and analysis of 8 unique measures.*
- *29 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 Duke Energy sponsorship of the kits*
- *Parents largely learning abut 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*
- *Teachers are not using materials as much as previous years*

Appendix B Measure Impact Results

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

Measure Category	Gross Energy Savings (kWh)	Gross Summer Demand (kW)	Gross Winter Demand (kW)	Realization Rate (Energy)	Free Ridership	Spillover	Net to Gross Ratio	M&V Factor (Energy) (RR x NTG)	Measure Life
9 Watt LEDs*	27.0	0.005	0.002	N/A	0.26	**0.09**	**0.93**	N/A	5
Nightlight	9.8	0.000	0.000	N/A	0.17			N/A	8
1.5 GPM Showerhead	121.6	0.010	0.027	N/A	0.16			N/A	10
1.0 GPM Bathroom Faucet Aerator	12.4	0.002	0.003	N/A	0.12			N/A	9
1.5 GPM Kitchen Faucet Aerator	38.2	0.005	0.008	N/A	0.13			N/A	9
Water Temperature Gauge Card	23.7	0.003	0.005	N/A	0.16			N/A	4
Outlet Insulating Gaskets	6.3	0.008	0.000	N/A	0.12			N/A	15
Behavioral Changes	32.3	0.001	0.002	N/A	-	-	1.00	N/A	0.3
Total	**271.3**	**0.034**	**0.048**	**135.0%**	**0.16**	**0.09**	**0.94**	**125.2%**	**-**

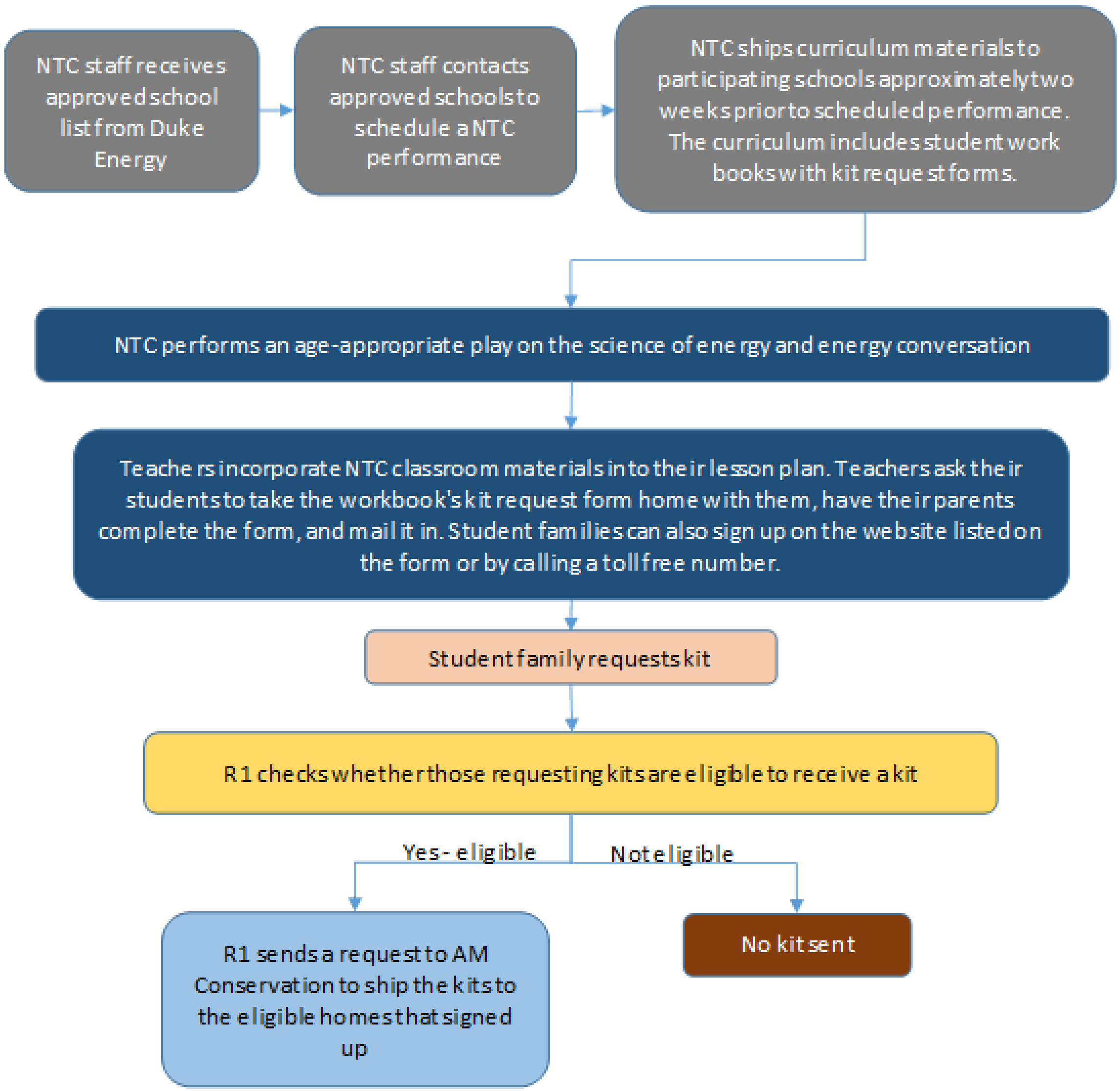
*Represents two 9 watt LEDs

Table B-2: DEP Program Year 2017-2018 per Unit Verified Impacts by Measure – Key Measure Parameters

Measure Category	Gross Energy Savings (kWh)	Gross Summer Demand (kW)	Gross Winter Demand (kW)	Realization Rate (Energy)	Free Ridership	Spillover	Net to Gross Ratio	M&V Factor (Energy) (RR x NTG)	Measure Life
9 Watt LEDs*	25.4	0.004	0.002	N/A	0.24	**0.05**	**0.92**	N/A	5
Nightlight	10.9	0.000	0.000	N/A	0.14			N/A	8
1.5 GPM Showerhead	168.1	0.013	0.038	N/A	0.14			N/A	10
1.0 GPM Bathroom Faucet Aerator	16.4	0.002	0.004	N/A	0.06			N/A	9
1.5 GPM Kitchen Faucet Aerator	62.3	0.008	0.014	N/A	0.10			N/A	9
Water Temperature Gauge Card	23.5	0.003	0.005	N/A	0.13			N/A	4
Outlet Insulating Gaskets	6.8	0.009	0.000	N/A	0.08			N/A	15
Behavioral Changes	30.1	0.001	0.002	N/A	-	-	1.00	N/A	0.3
Total	**343.5**	**0.041**	**0.064**	**124.3%**	**0.13**	**0.05**	**0.92**	**114.0%**	**-**

*Represents two 9 watt LEDs

Appendix C Program Process Flow Chart



Appendix D Program Performance Metrics

This appendix provides key program performance metrics, or PPIs. See Section 6.2 for the underlying results and more detailed findings.

Figure D-1: Program Experience PPIs – DEC

	Student Families		Teachers	
Awareness PPIs	**%**	**n**	**%**	**n**
Aware of DEC sponsorship	94%	334	84%	44
Learned of DEC sponsorship via program collateral	68%	334	32%	37
Learned of DEC sponsorship via teachers	28%	334	38%	37
Read Energy Saver Booklet	73%	334	-	
Rated Energy Saver Booklet as highly informative	82%	245		
Satisfaction PPIs				
NTC performance	-		95%	44
Usefulness of classroom materials	-		77%	26
Overall satisfaction with classroom materials	-		92%	26
Bathroom faucet aerator	86%	104	-	
Insulator gaskets	85%	103	-	
Night light	95%	259	-	
Light bulbs	95%	297	-	
Showerhead	86%	153	-	
Kitchen faucet aerator	85%	109	-	
Program influence on behavior PPIs				
Installed at least one kit measure	93%	334	-	
Plan to install measure[s] (of those that did not install any measures)	91%	22	-	
Respondents reporting spillover	19%	334	-	
Adopted new energy saving behaviors: parents	51%	334	-	
Adopted new energy saving behaviors: children	51%	334	-	
Challenges and opportunities for improvement PPIs				
Used NTC materials in classroom	-		59%	44
Suggested improvements to NTC performance	-		23%	44
Distributed kit forms to classroom	-		95%	44
Mentioned challenges/concerns with instructional materials	-		5%	44
Suggested curriculum improvements	-		14%	44

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

Figure D-2: Program Experience PPIs – DEP

	Student Families		Teachers	
Awareness PPIs	**%**	**n**	**%**	**n**
Aware of DEP sponsorship	88%	172	79%	29
Learned of DEP sponsorship via program collateral	63%	172	65%	23
Learned of DEP sponsorship via teachers	27%	172	30%	23
Read Energy Saver Booklet	74%	172	-	
Rated Energy Saver Booklet as highly informative	86%	128	-	
Satisfaction PPIs				
NTC performance	-		59%	29
Usefulness of classroom materials	-		80%	10
Overall satisfaction with classroom materials	-		80%	10
Bathroom faucet aerator	88%	60	-	
Insulator gaskets	91%	54	-	
Night light	95%	130	-	
Light bulbs	97%	149	-	
Showerhead	93%	86	-	
Kitchen faucet aerator	90%	68	-	
Program influence on behavior PPIs				
Installed at least one kit measure	93%	172	-	
Plan to install measure[s] (of those that did not install any measures)	100%	12	-	
Respondents reporting spillover	18%	172	-	
Adopted new energy saving behaviors: parents	48%	172	-	
Adopted new energy saving behaviors: children	50%	172	-	
Challenges and opportunities for improvement PPIs				
Used NTC materials in classroom	-		34%	29
Suggested improvements to NTC performance	-		10%	29
Distributed kit forms to classroom	-		97%	29
Mentioned challenges/concerns with instructional materials	-		0%	29
Suggested curriculum improvements	-		10%	29

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

Figure D-3: Student Family Demographics Reach PPIs

Duke Energy Carolinas

Housing Type

Detached	74%
Attached	16%
Mobile	11%

Ownership Status

Own	63%
Rent	35%
Occupy rent-free	1%

Household Size

One to two	14%
Three	20%
Four	35%
Five+	31%

Education

High school or less	22%
Some college	32%
Bachelors Degree	20%
Graduate Degree	22%
Refused / Don't know	4%

Income

< $30k	24%
$30k to < $60k	27%
$60k to < $75k	6%
$75k to < $100k	12%
$100k+	13%
Refused / Don't know	17%

Duke Energy Progress

Housing Type

Detached	60%
Attached	20%
Mobile	19%

Housing Type

Detached	60%
Attached	20%
Mobile	19%

Ownership Status

Own	65%
Rent	35%

Education

High school or less	24%
Some college	31%
Bachelors Degree	22%
Graduate Degree	22%
Refused / Don't know	1%

Education

High school or less	24%
Some college	31%
Bachelors Degree	22%
Graduate Degree	22%
Refused / Don't know	1%

Appendix E 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 false enrollment dates 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	52.9	52.8	-0.11	-0.20%	0.0%	0.0%
Sep-15	54.8	54.6	-0.18	-0.34%	0.0%	0.0%
Oct-15	41.6	41.4	-0.15	-0.36%	0.0%	0.0%
Nov-15	32.5	32.3	-0.16	-0.50%	0.0%	0.0%
Dec-15	40.4	40.3	-0.13	-0.31%	0.0%	0.0%
Jan-16	53.9	53.8	-0.17	-0.32%	0.0%	0.0%
Feb-16	58.0	57.9	-0.19	-0.32%	0.0%	0.0%
Mar-16	53.9	53.8	-0.10	-0.19%	0.0%	0.0%
Apr-16	41.9	41.7	-0.15	-0.36%	0.0%	0.0%
May-16	32.5	32.3	-0.21	-0.66%	0.0%	0.0%
Jun-16	36.2	35.9	-0.27	-0.74%	0.0%	0.0%
Jul-16	41.8	41.5	-0.29	-0.69%	0.0%	0.0%
Aug-16	51.4	50.9	-0.44	-0.85%	0.0%	0.0%
Sep-16	49.4	49.1	-0.25	-0.51%	0.0%	0.0%
Oct-16	36.1	36.0	-0.11	-0.30%	0.0%	0.0%
Nov-16	33.0	33.1	0.06	0.18%	0.0%	0.0%
Dec-16	38.1	38.6	0.48	1.25%	0.0%	0.0%
Jan-17	51.4	51.7	0.34	0.67%	0.0%	0.0%
Feb-17	60.4	60.7	0.22	0.36%	0.0%	0.0%
Mar-17	58.4	59.3	0.85	1.45%	0.0%	0.0%
Apr-17	48.1	49.2	1.12	2.32%	0.0%	0.2%
May-17	34.1	34.8	0.69	2.03%	0.0%	6.5%
Jun-17	36.9	37.2	0.25	0.67%	0.0%	26.3%
Jul-17	46.5	46.7	0.15	0.32%	0.0%	45.6%

**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

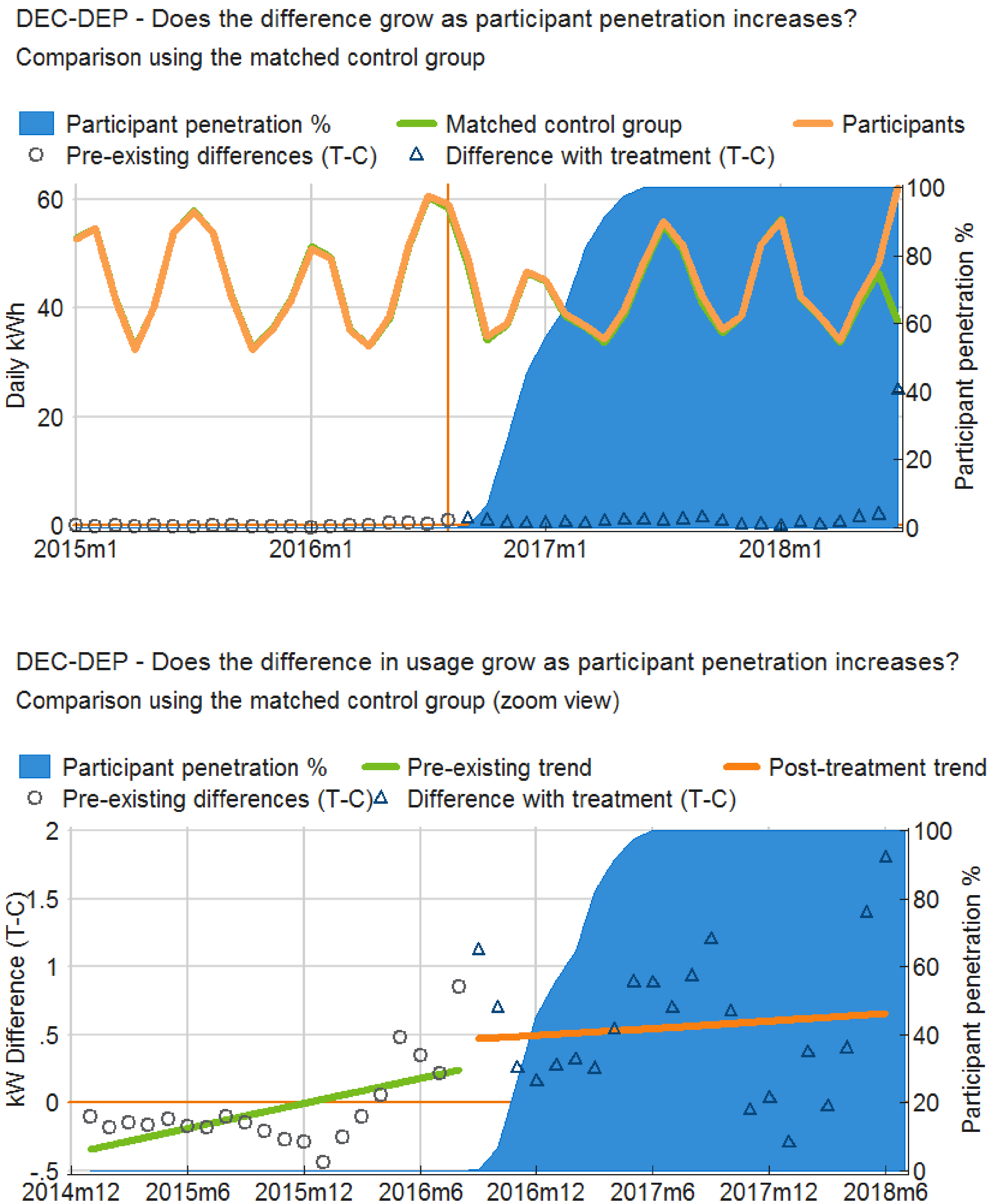


Figure E-2: Difference-in-Differences Panel Regression Model Placebo Test Results – 3 Months Prior

```
Linear regression, absorbing indicators         Number of obs     =    628258
                                                F(  27, 594755)   =  12265.82
                                                Prob > F          =    0.0000
                                                R-squared         =    0.7144
                                                Adj R-squared     =    0.6983
                                                Root MSE          =   12.2402
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo3_post	-.5256702	.0923383	-5.69	0.000	-.7066503	-.3446901
pseudo3_partxpost	.474797	.1007961	4.71	0.000	.2772399	.6723541
daily_cdd	-.2624074	.020821	-12.60	0.000	-.3032158	-.2215991
daily_hdd	-.2409448	.0212211	-11.35	0.000	-.2825375	-.199352
moyr						
665	14.97549	.1756674	85.25	0.000	14.63119	15.31979
666	19.55672	.2106636	92.83	0.000	19.14383	19.96961
667	14.80155	.1643195	90.08	0.000	14.47949	15.12361
668	1.706849	.1002563	17.02	0.000	1.51035	1.903349
669	-7.909724	.2232815	-35.42	0.000	-8.347349	-7.4721
670	-3.208551	.315886	-10.16	0.000	-3.827677	-2.589425
671	2.497413	.3207077	7.79	0.000	1.868836	3.12599
672	15.58922	.6469555	24.10	0.000	14.3212	16.85723
673	12.54181	.5461112	22.97	0.000	11.47145	13.61217
674	-3.647916	.2698748	-13.52	0.000	-4.176861	-3.11897
675	-7.109081	.2069337	-34.35	0.000	-7.514665	-6.703498
676	-2.215585	.1125347	-19.69	0.000	-2.436149	-1.99502
677	12.51956	.17157	72.97	0.000	12.18328	12.85583
678	22.42831	.2298776	97.57	0.000	21.97776	22.87886
679	20.59289	.2123426	96.98	0.000	20.17671	21.00908
680	9.216912	.1433816	64.28	0.000	8.935889	9.497936
681	-6.136477	.1697139	-36.16	0.000	-6.469111	-5.803843
682	-1.411565	.3650647	-3.87	0.000	-2.12708	-.6960503
683	9.723139	.5300884	18.34	0.000	8.684183	10.7621
684	7.686554	.487174	15.78	0.000	6.731709	8.6414
685	.8500553	.3933818	2.16	0.031	.0790395	1.621071
686	-.8975118	.4275042	-2.10	0.036	-1.735406	-.0596172
687	-5.511773	.2879834	-19.14	0.000	-6.076211	-4.947335
_cons	41.93327	.1165433	359.81	0.000	41.70485	42.1617
account_id	F(33475, 594755) =		34.112	0.000	(33476 categories)	

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

```
Linear regression, absorbing indicators          Number of obs   =     659041
                                                 F(  27, 625538) =   13689.79
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.7165
                                                 Adj R-squared   =     0.7013
                                                 Root MSE        =    12.1196
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo4_post	-.4247787	.0840387	-5.05	0.000	-.5894918	-.2600656
pseudo4_partxpost	.4851166	.0846007	5.73	0.000	.3193019	.6509313
daily_cdd	-.2654691	.020141	-13.18	0.000	-.3049448	-.2259935
daily_hdd	-.2354826	.0207305	-11.36	0.000	-.2761137	-.1948515
moyr						
664	8.183583	.1832708	44.65	0.000	7.824378	8.542788
665	23.18311	.3132845	74.00	0.000	22.56908	23.79713
666	27.77034	.3501534	79.31	0.000	27.08406	28.45663
667	23.00724	.3009306	76.45	0.000	22.41743	23.59705
668	9.896078	.2110981	46.88	0.000	9.482333	10.30982
669	.2304075	.1015936	2.27	0.023	.0312874	.4295276
670	4.905798	.166716	29.43	0.000	4.57904	5.232556
671	10.61005	.1711686	61.99	0.000	10.27457	10.94554
672	23.61627	.480162	49.18	0.000	22.67517	24.55737
673	20.59528	.3823227	53.87	0.000	19.84594	21.34462
674	4.478541	.1299933	34.45	0.000	4.223759	4.733324
675	1.033154	.0965464	10.70	0.000	.843926	1.222382
676	5.938123	.1368656	43.39	0.000	5.669871	6.206376
677	20.79924	.3093994	67.22	0.000	20.19283	21.40565
678	30.72265	.3700041	83.03	0.000	29.99745	31.44785
679	28.78262	.350431	82.13	0.000	28.09579	29.46946
680	17.32469	.271811	63.74	0.000	16.79195	17.85743
681	1.983447	.1159611	17.10	0.000	1.756167	2.210727
682	6.528178	.2243711	29.10	0.000	6.088418	6.967938
683	17.67602	.36939	47.85	0.000	16.95203	18.40002
684	15.79898	.3340732	47.29	0.000	15.1442	16.45375
685	8.773683	.2505606	35.02	0.000	8.282592	9.264774
686	7.24334	.2872157	25.22	0.000	6.680406	7.806273
_cons	33.76435	.1042117	324.00	0.000	33.5601	33.9686
account_id	F(33475, 625538) =		35.716	0.000	(33476 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	687621
F(27, 654118)	=	13444.51
Prob > F	=	0.0000
R-squared	=	0.7106
Adj R-squared	=	0.6958
Root MSE	=	12.2627

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo5_post	-.2841678	.0819632	-3.47	0.001	-.444813	-.1235227
pseudo5_partxpost	.5195482	.0770491	6.74	0.000	.3685345	.6705619
daily_cdd	-.4206152	.0186884	-22.51	0.000	-.4572439	-.3839866
daily_hdd	-.0656947	.0194092	-3.38	0.001	-.103736	-.0276534
moyr						
663	-9.246892	.2048831	-45.13	0.000	-9.648456	-8.845328
664	.2435606	.33841	0.72	0.472	-.4197121	.9068332
665	16.37426	.4606622	35.55	0.000	15.47138	17.27715
666	21.26268	.4942919	43.02	0.000	20.29388	22.23148
667	16.09737	.4494461	35.82	0.000	15.21647	16.97827
668	2.212501	.3655132	6.05	0.000	1.496107	2.928896
669	-9.344392	.1735278	-53.85	0.000	-9.684501	-9.004283
670	-5.481911	.1085518	-50.50	0.000	-5.694669	-5.269153
671	.1810658	.1061787	1.71	0.088	-.0270411	.3891727
672	10.49394	.275661	38.07	0.000	9.953652	11.03423
673	8.294643	.1902391	43.60	0.000	7.921781	8.667505
674	-5.512512	.1359901	-40.54	0.000	-5.779048	-5.245975
675	-8.374107	.1868889	-44.81	0.000	-8.740404	-8.007811
676	-2.477432	.2890254	-8.57	0.000	-3.043912	-1.910951
677	13.99713	.457528	30.59	0.000	13.10039	14.89387
678	24.32712	.512294	47.49	0.000	23.32304	25.3312
679	22.09522	.4942646	44.70	0.000	21.12648	23.06397
680	9.967723	.4222883	23.60	0.000	9.140051	10.79539
681	-7.01392	.2451765	-28.61	0.000	-7.494458	-6.533382
682	-4.366852	.132827	-32.88	0.000	-4.627189	-4.106516
683	5.525837	.200146	27.61	0.000	5.133557	5.918117
684	3.966411	.179768	22.06	0.000	3.614071	4.31875
685	-2.179574	.1592099	-13.69	0.000	-2.491621	-1.867528
_cons	42.38615	.2649444	159.98	0.000	41.86686	42.90543
account_id	F(33475, 654118) =		36.658	0.000	(33476 categories)	

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

```
Linear regression, absorbing indicators          Number of obs    =     710185
                                                 F(  27, 676682)  =   12262.54
                                                 Prob > F         =     0.0000
                                                 R-squared        =     0.6877
                                                 Adj R-squared    =     0.6723
                                                 Root MSE         =    13.1854
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo6_post	-.2160949	.0867745	-2.49	0.013	-.3861702	-.0460197
pseudo6_partxpost	.5809622	.0778351	7.46	0.000	.428408	.7335165
daily_cdd	-.596042	.0194923	-30.58	0.000	-.6342462	-.5578377
daily_hdd	.0785573	.019962	3.94	0.000	.0394324	.1176821
moyr						
662	-11.93424	.3343578	-35.69	0.000	-12.58957	-11.27891
663	-19.77144	.5154094	-38.36	0.000	-20.78162	-18.76125
664	-8.98844	.6590042	-13.64	0.000	-10.28007	-7.696813
665	8.382719	.7835346	10.70	0.000	6.847017	9.918421
666	13.61014	.8173818	16.65	0.000	12.0081	15.21218
667	7.990053	.7722869	10.35	0.000	6.476396	9.50371
668	-6.742756	.6868977	-9.82	0.000	-8.089053	-5.396459
669	-20.17191	.4789355	-42.12	0.000	-21.1106	-19.23321
670	-17.00842	.3865308	-44.00	0.000	-17.766	-16.25083
671	-11.37184	.3814024	-29.82	0.000	-12.11937	-10.6243
672	-3.371243	.1145078	-29.44	0.000	-3.595675	-3.146812
673	-4.869892	.1803676	-27.00	0.000	-5.223406	-4.516377
674	-16.63903	.4312435	-38.58	0.000	-17.48426	-15.79381
675	-19.06178	.4947421	-38.53	0.000	-20.03146	-18.0921
676	-12.19545	.6068682	-20.10	0.000	-13.38489	-11.00601
677	5.935216	.7802705	7.61	0.000	4.405911	7.46452
678	16.68188	.8351525	19.97	0.000	15.045	18.31875
679	14.25023	.817349	17.43	0.000	12.64826	15.85221
680	1.592694	.7453375	2.14	0.033	.1318565	3.053531
681	-17.40192	.5527553	-31.48	0.000	-18.4853	-16.31854
682	-16.24748	.3630762	-44.75	0.000	-16.9591	-15.53587
683	-7.499445	.2351205	-31.90	0.000	-7.960273	-7.038616
684	-8.718828	.2718093	-32.08	0.000	-9.251566	-8.186091
_cons	52.4287	.5864711	89.40	0.000	51.27924	53.57817
account_id	F(33475, 676682) =		34.163	0.000	(33476 categories)	

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

```
Linear regression, absorbing indicators          Number of obs   =    730052
                                                 F(  27, 696549) =  11715.39
                                                 Prob > F        =    0.0000
                                                 R-squared       =    0.6776
                                                 Adj R-squared   =    0.6621
                                                 Root MSE        =   13.6259
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo7_post	-.2046139	.0887691	-2.31	0.021	-.3785986	-.0306293
pseudo7_partxpost	.6511034	.076956	8.46	0.000	.5002723	.8019346
daily_cdd	-.6336218	.0198524	-31.92	0.000	-.6725317	-.5947118
daily_hdd	.0715356	.0200871	3.56	0.000	.0321655	.1109057
moyr						
661	1.614047	.1338197	12.06	0.000	1.351765	1.876329
662	-10.42732	.2601788	-40.08	0.000	-10.93726	-9.917377
663	-18.28754	.4388951	-41.67	0.000	-19.14776	-17.42732
664	-7.37477	.5835965	-12.64	0.000	-8.518601	-6.23094
665	10.23146	.7107887	14.39	0.000	8.838334	11.62458
666	15.53028	.7455107	20.83	0.000	14.0691	16.99145
667	9.812764	.6992321	14.03	0.000	8.442292	11.18324
668	-5.080311	.611999	-8.30	0.000	-6.279809	-3.880813
669	-18.69904	.4024735	-46.46	0.000	-19.48788	-17.91021
670	-15.51035	.3110742	-49.86	0.000	-16.12005	-14.90065
671	-9.86332	.3060847	-32.22	0.000	-10.46324	-9.263404
672	-1.774626	.1095627	-16.20	0.000	-1.989365	-1.559887
673	-3.233484	.1261926	-25.62	0.000	-3.480817	-2.986151
674	-15.18973	.3565045	-42.61	0.000	-15.88847	-14.49099
675	-17.60579	.4195775	-41.96	0.000	-18.42815	-16.78344
676	-10.6504	.5315033	-20.04	0.000	-11.69213	-9.60867
677	7.654997	.7077851	10.82	0.000	6.267762	9.042233
678	18.46994	.7642374	24.17	0.000	16.97206	19.96782
679	16.23986	.7468902	21.74	0.000	14.77598	17.70374
680	3.337503	.6722143	4.96	0.000	2.019985	4.655021
681	-15.97908	.4785406	-33.39	0.000	-16.917	-15.04115
682	-14.82792	.2934069	-50.54	0.000	-15.40299	-14.25285
683	-5.91968	.1847038	-32.05	0.000	-6.281694	-5.557667
_cons	51.02393	.508591	100.32	0.000	50.0271	52.02075
account_id	F(33475, 696549) =		33.802	0.000	(33476 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	714019
F(26, 680517)	=	12483.04
Prob > F	=	0.0000
R-squared	=	0.6803
Adj R-squared	=	0.6646
Root MSE	=	13.5214

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo8_post	-.2527771	.0879036	-2.88	0.004	-.4250653	-.0804889
pseudo8_partxpost	.7253856	.074626	9.72	0.000	.5791211	.8716502
daily_cdd	-.6138513	.0199662	-30.74	0.000	-.6529844	-.5747183
daily_hdd	.0639577	.0202341	3.16	0.002	.0242995	.1036159
moyr						
661	1.645427	.13356	12.32	0.000	1.383653	1.9072
662	-10.51839	.2614451	-40.23	0.000	-11.03081	-10.00597
663	-18.4631	.4416991	-41.80	0.000	-19.32882	-17.59739
664	-7.66233	.5874254	-13.04	0.000	-8.813665	-6.510996
665	9.811116	.7153954	13.71	0.000	8.408964	11.21327
666	15.07201	.7503207	20.09	0.000	13.60141	16.54261
667	9.405752	.7037725	13.36	0.000	8.02638	10.78512
668	-5.396655	.6160066	-8.76	0.000	-6.604007	-4.189302
669	-18.85279	.4049933	-46.55	0.000	-19.64656	-18.05901
670	-15.62536	.3128102	-49.95	0.000	-16.23845	-15.01226
671	-9.979628	.3077796	-32.42	0.000	-10.58287	-9.37639
672	-1.683788	.1102975	-15.27	0.000	-1.899968	-1.467609
673	-3.359955	.1290097	-26.04	0.000	-3.61281	-3.1071
674	-15.39415	.3595886	-42.81	0.000	-16.09893	-14.68937
675	-17.78332	.4224407	-42.10	0.000	-18.61129	-16.95535
676	-10.94766	.53508	-20.46	0.000	-11.9964	-9.89892
677	7.107528	.7126016	9.97	0.000	5.710852	8.504204
678	18.18085	.7703218	23.60	0.000	16.67104	19.69065
679	15.86131	.7514087	21.11	0.000	14.38857	17.33404
680	2.906622	.6767679	4.29	0.000	1.580179	4.233065
681	-16.19297	.4812871	-33.65	0.000	-17.13628	-15.24966
682	-14.87434	.2937033	-50.64	0.000	-15.44999	-14.29869
_cons	51.21454	.5121434	100.00	0.000	50.21075	52.21832
account_id	F(33475, 680517) =		33.117	0.000	(33476 categories)	

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

```
Linear regression, absorbing indicators          Number of obs    =     693985
                                                 F(  25, 660484)  =   12864.99
                                                 Prob > F         =     0.0000
                                                 R-squared        =     0.6806
                                                 Adj R-squared    =     0.6644
                                                 Root MSE         =    13.5794
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo9_post	-.2994821	.0883002	-3.39	0.001	-.4725477	-.1264165
pseudo9_partxpost	.7426867	.0742484	10.00	0.000	.5971623	.8882111
daily_cdd	-.63676	.0206267	-30.87	0.000	-.6771878	-.5963323
daily_hdd	.0884283	.020969	4.22	0.000	.0473298	.1295268
moyr						
661	1.544798	.1358086	11.37	0.000	1.278618	1.810979
662	-10.22824	.2696294	-37.93	0.000	-10.7567	-9.699775
663	-17.94059	.4570697	-39.25	0.000	-18.83643	-17.04474
664	-6.94917	.6086018	-11.42	0.000	-8.14201	-5.756331
665	10.69082	.7415713	14.42	0.000	9.237364	12.14428
666	15.99617	.7778181	20.57	0.000	14.47167	17.52066
667	10.27052	.729504	14.08	0.000	8.840714	11.70032
668	-4.645794	.6383212	-7.28	0.000	-5.896883	-3.394706
669	-18.37783	.4189051	-43.87	0.000	-19.19888	-17.55679
670	-15.27227	.3231137	-47.27	0.000	-15.90556	-14.63898
671	-9.577161	.3183308	-30.09	0.000	-10.20108	-8.953243
672	-1.819487	.1145699	-15.88	0.000	-2.04404	-1.594934
673	-3.36976	.1332714	-25.28	0.000	-3.630968	-3.108552
674	-14.96729	.371883	-40.25	0.000	-15.69617	-14.23841
675	-17.28389	.4372255	-39.53	0.000	-18.14084	-16.42695
676	-10.34816	.5544759	-18.66	0.000	-11.43491	-9.261405
677	8.208008	.7400288	11.09	0.000	6.757575	9.65844
678	19.20255	.798279	24.05	0.000	17.63795	20.76715
679	16.73138	.7791	21.48	0.000	15.20437	18.25839
680	3.777532	.7010761	5.39	0.000	2.403445	5.151618
681	-15.57675	.4972935	-31.32	0.000	-16.55143	-14.60207
_cons	50.60445	.5303875	95.41	0.000	49.56491	51.64399
account_id	F(33475, 660484) =		32.031	0.000	(33476 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	113864
F(14, 97080)	=	5848.72
Prob > F	=	0.0000
R-squared	=	0.8027
Adj R-squared	=	0.7686
Root MSE	=	10.6273

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo3_post	-.5314323	.1114073	-4.77	0.000	-.7497894	-.3130752
daily_cdd	-.3169182	.0425132	-7.45	0.000	-.4002436	-.2335929
daily_hdd	-.0590921	.0494516	-1.19	0.232	-.1560167	.0378326
month						
2	-5.511652	.3302651	-16.69	0.000	-6.158968	-4.864336
3	-7.344523	.3685627	-19.93	0.000	-8.066901	-6.622144
4	-10.10898	.8802062	-11.48	0.000	-11.83418	-8.383791
5	-6.835175	.9498222	-7.20	0.000	-8.696816	-4.973534
6	8.631092	1.343093	6.43	0.000	5.998646	11.26354
7	18.64833	1.461028	12.76	0.000	15.78474	21.51193
8	17.08849	1.420058	12.03	0.000	14.30519	19.87178
9	5.656242	1.254013	4.51	0.000	3.198392	8.114093
10	-10.81806	.8036582	-13.46	0.000	-12.39322	-9.242901
11	-8.042124	.3424341	-23.49	0.000	-8.713291	-7.370957
12	1.264436	.2383657	5.30	0.000	.7972415	1.73163
_cons	46.49572	.9312778	49.93	0.000	44.67042	48.32101
account_id	F(16769, 97080) =		18.288	0.000	(16770 categories)	

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

```
Linear regression, absorbing indicators          Number of obs     =    130634
                                                 F(  14, 113850)   =   7702.38
                                                 Prob > F          =    0.0000
                                                 R-squared         =    0.7963
                                                 Adj R-squared     =    0.7663
                                                 Root MSE          =   10.5521
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo4_post	-.1019962	.1000816	-1.02	0.308	-.2981547	.0941622
daily_cdd	-.2495264	.037817	-6.60	0.000	-.3236471	-.1754057
daily_hdd	-.1536438	.0435237	-3.53	0.000	-.2389495	-.0683381
month						
2	-6.529509	.2999275	-21.77	0.000	-7.117362	-5.941655
3	-8.272702	.3264474	-25.34	0.000	-8.912534	-7.63287
4	-13.7987	.6396182	-21.57	0.000	-15.05234	-12.54505
5	-8.457698	.8622915	-9.81	0.000	-10.14778	-6.76762
6	6.275922	1.206549	5.20	0.000	3.911103	8.64074
7	16.04963	1.307554	12.27	0.000	13.48685	18.61242
8	14.40293	1.267052	11.37	0.000	11.91952	16.88633
9	3.200197	1.120023	2.86	0.004	1.004968	5.395425
10	-12.40505	.7229552	-17.16	0.000	-13.82203	-10.98807
11	-9.062039	.3227195	-28.08	0.000	-9.694565	-8.429514
12	1.292102	.2099939	6.15	0.000	.8805167	1.703686
_cons	48.17469	.8450344	57.01	0.000	46.51844	49.83095
account_id	F(16769, 113850) =		19.675	0.000	(16770 categories)	

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

```
Linear regression, absorbing indicators          Number of obs    =    147404
                                                 F(  14, 130620)  =   8335.33
                                                 Prob > F         =    0.0000
                                                 R-squared        =    0.7833
                                                 Adj R-squared    =    0.7554
                                                 Root MSE         =   10.7176
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo5_post	.4194159	.0891347	4.71	0.000	.2447135	.5941182
daily_cdd	-.3738546	.0305868	-12.22	0.000	-.4338041	-.313905
daily_hdd	-.0206818	.0302047	-0.68	0.494	-.0798825	.0385188
month						
2	-5.88248	.2519248	-23.35	0.000	-6.376248	-5.388711
3	-8.575499	.3207776	-26.73	0.000	-9.204218	-7.946781
4	-11.24155	.4305582	-26.11	0.000	-12.08543	-10.39766
5	-5.291916	.581889	-9.09	0.000	-6.432408	-4.151423
6	10.73817	.8377623	12.82	0.000	9.096175	12.38017
7	20.74429	.9219409	22.50	0.000	18.9373	22.55128
8	18.87646	.8943449	21.11	0.000	17.12356	20.62936
9	7.029936	.7837181	8.97	0.000	5.493863	8.56601
10	-9.87039	.5036506	-19.60	0.000	-10.85754	-8.883244
11	-8.10301	.2452054	-33.05	0.000	-8.583609	-7.622412
12	1.338839	.1979009	6.77	0.000	.9509568	1.726721
_cons	45.06678	.5613088	80.29	0.000	43.96663	46.16694
account_id	F(16769, 130620) =		20.732	0.000	(16770 categories)	

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

```
Linear regression, absorbing indicators         Number of obs     =    164174
                                                F(  14, 147390)   =   6405.51
                                                Prob > F          =    0.0000
                                                R-squared         =    0.7329
                                                Adj R-squared     =    0.7025
                                                Root MSE          =   12.2721
```

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo6_post	-.9050612	.0909866	-9.95	0.000	-1.083393	-.7267292
daily_cdd	-1.063065	.0274973	-38.66	0.000	-1.11696	-1.009171
daily_hdd	.6265702	.0196531	31.88	0.000	.5880505	.6650899
month						
2	-.3945862	.1888234	-2.09	0.037	-.7646763	-.024496
3	-3.983506	.2961308	-13.45	0.000	-4.563916	-3.403096
4	-3.870804	.3644687	-10.62	0.000	-4.585155	-3.156453
5	6.108178	.4574688	13.35	0.000	5.211549	7.004808
6	29.04072	.6475631	44.85	0.000	27.77151	30.30993
7	41.23932	.7144837	57.72	0.000	39.83894	42.63969
8	38.68867	.6880759	56.23	0.000	37.34005	40.03728
9	24.37551	.5916628	41.20	0.000	23.21586	25.53515
10	-.0603162	.3778493	-0.16	0.873	-.8008932	.6802609
11	-4.625116	.2321373	-19.92	0.000	-5.0801	-4.170131
12	-.2016072	.2094856	-0.96	0.336	-.6121949	.2089805
_cons	34.95556	.4414944	79.18	0.000	34.09024	35.82088
account_id	F(16769, 147390) =		18.564	0.000	(16770 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	180944
F(14, 164160)	=	5736.80
Prob > F	=	0.0000
R-squared	=	0.7117
Adj R-squared	=	0.6823
Root MSE	=	13.0199

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo7_post	-.8407146	.095874	-8.77	0.000	-1.028626	-.6528037
daily_cdd	-1.141725	.0275736	-41.41	0.000	-1.195768	-1.087681
daily_hdd	.5698512	.0177381	32.13	0.000	.5350848	.6046175
month						
2	.0439932	.1488409	0.30	0.768	-.2477317	.3357181
3	-4.113582	.3049181	-13.49	0.000	-4.711215	-3.51595
4	-3.996618	.3745488	-10.67	0.000	-4.730726	-3.262511
5	5.926219	.4669832	12.69	0.000	5.010942	6.841496
6	29.21162	.6597604	44.28	0.000	27.9185	30.50474
7	41.49021	.7276829	57.02	0.000	40.06397	42.91645
8	39.25332	.6999674	56.08	0.000	37.8814	40.62524
9	24.52563	.5964482	41.12	0.000	23.35661	25.69466
10	-.4510099	.3884665	-1.16	0.246	-1.212396	.310376
11	-4.661574	.2371764	-19.65	0.000	-5.126434	-4.196713
12	.27908	.1831745	1.52	0.128	-.0799381	.6380981
_cons	35.67814	.4570338	78.06	0.000	34.78236	36.57391
account_id	F(16769, 164160) =		19.220	0.000	(16770 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	197714
F(14, 180930)	=	6483.45
Prob > F	=	0.0000
R-squared	=	0.7191
Adj R-squared	=	0.6931
Root MSE	=	12.6061

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo8_post	-.6826227	.0717895	-9.51	0.000	-.8233285	-.5419168
daily_cdd	-1.109996	.02343	-47.37	0.000	-1.155918	-1.064073
daily_hdd	.5780858	.0111235	51.97	0.000	.556284	.5998875
month						
2	-.0808791	.1344885	-0.60	0.548	-.3444736	.1827153
3	-4.021167	.21272	-18.90	0.000	-4.438094	-3.604241
4	-3.895118	.2534334	-15.37	0.000	-4.391842	-3.398394
5	5.953745	.3119416	19.09	0.000	5.342347	6.565144
6	28.81599	.4565089	63.12	0.000	27.92124	29.71074
7	41.53259	.5171521	80.31	0.000	40.51899	42.5462
8	39.11434	.4945979	79.08	0.000	38.14493	40.08374
9	24.27672	.4197223	57.84	0.000	23.45408	25.09937
10	-.508134	.2831966	-1.79	0.073	-1.063193	.0469248
11	-4.77302	.2041849	-23.38	0.000	-5.173218	-4.372823
12	-.0497681	.1625679	-0.31	0.760	-.3683974	.2688612
_cons	35.50422	.2853676	124.42	0.000	34.9449	36.06353
account_id	F(16769, 180930) =		22.212	0.000	(16770 categories)	

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

Linear regression, absorbing indicators

Number of obs	=	214484
F(14, 197700)	=	7887.48
Prob > F	=	0.0000
R-squared	=	0.7267
Adj R-squared	=	0.7035
Root MSE	=	12.2177

daily_kwh	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
pseudo9_post	-.4499133	.065228	-6.90	0.000	-.5777586	-.322068
daily_cdd	-1.043921	.021781	-47.93	0.000	-1.086611	-1.001231
daily_hdd	.5762994	.0107475	53.62	0.000	.5552346	.5973642
month						
2	-.2012934	.1329344	-1.51	0.130	-.4618416	.0592548
3	-3.977699	.2044698	-19.45	0.000	-4.378455	-3.576943
4	-3.984402	.2431879	-16.38	0.000	-4.461045	-3.50776
5	5.606003	.3005122	18.65	0.000	5.017007	6.195
6	28.40953	.4369316	65.02	0.000	27.55315	29.2659
7	40.61824	.4882978	83.18	0.000	39.66119	41.57529
8	38.03025	.4704454	80.84	0.000	37.10819	38.95231
9	23.54459	.400655	58.77	0.000	22.75932	24.32987
10	-.7655753	.2733795	-2.80	0.005	-1.301392	-.2297581
11	-5.323539	.1767645	-30.12	0.000	-5.669993	-4.977085
12	-.0229054	.1571798	-0.15	0.884	-.330974	.2851632
_cons	35.44876	.2723991	130.14	0.000	34.91486	35.98266
account_id	F(16769, 197700) =		24.813	0.000	(16770 categories)	

Appendix F Instruments

F.1 Program Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program the Duke Energy Progress and Carolinas territories. 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 Duke Energy and your role in the 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 for North and South Carolina.
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. Are R1 and AM Conservation still acting as fulfillment contractors? Is their role any different from last year?
8. From the teacher and student family perspective, has the student family kit request process changed at all?

Kits

Let's talk about the kits a little bit. The kits includes:

- LED Bulbs
- LED Night Light
- Energy-Efficient Showerhead
- Kitchen Faucet Aerator
- Bathroom Faucet Aerator
- Water Flow Meter Bag
- Switch and Outlet Insulators
- Teflon Tape (used for installing the Showerhead and Faucet Aerators)
- Hot Water Gauge Card
- D.O.E. Energy Savers Booklet
- Glow Ring Toy
- Product Information/Instruction Sheet

Q4. Were there any changes to the items in the kit since 2015-2016 program year?

Q5. Do you know when the program switched from CFLs to LEDs? (Was it April 2016?)

Q6. They get two LEDs, twelve outlet gaskets, and one of each of the other items, right?

Q7. Is the product information sheet purely instructional, or does it have behavior tips on it? Can you email me a copy?

Q8. Is the DOE Energy Savers Booklet the 45-page booklet that is available online on the DOE's website?

We are almost done. I have a few more questions.

Wrap Up

Q9. 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 Duke? Is that a priority?

Q10. What would you say are the greatest strengths of this program?

Q11. What would you say is the biggest challenge in administering this program?

Q12. Is there anything else about the program that we have not discussed that you feel should be mentioned?

Q13. What would you like to learn from the program evaluation?

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

F.2 NTC Staff In-Depth Interview Guide

Introduction

Today, we'll be discussing your role in the Energy Efficiency Education Program in the Duke Energy Progress and Carolinas territories. 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 for North and South Carolina.
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.

F.3 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!

F.4 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?

F.5 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 G Survey Results

G.1 Teacher Survey - DEP

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

Response Option	Count	Percent (n=29)
Pre-K	0	0%
Kindergarten	4	14%
Grade 1	1	3%
Grade 2	3	10%
Grade 3	3	10%
Grade 4	6	21%
Grade 5	4	14%
Grade 6	5	17%
Grade 7	3	10%
Grade 8	8	28%
Grades 9 - 12	1	3%

Q2. Are you a home room teacher?

Response Option	Count	Percent (n=29)
Yes	19	66%
No	10	34%

Q3. What subjects do you teach?

Response Option	Count (n=10)
Math	2
Natural sciences	4
English/language arts	2
Social studies/social sciences/history	5
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=29)
Yes	24	83%
No	5	17%

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=29)
Yes	19	66%
No	10	34%

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=44)
Yes	10	34%
No	19	66%

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=44)
Yes	23	79%
No	6	21%
Don't know	0	0%

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

Response Option	Count	Percent (n=23)
Another teacher	7	30%
Duke Energy marketing materials	8	35%
Duke Energy staff	1	4%
The National Theatre for Children staff	8	35%
The National Theatre for Children materials	7	30%
Other	0	0%

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=29)
Far too advanced for most of your students	0	0%
Somewhat too advanced for most of your students	2	7%
About right for most of your students	27	93%
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	0	0%

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

Response Option	Count (n=2)
Pre-k through second grade attends the performance and some of the vocabulary is over their head and not explained thoroughly or is done too quickly	1
Some of the concepts about energy the students may not have understood.	1

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

Response Option	Count	Percent (n=29)
Yes	1	3%
No	26	90%
Don't know	2	7%

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

Response Option	Count (n=1)
Advantages/disadvantages of renewable and nonrenewable resources.	1

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

Response Option	Count	Percent (n=29)
1 - Not at all satisfied	0	0%

2	0	0%
3	0	0%
4	4	14%
5 - Completely satisfied	25	86%
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=29)
Yes	12	41%
No	11	38%
Don't know	6	21%

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	2	17%
A little	2	17%
Moderately	4	33%
A lot	4	33%
Extensively	0	0%
Not at all	0	0%
Don't know	2	0%

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

Response Option	Count (n=2)
This is not part of our curriculum so we could only touch on it.	1
We only received one workbook, but a ton of materials telling the kids about the kit. If I had enough workbooks for my entire class I would have definitely used them. We study electricity and magnetism in 4th grade and it would be a great addition to the curriculum.	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=10)
Yes	4	40%
No	6	60%

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

Response Option	Count	Percent (n=10)
Far too advanced for most of your students	0	0%
Somewhat too advanced for most of your students	2	20%
About right for most of your students	7	70%
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	1	10%
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=10)
1 - Not at all useful	0	0%
2	0	0%
3	2	20%
4	5	50%
5 - Extremely useful	3	30%
Don't know	0	0%

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=10)
Completely aligned	1	10%
Mostly aligned	6	60%
Somewhat aligned	1	10%
Not aligned at all	0	0%
Don't know	2	20%

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

Response Option	Count	Percent (n=10)
No	10	100%

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

Response Option	Count	Percent (n=10)
Yes	0	0%
No	9	90%
Don't know	1	10%

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	2	20%
4	3	30%
5 - Completely satisfied	5	50%
Don't know	0	0%

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

Response Option	Count (n=2)
I just don't have the time in the day and I'm a Science Teacher. If the materials aren't related to a standard, I don't teach it.	1
Not enough time to add in on top of our own curriculum materials	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=29)
Yes	3	10%
No	21	72%
Don't know	5	17%

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	Percent (n=9)
1 - Not at all satisfied	0	0%
2	0	0%
3	0	0%
4	0	0%
5 - Completely satisfied	3	100%
Don't know	0	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	28	97%
No	1	3%
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=29)
MyEnergyKit.org poster	13	45%
Vocally encouraged students to sign up for a kit	24	83%
Used my classroom web portal to encourage families to sign up for a kit	3	10%
Emailed parents to encourage them to sign up for a kit	11	38%

Spoke with parents in person to encourage them to sign up for a kit	5	17%
Other	2	7%
No other actions taken	0	0%
Don't recall	2	7%

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

Response Option	Count	Percent (n=29)
Yes	15	52%
No	13	45%
Don't know	1	3%

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

Response Option	Count	Percent (n=15)
0% to 10%	3	20%
11% to 20%	2	13%
21% to 30%	2	13%
31% to 40%	3	20%
41% to 50%	1	7%
51% to 60%	1	7%
61% to 70%	0	0%
71% to 80%	0	0%
81% to 90%	1	7%
91% to 100%	1	7%

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

Response Option	Count (n=29)
Is it possible for the performers to have a mic? It is very difficult to hear in the back even though the actors project their voice.	1
Share info about kits before coming to school and preforming.	1
The performers were a little late (coming from a distant school), and the limited time they had forced them to either skip or rush through certain portions - pace was very quick. With more time devoted, the material would be better reinforced.	1

Response Option	Count (n=29)
None	26

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

Response Option	Count
I teach 5th grade, but we are at a Middle school so if materials for elementary are available, it might be more appropriate	1
Provide standards to go along with instructional materials.	1
We were sent way too many.	1
None	26

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=29)
Yes, I am willing to be interviewed	14	48%
No, I am not willing to be interviewed	15	52%

G.2 Teacher Survey - DEC

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

Response Option	Count	Percent (n=44)
Pre-K	0	0%
Kindergarten	10	23%
Grade 1	6	14%
Grade 2	8	18%
Grade 3	3	7%
Grade 4	5	11%
Grade 5	10	23%
Grade 6	8	18%
Grade 7	4	9%
Grade 8	1	2%
Grades 9 - 12	1	2%

Q2. Are you a home room teacher?

Response Option	Count	Percent (n=44)
Yes	33	75%
No	11	25%

Q3. What subjects do you teach?

Response Option	Count (n=11)
Math	5
Natural sciences	6
English/language arts	1
Social studies/social sciences/history	3
Music	0
Art	0
Physical education	0
Other	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)?

Response Option	Count	Percent (n=44)
Yes	35	80%
No	9	20%

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=44)
Yes	34	77%
No	10	23%

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=44)
Yes	10	23%
No	34	77%

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=44)
Yes	37	84%
No	7	16%
Don't know	0	0%

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

Response Option	Count	Percent (n=37)
Another teacher	14	38%
Duke Energy marketing materials	6	16%
Duke Energy staff	1	3%
The National Theatre for Children staff	12	32%
The National Theatre for Children materials	6	16%
Other	0	0%

Don't know	5	14%

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=44)
Far too advanced for most of your students	0	0%
Somewhat too advanced for most of your students	3	7%
About right for most of your students	40	91%
Somewhat too basic for most of your students	1	2%
Far too basic for most of your students	0	0%
Other	0	0%
Don't know	0	0%

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

Response Option	Count (n=3)
First grade standards are limited to recycling and natural resources.	1
Some of the vocabulary and jokes were above their heads, but it's first grade so I expect that to happen.	1
The performance was great. However, I teach very low level special needs students, so the fast pace and large group they were in made things over their heads. I know it would be time consuming, but a program a little slower paced with special needs children in mind would be amazing.	1

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

Response Option	Count	Percent (n=44)
Yes	2	5%
No	35	80%
Don't know	7	16%

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

Response Option	Count (n=2)
All were covered	1
Natural resources	1

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

Response Option	Count	Percent (n=44)
1 - Not at all satisfied	0	0%
2	0	0%
3	2	5%
4	3	7%
5 - Completely satisfied	39	89%
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=44)
Yes	29	66%
No	11	25%
Don't know	4	9%

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	10%
A little	8	28%
Moderately	12	41%
A lot	4	14%
Extensively	2	7%
Not at all	0	0%
Don't know	3	10%

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

Response Option	Count (n=8)
It is difficult for them to use due to lack of reading skills	1
Limited class time. Plus some of it repeated the curriculum we had already covered	1
The information in the workbooks was a bit above the kindergarten grade level. I used the books as a review and allowed students to take them home to do with the help of a parent.	1
The only available date for our area was in February but me covered the material in October. Our school has been impressed by the performances and was willing to wait until February to see it this year. The performance also provided our students with a review of our lesson	1
They were a little too elementary for my 6th graders.	1

Time factor	1
Timing was off	1
We cover those subjects in the Spring so at the time of the program performance I did not use the resources very much.	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=26)
Yes	11	42%
No	18	58%

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

Response Option	Count	Percent (n=26)
Far too advanced for most of your students	1	4%
Somewhat too advanced for most of your students	5	19%
About right for most of your students	18	69%
Somewhat too basic for most of your students	1	4%
Far too basic for most of your students	1	4%
Other	0	0%
Don't know	0	0%
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=10)
1 - Not at all useful	0	0%
2	0	0%
3	6	23%
4	11	42%
5 - Extremely useful	9	35%
Don't know	0	0%

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=26)
Completely aligned	5	19%
Mostly aligned	9	35%
Somewhat aligned	7	27%
Not aligned at all	1	4%
Don't know	4	15%

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

Response Option	Count	Percent (n=10)
Yes	2	8%
NO	20	77%
Don't know	4	15%

Q19. What concepts did your students have particular trouble with?

Response Option	Count (n=2)
Speed of presentation	1
The concept of saving energy because it is not a physical thing that they can hold or truly see, they sometimes have a hard time with abstract concepts.	1

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

Response Option	Count	Percent (n=10)
Yes	1	4%
No	19	73%
Don't know	6	23%

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

Response Option	Count (n=2)
If there could be more information on how energy travels that would be great! There's a lot in our curriculum about energy waves.	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=26)
1 - Not at all satisfied	0	0%
2	0	0%
3	2	8%
4	9	35%
5 - Completely satisfied	15	58%
Don't know	0	0%

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

Response Option	Count (n=3)
I have other state tested material that takes priority in math	1
No time	1
We did not receive the materials until the last minute.	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=44)
Yes	6	14%
No	35	80%
Don't know	3	7%

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	Percent (n=0)
1 - Not at all satisfied	0	0%
2	0	0%
3	0	0%
4	0	0%
5 - Completely satisfied	0	0%
Don't know	0	0%

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

Response Option	Count	Percent (n=44)
Yes	42	95%
No	1	2%
Don't know	1	2%

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=44)
MyEnergyKit.org poster	17	39%
Vocally encouraged students to sign up for a kit	40	91%
Used my classroom web portal to encourage families to sign up for a kit	12	27%
Emailed parents to encourage them to sign up for a kit	18	41%
Spoke with parents in person to encourage them to sign up for a kit	8	18%
Other	0	0%
No other actions taken	1	2%
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=44)
Yes	15	34%
No	29	66%
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=15)
0% to 10%	5	33%
11% to 20%	3	20%
21% to 30%	3	20%
31% to 40%	0	0%
41% to 50%	1	7%
51% to 60%	1	7%

61% to 70%	1	7%
71% to 80%	0	0%
81% to 90%	0	0%
91% to 100%	0	0%
Don't know	1	7%

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

Response Option	Count (n=44)
Fewer students per presentation. Pre/Post Test	1
For the performance to be at a slower pace	1
Get the students more involved in the performance.	1
Have performers speak slowly. Many of our English Language Learners couldn't understand them because they were talking so fast.	1
Hearing them was an issue. Not sure if it were because of them or the equipment.	1
It may be that another teacher was provided the information prior to the performance, but I felt a bit uninformed regarding what topics the performance was about. Also, really wish I had been given the workbooks/comics (whatever materials I was supposed to be able to give to students).	1
Just what I stated earlier. Have a program geared toward special needs students, providing the same information, just in a format more suitable to them, because the program was great!	1
More at-home materials to show parents what students learned	1
None	36

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

Response Option	Count (n=44)
Change the content a little more from year to year so that the kids aren't bored of the items.	1
Include more worksheet activities on 6th grade level for independent work time.	1
Make them more related to the NC Standards by grade level. Or, we could simply have the science teacher responsible for it.	1
Maybe get the kids more involved with the show more.	1
Sometimes, we use the program as an introduction to our Energy Unit, other years we have used it as a culminating activity. We we use it as an introduction, it would be nice to see it prior to the program and before our teaching begins, so we can plan more efficiently.	1
You could likely save paper by using online only materials.	1

Response Option	Count (n=44)
None	38

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=44)
Yes, I am willing to be interviewed	25	57%
No, I am not willing to be interviewed	19	43%

G.3 Student Parent Survey - DEP

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

Response Option	Count	Percent (n=172)
Yes	151	88%
No	21	12%
Don't know	0	0%

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

Response Option	Count	Percent (n=151)
Classroom materials brought home by child	86	57%
My child's teacher/school	46	30%
Information material included in/on the kit	40	26%
Other	18	12%
Don't know	3	2%

Q3. Other…

Response Option	Count
Bill	1
By information we received before we received the kit	1
Email from School	1
Granddaughter is a student at the school.	1
Grandson brought home brochure from school	1
Grandson told me about the program	1
Mail	1
Mail flyer	1
My child spoke about it	1
Received packages from Duke	1
Saw it on a paper my grandson got	1
Someone called me to verify that I received it	1
The school sent paperwork home with my kids containing material about the program.	1
We had an in-home energy efficiency rep come to our house.	1
Wife is active in the PTA	1
Word of mouth from daughter (School secretary)	1
Word of mouth from family	1
Written on box and a paper brought home with it	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=172)
Classroom materials brought home by child	118	69%
School newsletter	19	11%
Email from my child's teacher/school	23	13%
School website or school web portal	10	6%
In-person conversations with my child's teacher	9	5%
Saw a poster at my child's school	5	3%
After hours event at my child's school	1	1%
Other (please specify in the box below)	31	18%
Don't know	7	4%

Q3a. Other…

Response Option	Count
Ad on Facebook	1
Bill	1
Daughter mentioned it	3
Daughter works for the school	1
Duke Energy had sent me a post card in the mail that explained all about the kit.	1
Duke site	3
Email also	1
Flyer came in mail	1
Form from school	1
From my daughter's school, they sent it in their packet	1
From the school	1
From the school, a brochure	1
I received a phone call	1
It just came	1
Kids told me	1
Mail flyer	1
My child spoke about it	1
Paper sent home with child	1
Provided by grandchild	1
PTA meeting at the school	1

Response Option	Count
Relatives who work at the school	1
School	2
School Facebook Page.	1
Southern Academy Promoted it	1
The principle informed her	1
The school PTA	1
Wife works for PTA	1
Word of mouth	1
Word of mouth from daughter	2

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

Response Option	Count	Percent (n=172)
Yes	128	74%
No	31	18%
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=128)
0	0	0%
1	0	0%
2	0	0%
3	2	2%
4	0	0%
5	6	5%
6	8	6%
7	18	14%
8	23	18%
9	17	13%
10 - Very helpful	52	41%
Don't know	2	2%

Q6. What might have made the information more helpful?

Response Option	Count
I didn't read all of the booklet	1
I have already seen and understood most of the things that were there. I have used energy-saving aerators and LED bulbs. If I was looking for something useful, I would consider solar energy (even though I live in the woods) and insulation for my house.	1
I thought is was a good learning tool. I just already understood most of the info	1
If it was true and accurate	1
If there was more information for log cabins old or new.	1
More specifics, but that's difficult for a variety of houses.	1
Nothing many of the things listed we already knew about or do.	1
Nothing. I'm very aware of most of the topics	1
Quick summary of 44-page energy saving tips	1
Was more of a refresher than new information being brought up. Already has a lot of the suggestions in place in the home.	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=172)
Yes	42	24%
No	128	74%
Don't know	2	1%

Q9. Where did you hear about this program?

Response Option	Count	Percent (n=42)
From my child/children	28	67%
From a teacher/school administrator	17	41%
On the Duke Energy website	0	0%
Other	6	14%
Don't remember	0	0%

Q9a. Other…

Response Option	Count
From my grandson	1
From the school	1

From your child	1
Included with the information, probably in the initial form	1
PTA	1
Weekly information call from school	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=172)
Yes	160	93%
No	12	7%
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	86	54%
Kitchen faucet aerator	68	43%
Bathroom faucet aerator	60	38%
Night light	130	81%
Energy efficient light bulb(s) (LEDs)	149	93%
Insulator gaskets for light switches and electricity outlets	54	34%
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=149)
Yes - I installed both LEDs	119	80%
No - I installed only one LED light bulb	28	19%
Don't know	2	1%

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=54)
None	0	0%
One	5	9%

Two	19	35%
Three	3	6%
Four	25	46%
Don't know	2	4%

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=54)
None	2	4%
One	2	4%
Two	20	37%
Three	1	2%
Four	7	13%
Five	0	0%
Six	3	6%
Seven	2	4%
Eight	11	20%
Don't know	6	11%

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	0%	0%	1%	1%	1%	3%	0%	10%	13%	8%	62%	0%	86
Kitchen faucet aerator	0%	1%	0%	1%	0%	3%	3%	6%	7%	9%	68%	1%	68
Bathroom faucet aerator	0%	0%	0%	2%	5%	2%	2%	8%	10%	10%	60%	2%	60
Night light	1%	0%	0%	1%	1%	1%	1%	4%	5%	5%	82%	1%	130

Energy efficient light bulbs (LEDs)	1%	0%	0%	0%	1%	0%	1%	3%	4%	7%	83%	1%	149
Insulator gaskets	0%	0%	0%	0%	0%	6%	0%	4%	13%	7%	67%	4%	54

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

Response Option	Count
Decreased water output	1
Doesn't give much power	1
Leaked	1
The pressure is so low	1
The showerhead is a water waster. So much water comes out so quickly that it drains our water heater. We have to put less pressure on the faucet so that less water comes out to be able to use it, in other words--not at capacity.	1

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

Response Option	Count
Because the water comes out very slow	1
Didn't fit well	1
The water flow is terrible, very slow	1

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

Response Option	Count
Bulb is super bright. Faucet piece leaked	1
Didn't fit well	1
I had to take the guts out of the aerator and put them in the casing that was already on my faucet	1
Slow	1
Water barely come out	1

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

Response Option	Count
It didn't work and only one led light	1

Response Option	Count
It's very low. The light is not enough.	1
Stopped working after a few days	1

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

Response Option	Count
Did not work	1
I'm not dissatisfied, it's just like any other light	1
My bill went up. I usually pay $30 a month but after changing the it is $50 a month.	1
Still stuck on the old light bulbs. These need to "warm" up before getting good lighting	1

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

Response Option	Count
Our home was built in the last 4 years and most already had some outlets were difficult to put back. It really had nothing to do with the insulators more that I took off covers and they already had so i wasted a lot of time.	1
There wasn't an equal amount in each pack	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	3	2%
No	157	98%
Don't know	0	0%

Q19. Which of the items did you uninstall?

Response Option	Count
Showerhead	0
Kitchen faucet aerator	0
Bathroom faucet aerator	1
Night light	1
Energy efficient light bulbs (LEDs)	1
Insulator gaskets	0
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	0
Didn't like how it looked	0
Don't know	0

Q20b. the kitchen faucet aerator?

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

Q20c. the bathroom faucet aerator?

Response Option	Count
It was broken	0
Didn't like how it worked	0
Didn't like how it looked	1
Don't know	0

Q20d. the night light?

Response Option	Count
It was broken	1
Didn't like how it worked.	0
Didn't like how it looked.	0
Don't know	0

Q20e. the energy efficient light bulbs (LEDs)?

Response Option	Count
It was broken	0
Didn't like how it worked.	0
Didn't like how it looked.	0
Other – Because it was super bright	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
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=150)
Showerhead	37	25%
Kitchen faucet aerator	40	27%
Bathroom faucet aerator	48	32%
Night light	24	16%
Energy efficient lightbulbs (LEDs)	16	11%
Insulator gaskets	50	33%
Im not planning on installing any of these in the next three months.	50	33%

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

Q22. Showerhead…

Response Option	Count	Percent (n=49)
Didn't know what that was	1	2%
Tried it, didn't fit	7	14%
Tried it, didn't work as intended (please explain in the box below)	5	10%
Haven't gotten around to it	2	4%
Current one is still working	11	22%
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	2%
Already have an efficient showerhead	18	37%
Other (please specify in the box below)	12	24%
Don't know	1	2%

Q22. Kitchen faucet aerator…

Response Option	Count	Percent (n=64)
Didn't know what that was	2	3%
Tried it, didn't fit	11	17%
Tried it, didn't work as intended (please explain in the box below)	5	8%
Haven't gotten around to it	14	22%
Current one is still working	11	17%
Takes too much time to install it / No time / Too busy	1	2%
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)	1	2%
Already have an efficient kitchen faucet aerator	11	17%
Other (please specify in the box below)	10	16%
Don't know	3	5%

Q22. Bathroom faucet aerator…

Response Option	Count	Percent (n=64)
Didn't know what that was	4	6%
Tried it, didn't fit	10	16%
Tried it, didn't work as intended (please explain in the box below)	4	6%
Haven't gotten around to it	11	17%
Current one is still working	14	22%
Takes too much time to install it / No time / Too busy	1	2%
Too difficult to install it, don't know how to do it	3	5%
Don't have the tools I need	3	5%
Don't have the items any longer (threw away, gave away)	1	2%
Already have an efficient bathroom faucet aerator	11	17%
Other (please specify in the box below)	11	17%
Don't know	4	6%

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	1	14%
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	1	14%
Don't have the tools I need	0	0%
Don't have the items any longer (threw away, gave away)	0	0%
Already have LEDs	1	14%
Other (please specify in the box below)	3	43%
Don't know	0	0%

Q22. Night lights…

Response Option	Count	Percent (n=16)
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)	1	6%
Haven't gotten around to it	3	19%
Current one is still working	4	25%
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)	0	0%
Other (please specify in the box below)	7	44%
Don't know	2	17%

Q22. Insulator gaskets…

Response Option	Count	Percent (n=66)
Didn't know what that was	7	11%
Tried it, didn't fit	3	5%
Tried it, didn't work as intended (please explain in the box below)	0	0%
Haven't gotten around to it	23	35%
Current one is still working	9	14%

Takes too much time to install it / No time / Too busy	3	5%
Too difficult to install it, don't know how to do it	0	0%
Don't have the tools I need	1	2%
Don't have the items any longer (threw away, gave away)	1	2%
Other (please specify in the box below)	13	20%
Don't know	7	11%

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=161)
Yes, I would like another energy-efficient showerhead	43	27%
Yes, I would like another kitchen faucet aerator	25	16%
Yes, I would like more bathroom faucet aerators	29	18%
Yes, I would like more energy-efficient night lights	97	60%
Yes, I would like more energy-efficient light bulbs (LEDs)	132	82%
Yes, I would like more switch/outlet gasket insulators	31	19%
No, I am not interested in receiving any more of the items	17	11%
Don't know	0	0%

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

Response Option	Count	Percent (n=144)
Internet	88	61%
Telephone	26	18%
Pre-paid postcard	42	29%
Other, please specify	3	2%
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=129)
Yes	88	68%
No	41	32%
Don't know	0	0%

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

Response Option	Count	Percent (n=88)
Yes	64	73%
No	20	23%
Don't know	4	5%

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=148)
All incandescent (old fashioned light bulb - likely purchased more than two years ago)	59	40%
All halogen (looks like an incandescent, but has a glass tube inside of the bulb)	7	5%
All CFL (spiral or twisty shaped bulb that fits into ordinary light fixtures)	67	45%
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)	6	4%
Don't know	4	3%

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

Response Option	Count	Percent (n=148)
Living room	59	40%
Dining room	13	9%
Bedroom	60	41%
Kitchen	28	19%
Bathroom	16	11%
Den	3	2%
Garage	3	2%
Hallway	13	9%
Basement	0	0%
Outdoors	2	1%
Other area (please specify in the box below)	4	3%
Don't Know	2	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=172)
Yes	25	15%
No	111	65%
Don't recall seeing the Hot Water Gauge Card	26	15%
Don't know	10	6%

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

Response Option	Count	Percent (n=25)
Yes	3	12%
No	22	88%

Q31a. Temperature setting...

Response Option	Count
110	1
135	1
20 or 50-something	1

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

Response Option	Count
70	1
100	1
120	2
125	1
130	1
176	1

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

Response Option	Count	Percent (n=25)
Yes	22	88%
No	2	8%
Don't know	1	4%

Q34. Why did you change the water heater temperature a second time?

Response Option	Count
Customer says it was not too hot	1
We had an element that went out. We put it back and it will be replaced next week.	1

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

Response Option	Count	Percent (n=172)
Electricity	134	78%
Natural Gas	28	16%
Other (please specify in the box below)	2	1%
Don't know	8	5%

Q36. How old is your water heater?

Response Option	Count	Percent (n=172)
Less than five years old	49	29%
Five to nine years old	38	22%
Ten to fifteen years old	24	14%
More than fifteen years old	13	8%
Don't know	48	28%

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	60	38%
No	70	44%
Don't know	29	18%

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

Response Option	Count	Percent (n=58)
Energy-Efficient Showerhead	11	19%
Kitchen faucet aerator	7	12%
Bathroom faucet aerator	2	3%
Energy-Efficient Night light	20	35%
Energy efficient lightbulbs (LEDs)	53	91%
Switch/Outlet Gasket Insulators	3	5%

No I would not have purchased any of the items	0	0%
Other	0	0%
Don't know	1	2%

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=45)
One	2	4%
Two	34	76%
Don't know	9	20%

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	4%	0%	0%	1%	1%	3%	3%	7%	8%	6%	67%	1%	106
The fact that the items were mailed to your house	1%	0%	0%	0%	0%	3%	2%	4%	5%	7%	79%	0%	106
The chance to win cash prizes for your household and school	8%	2%	2%	2%	1%	6%	6%	4%	7%	8%	53%	4%	106
Information in the kit about how the items would save energy	0%	0%	0%	1%	2%	4%	6%	6%	10%	9%	60%	2%	106
Information that your child brought home from school	3%	0%	1%	1%	0%	5%	7%	8%	11%	9%	52%	2%	106
Other information or advertisements from Duke Energy, including its website	8%	1%	0%	4%	3%	8%	5%	10%	15%	5%	37%	4%	106

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%	4%	1%	5%	5%	4%	79%	1%	148
The fact that the items were mailed to your house	0%	0%	0%	1%	1%	2%	1%	3%	7%	5%	80%	1%	148
The chance to win cash prizes for your household and school	7%	2%	1%	3%	1%	9%	4%	3%	6%	3%	57%	4%	148
Information in the kit about how the items would save energy	1%	0%	0%	1%	3%	8%	3%	6%	11%	6%	59%	1%	148
Information that your child brought home from school	5%	1%	0%	1%	3%	7%	3%	7%	9%	6%	53%	3%	148
Other information or advertisements from Duke Energy, including its website	11%	1%	1%	3%	5%	8%	3%	7%	7%	8%	41%	4%	148

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=110)
Yes	90	82%
No	13	12%
Don't know	7	6%

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

Response Option	Count	Percent (n=90)
Never	1	1%
Sometimes	25	28%
Always	64	71%
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	29
Purchased energy saving products for my home and received a Duke Energy rebate	8
Purchased energy saving products for my home but did not receive a Duke Energy rebate	9
Made energy saving modifications to my home (example: installed insulation or windows)	18
Adjusted how or when I use energy in my home	33
Looked for additional information on how to save energy	9
Other (please specify in the box below)	7
Don't know	4

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
Not applicable - no new behaviors	48
Turn off lights when not in a room	97
Turn off electronics when not using them	65
Take shorter showers	35
Other	17
Don't know	8

Q45a. Other…

Response Option	Count
I don't have any children	1
I really haven't noticed anything.	1
Make sure all the doors and windows are closed	1
My child just turned 3. She doesn't really understand about it yet, but we've raised her to always turn off lights when they're not being used.	1
My daughter is now aware of saving electricity and encourages recycling.	1
Not that I know of, because she's only six.	1
Saving/not wasting water	3
She lectures everyone about turning lights off and closing the refrigerator and turning off electronics	1
Turning off water while brushing teeth	3
Turns off the water.	1
Unplugging computers and TV's when leaving the house.	1
Unplugs nightlight when not using it.	1
Using less water.	1

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

Response Option	Count	Percent (n=54)
Turning off lights when not in a room	42	78%
Turning off electronics when not using them	18	33%
Taking shorter showers	7	13%
Other	5	9%

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	41
Turning off lights when not in a room	85
Turning off furnace when not home	19
Turning off air conditioning when not home	33
Changed thermostat settings to use less energy	72
Using fans instead of air conditioning	55
Turning off electronics when we are not using them	62
Taking shorter showers	28
Turning water heat thermostat down	18
Other (please specify in the box below)	16
Don't know	1

Q46a. Other…

Response Option	Count
Adjusted the thermostat	1
Buy LEDs when lights go out.	4
Consider using more LED bulbs	1
I installed more things for the a/c area.	1
I'm leaving the new LED bulb in the hallway on 24 hours a day so I can see how much energy LED's save.	1
Installed LED bulbs	1
More mindful of the use meter	1
Try not to do but 1 load of laundry a day	1
Turn off the a/c when we go to bed	1
Turning hot water heater down and checking it	1
Use LEDs	1
Using energy-efficient appliances	1
Wash clothes later on at night	1
Washer machine unplugged	1
Watching the thermostat and making adjustments when needed	1
We keep everything unplugged when we're not using them.	1

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

Response Option	Count	Percent (n=89)
Turning off lights when not in a room	60	67%
Turning off furnace when not home	10	11%
Turning off air conditioning when not home	17	19%
Changing thermostat settings so heating or cooling system uses less energy	31	35%
Using fans instead of air conditioning	35	39%
Turning off electronics when not using them	29	33%
Taking shorter showers	12	13%
Turning water heat thermostat down	4	4%
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=130)
0 – Not at all influential	4	3%
1	0	0%
2	1	1%
3	2	2%
4	0	0%
5	7	5%
6	3	2%
7	21	16%
8	17	13%
9	10	8%
10 - Extremely influential	64	49%
Don't know	1	1%

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=172)
Yes	115	67%
No	30	17%
Don't know	27	16%

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

Response Option	Count
Energy efficient appliances	48
Efficient heating or cooling equipment	24
Efficient windows	30
Adding insulation	25
Sealing air leaks	30
Sealing or insulating ducts	15
Efficient lighting (LEDs)	87
Energy efficient water heater	19
Internet connected “smart” thermostat	23
Other	16
Don't know	7

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=172)
Yes	46	27%
No	120	70%
Don't know	6	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	8
Moved into an ENERGY STAR home	2
Bought efficient heating or cooling equipment	4
Bought efficient windows	2
Added insulation	8
Sealed air leaks	10
Sealed ducts	3
Bought LEDs	29
Bought CFLs	1
Installed an energy efficient water heater	1
None – no other actions taken	0
Other (please specify in the box below)	8
Don’t know	1

Q49a. Other…

Response Option	Count
Added a smart thermostat	1
Air Conditioning Service, making sure it is properly maintained to save on energy costs	1
Bought and installed a new heat pump	1
Dish Washer, Refrigerator and Stove	1
Drapes for blackouts so that the sun doesn't heat up the rooms during Summer	1
Just the a/c things	1
Solar panels	1
Upgraded A/C filters	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	2
Moved into an ENERGY STAR home	0
Bought efficient heating or cooling equipment	0
Bought efficient windows	0
Bought additional insulation	0
Sealed air leaks	0
Sealed ducts	0
Bought LEDs	1
Bought CFLs	0
Installed an energy efficient water heater	0
Other	1
I did not get any Duke Rebates	36
Don't know	5

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	Don’t Know	Total
Buy energy efficient appliances	0%	0%	13%	0%	13%	0%	13%	13%	13%	0%	38%	0%	14
Move into an ENERGY STAR home	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	50%	0%	1
Buy efficient heating or cooling equipment	50%	0%	0%	0%	25%	25%	0%	0%	0%	0%	0%	0%	5
Buy efficient windows	50%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5
Add insulation	25%	0%	0%	0%	0%	13%	13%	0%	13%	13%	25%	0%	12
Seal air leaks	10%	0%	0%	0%	0%	0%	10%	0%	20%	10%	50%	0%	6
Seal ducts	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	67%	0%	1
Buy LEDs	3%	0%	0%	7%	3%	10%	7%	0%	17%	7%	41%	3%	28
Buy CFLs	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	1
Install an energy efficient water heater	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	3
Other	38%	0	0	0	0	1	0	0	1	0	25%	13	10

		%	%	%	%	3 %	%	%	3 %	%		%	

Q52. What kinds of appliance(s) did you buy?

Response Option	Count
Refrigerator	4
Stand-alone Freezer	0
Dishwasher	3
Clothes washer	5
Clothes dryer	6
Oven	0
Microwave	1
Other	0
Don’t know	0

Q53. Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=7)
Refrigerator	4	57%
Stand-alone Freezer	0	0%
Dishwasher	2	29%
Clothes washer	4	57%
Clothes dryer	5	71%
Oven	0	0%
Microwave	1	14%
Other	0	0%

Q54. Does the new clothes dryer use natural gas?

Response Option	Count
Yes- it uses natural gas	1
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=2)
Central air conditioner	1	50%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	0	0%
Geothermal heat pump	0	0%
Boiler	0	0%

Response Option	Count	Percent (n=2)
Furnace	0	0%
Wifi-enabled thermostat	0	0%
Other (please specify in the box below)	0	0%
Don't know	1	50%

Q55a. Other…

Response Option	Count
Not applicable	0

Q56. Does the new [INSERT Q55 RESPONSE] use natural gas?

Response Option	Count
Not applicable	0

Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=1)
Central air conditioner	1	100%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	0	0%
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
10	1

Q59. Did you add insulation to your attic, walls, or below the floor? [MULTIPLE RESPONSE]

Response Option	Count
Attic	5
Walls	3
Below the floor	1
Don’t know	0

Q60a. Approximately what proportion of the attic space did you add insulation?

Response Option	Count
50	1
50%	1
90%	1
Don’t know	0

Q60b. Approximately what proportion of the wall space did you add insulation?

Response Option	Count
3	1
50%	1
Don’t know	0

Q60c. Approximately what proportion of the below the floor space did you add insulation?

Response Option	Count
50%	1

Q61. Do you know how many of LEDs you installed at your property?

Response Option	Count
Yes	25
Don't know	3

Q61a. How many of LEDs did you install in your property?

Response Option	Count
2	2
3	1
4	2
5	1
6	7
8	1
8 plus 2 from the box	1
10	2
12	1
15	1
20	4
25	1

Response Option	Count
30	1
Don't know	0

Q62. How many of CFLs did you install in your property?

Response Option	Count
Yes	1
Don't know	1

Q62. Number of CFLS installed…

Response Option	Count
2	1

Q63. Does the new water heater use natural gas?

Response Option	Count
Yes - it uses natural gas	1
No – does not use natural gas	0
Don't know	0

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	0
A tankless water heater that provides hot water on demand	1
A solar water heater	0
Other	0
Don't' know	0

Q65. Is the new water heater an ENERGY STAR model?

Response Option	Count
Yes	1
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=172)
Single-family detached house	102	59%
Single-family attached home (such as a townhouse or condo)	9	5%
Duplex, triplex or four-plex	3	2%
Apartment or condominium in a building with 5 units or more	22	13%
Manufactured or mobile home	32	19%
Other	2	1%
Don't know	1	1%

Q66. Other…

Response Option	Count
Buying own house soon and will want to make more energy efficient	1
Single family log cabin	1

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=172)
Less than 500 square feet	1	1%
500 to under 1,000 square feet	12	7%
1,000 to under 1,500 square feet	42	24%
1,500 to under 2,000 square feet	20	12%
2,000 to under 2,500 square feet	22	13%
2,500 to under 3,000 square feet	16	9%
Greater than 3,000 square feet	17	10%
Don't know	42	24%

Q68. Do you or members of your household own your home, or do you rent it?

Response Option	Count	Percent (n=172)
Own / buying	111	65%
Rent / lease	61	36%
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=172)
I live by myself	8	5%
Two people	25	15%
Three people	42	24%
Four people	54	31%
Five people	30	17%
Six people	9	5%
Seven people	3	2%
Eight or more people	1	1%
Don't know	0	0%

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

Response Option	Count	Percent (n=172)
Under $20,000	27	16%
$20,000 to under $30,000	19	11%
$30,000 to under $40,000	18	10%
$40,000 to under $50,000	14	8%
$50,000 to under $60,000	11	6%
$60,000 to under $75,000	9	5%
$75,000 to under $100,000	19	11%
$100,000 to under $150,000	20	12%
$150,000 to under $200,000	9	5%
$200,000 or more	3	2%
Don’t know	4	2%
Prefer not to say	19	11%

Q71. What is the highest level of education achieved among those living in your household?

Response Option	Count	Percent (n=172)
Less than high school	1	1%
Some high school	7	4%
High school graduate or equivalent (such as GED)	33	19%
Trade or technical school	4	2%
Some college (including Associate degree)	50	29%

Response Option	Count	Percent (n=172)
College degree (Bachelor's degree)	38	22%
Some graduate school	5	3%
Graduate degree, professional degree	32	19%
Doctorate	1	1%
Don't know	0	0%
Prefer not to say	1	1%

G.4 Student Parent Survey - DEC

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

Response Option	Count	Percent (n=334)
Yes	313	94%
No	19	6%
Don't know	2	1%

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

Response Option	Count	Percent (n=313)
Classroom materials brought home by child	183	58%
My child's teacher/school	92	29%
Information material included in/on the kit	92	29%
Other	33	11%
Don't know	6	2%

Q3. Other…

Response Option	Count
A friend	1
Advertisement sent home from school that we signed up for	1
By a letter	1
contest sponsored at daughter's school	1
Duke Energy	1
Flyer	1
Friend told me	1
From Duke Power.	1
Had to fill something out online and it was on the box as well	1

Response Option	Count
Heard some of the parents talking about it.	1
I signed up for it online.	1
I use to work as a substitute teacher part time.	1
I work for Duke HEHC Program	1
In the papers that came with it	1
Informed by neighbors on the next door app	1
Internet	1
My daughter shared her experiences with me prior to receiving the materials	1
My wife teaches at the middle school level.	1
Neighbor is a retired Duke Employee.	1
Network neighborhood site	1
Online	2
Pervious Experience	1
Previous participation in the LED kit.	1
PTO promotion of kit!	1
Requested it when I moved into my house	1
Saw information about the kit online	1
School's Social Media	1
Teacher told me	1
Website	3
When it arrived I was told by my grandson it was from Duke	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=334)
Classroom materials brought home by child	238	71%
School newsletter	57	17%
Email from my child’s teacher/school	46	14%
School website or school web portal	20	6%
In-person conversations with my child’s teacher	14	4%
Saw a poster at my child’s school	12	4%
After hours event at my child’s school	8	2%
Other (please specify in the box below)	44	13%
Don't know	10	3%

Q3a. Other…

Response Option	Count
A friend	1
Assembly sponsored by Duke Energy.	1
Call from my child's school	1
Class Dojo message from school	1
Contest at my daughter's school	1
Duke Energy Website	1
Either something we filled out or something that came home with the kids from school	1
Facebook	1
Flyer from school	2
Friend told me.	1
From my niece Stacey Johnson	1
From the school	1
Grand daughter brought home a card	1
Heard about it from another child’s parent	1
Heard some of the parents talking about it.	1
I saw it on my light bill.	1
It just came in the mail	1
Letter from the school	1
Monthly Bill	1
My child	1
My child told me.	1
My wife teaches at the school.	1
Neighbors posted on nextdoor app	1
Network neighborhood site	1
Once it arrived	1
Pervious Experience	1
Room Parent emails PTO newsletter PTO Facebook posts	1
Saw it on Facebook	1
School	1
School Facebook page	1
School sent me a brochure	1
Social media from school	1
Supporter of saving the environment, step daughter brought home paper from school	1
The school may have given us flyers	1
Was told by my child	1

Response Option	Count
Website	3
When it arrived I was told it was from Duke by my grandson	1
Word of mouth from family	1
Work for duke	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=334)
Yes	245	73%
No	62	19%
Don't know	27	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=245)
0	1	0%
1	1	0%
2	0	0%
3	2	1%
4	5	2%
5	17	7%
6	17	7%
7	42	17%
8	43	18%
9	24	10%
10 - Very helpful	93	38%
Don't know	0	0%

Q6. What might have made the information more helpful?

Response Option	Count
A chart of the options and other ways to save.	1
Adding more statistical data to prove that what's actually stated is true	1
Better as video than booklet.	1
Could have used more specific info on insulating pipes.	1

Response Option	Count
Different ways to save energy.	1
I already knew the info. I'm sure it would be helpful to someone who didn't already know.	1
I did this line of work for a living so I already knew the info	1
I don't know but it was stuff I already knew	1
I was pretty much aware of all the ways to save energy. I am very conservative with everything.	1
Including information to help renters	1
It was kind of confusing, need more detail	1
It was too long	1
It was very helpful. We rent so there is only so much we can do.	1
Just didn't apply to me	1
Low income resources	1
More ideas on savings.	1
More incentive to use the items... Example rebates...note with power bill telling how much your own home saved after using the items make it more personal not a average	1
More info for energy savings in a mobile home	1
More options and more detailed information and instructions.	1
More pictures. More info	1
Sleep	1
Tell how to really save energy	1
The reading	1
Tips	1
We tend to try our best at club conservation, so I'm not the best to think of with changing minds.	1
Well the showerheads need to be a little bigger for my shower	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=334)
Yes	104	31%
No	228	68%
Don't know	2	1%

Q9. Where did you hear about this program?

Response Option	Count	Percent (n=104)
From my child/children	80	77%
From a teacher/school administrator	29	28%
On the Duke Energy website	15	14%
Other	5	5%
Don't remember	2	2%

Q9a. Other…

Response Option	Count
From the school	1
Network neighborhood site	1
PTO	1
School's website.	1
Through the school newsletter	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=334)
Yes	312	93%
No	22	7%
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=312)
Showerhead	153	49%
Kitchen faucet aerator	109	35%
Bathroom faucet aerator	104	33%
Night light	259	83%
Energy efficient light bulb(s) (LEDs)	297	95%
Insulator gaskets for light switches and electricity outlets	103	33%
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=297)
Yes - I installed both LEDs	237	80%
No - I installed only one LED light bulb	50	17%
Don't know	10	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=103)
None	3	3%
One	11	11%
Two	31	30%
Three	7	7%
Four	44	43%
Don't know	7	7%

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=103)
None	4	4%
One	6	6%
Two	29	28%
Three	5	5%
Four	20	19%
Five	2	2%
Six	5	5%
Seven	1	1%
Eight	18	17%
Don't know	13	13%

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%	1%	1%	5%	3%	13%	13%	10%	50%	1%	153
Kitchen faucet aerator	2%	0%	1%	1%	1%	5%	3%	7%	8%	3%	67%	3%	109
Bathroom faucet aerator	2%	1%	0%	3%	0%	5%	3%	9%	9%	7%	62%	1%	104
Night light	0%	1%	0%	1%	0%	1%	1%	3%	10%	8%	75%	0%	259
Energy efficient light bulbs (LEDs)	1%	0%	0%	1%	0%	0%	2%	3%	5%	10%	77%	0%	297
Insulator gaskets	0%	0%	0%	1%	2%	2%	1%	6%	14%	7%	59%	9%	103

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

Response Option	Count
Absolutely no water pressure. Takes forever to rinse soap off. Had another water saver head and it had tons of pressure. Uninstalled the free one after 2 days. I was itchy because soap would not rinse off without leaving the water on forever. I feel I used more water using this head because I had to leave the water on longer.	1
I wish there was flow from the center of the shower head as well as the circle. It makes washing longer hair a little harder to get the shampoo out.	1
It was not like the one we already had installed. The one we had was flatter and spread more water.	1
It's a dumb criticism, but it doesn't look as cool as it could.	1
Live in apartment it isn’t dissatisfaction with the shower head but with the general water pressure at apartment	1
Pressure was very poor	1
Shower head leaks water	1
The water flow is different and we have to get used to it.	1
Too slow	1
Very slow	1

Response Option	Count
Water flow pressure was very low. Took longer to wash out soap or to clean off!	1

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

Response Option	Count
Came out to slow	1
Didn't properly fit right on the sink.	1
It kept leaking even when the water was shut off so i had to put the old one back on.	1
It made water squirt out everywhere	1
It was too large for my faucet, it needed an additional adapter	1
Just don't like the loss of flow	1
Low water pressure. Very hard to rinse off dishes and takes longer!	1
Not saving	1
the only con is the kitchen water doesn't have as much water power/pressure when washing as it used to	1
There was not enough pressure	1
We couldn’t install it correctly. Wasn’t matching the sink I believe.	1

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

Response Option	Count
Cut back too much water	1
Didn't properly fit right.	1
It didn’t fit our faucet correctly	1
Low water pressure and so wouldn't even wash tooth paste off tooth brushes!! Removed them all.	1
Made water squirt out everywhere	1
Not saving	1
Sprays water out	1

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

Response Option	Count
I'd prefer it to have an on/off switch	1
I'm not really sure what the nightlight does or how it will save me energy at this time.	1
It is not bright enough.	1
It's not very bright	1

Response Option	Count
No just wasn't needed.	1
Not bright enough for my needs	1
Not saving	1
Nothing but an energy user with little helping of light	1
very happy with the night light	1
Wasn't bright enough for my child	1

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

Response Option	Count
Blink sometimes	1
Not a huge fan of the type of lighting they provide	1
Not enough	1
Not saving	1
There are not as bright. I brought lights that were brighter.	1
They were not bright enough for the area	1
They were too dim and it took a long time to actually get bright	1

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

Response Option	Count
I have an older home built in 1986. I have not noticed a difference in my home insulation since installing these. I installed them only on exterior walls.	1
I still feel air coming through.	1
Not saving	1

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

Response Option	Count	Percent (n=312)
Yes	30	10%
No	279	89%
Don't know	3	1%

Q19. Which of the items did you uninstall?

Response Option	Count (n=30)
Showerhead	13

Response Option	Count (n=30)
Kitchen faucet aerator	10
Bathroom faucet aerator	4
Night light	8
Energy efficient light bulbs (LEDs)	5
Insulator gaskets	1
Don’t know	1

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

Q20a. the showerhead?

Response Option	Count
It was broken	1
Didn't like how it worked	8
Didn't like how it looked	2
Other – Leaks water	1
Other – Switched to handheld shower	1
Other – Wanted to install the one with the water line	1
Don’t know	0

Q20b. the kitchen faucet aerator?

Response Option	Count
It was broken	1
Didn't like how it worked.	5
Didn't like how it looked.	0
Other – Couldn’t install it correctly	1
Other – Did not have an adapter	1
Other – Had to install a filter Brita system	1
Other – Water kept leaking out of it even when the water was turned off.	1
Don’t know	0

Q20c. the bathroom faucet aerator?

Response Option	Count
It was broken	0
Didn't like how it worked	2
Didn't like how it looked	0
Other – Didn’t fit correctly	1

Response Option	Count
Other – Sprays water out instead of the normal	1
Don't know	0

Q20d. the night light?

Response Option	Count
It was broken	2
Didn't like how it worked.	0
Didn't like how it looked.	1
Other – Child removed and lost the light	1
Other – To keep my lamps off	1
Other – Too bright	1
Other – Wasn't needed	1
Other – We had to move the night light to a different outlet.	1
Don't know	0

Q20e. the energy efficient light bulbs (LEDs)?

Response Option	Count
It was broken	2
Didn't like how it worked.	1
Didn't like how it looked.	1
Other – They went out	1
Other – Was not bright enough in the area but we did install into just a simple lamp	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.	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=314)
Showerhead	63	20%

Kitchen faucet aerator	68	22%
Bathroom faucet aerator	82	26%
Night light	40	13%
Energy efficient lightbulbs (LEDs)	26	8%
Insulator gaskets	92	29%
Im not planning on installing any of these in the next three months.	106	34%

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

Q22. Showerhead…

Response Option	Count	Percent (n=118)
Didn't know what that was	2	2%
Tried it, didn't fit	9	8%
Tried it, didn't work as intended (please explain in the box below)	6	5%
Haven't gotten around to it	11	9%
Current one is still working	33	28%
Takes too much time to install it / No time / Too busy	3	3%
Too difficult to install it, don't know how to do it	2	2%
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	45	38%
Other (please specify in the box below)	21	18%
Don't know	2	2%

Q22. Kitchen faucet aerator…

Response Option	Count	Percent (n=156)
Didn't know what that was	9	6%
Tried it, didn't fit	32	21%
Tried it, didn't work as intended (please explain in the box below)	8	5%
Haven't gotten around to it	28	18%
Current one is still working	26	17%
Takes too much time to install it / No time / Too busy	2	1%
Too difficult to install it, don't know how to do it	4	3%
Don't have the tools I need	1	1%

Don't have the items any longer (threw away, gave away)	2	1%
Already have an efficient kitchen faucet aerator	34	22%
Other (please specify in the box below)	23	15%
Don't know	3	2%

Q22. Bathroom faucet aerator…

Response Option	Count	Percent (n=148)
Didn't know what that was	13	9%
Tried it, didn't fit	30	20%
Tried it, didn't work as intended (please explain in the box below)	6	4%
Haven't gotten around to it	32	22%
Current one is still working	15	10%
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	3	2%
Don't have the items any longer (threw away, gave away)	2	1%
Already have an efficient bathroom faucet aerator	24	16%
Other (please specify in the box below)	25	17%
Don't know	4	3%

Q22. Energy efficient lightbulbs (LEDs)…

Response Option	Count	Percent (n=11)
Didn't know what that was	0	0%
Tried it, didn't fit	1	9%
Tried it, didn't work as intended (please explain in the box below)	0	0%
Haven't gotten around to it	1	9%
Current one is still working	2	18%
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)	0	0%
Already have LEDs	3	27%
Other (please specify in the box below)	3	27%

Don't know	1	9%

Q22. Night lights…

Response Option	Count	Percent (n=35)
Didn't know what that was	0	0%
Tried it, didn't fit	1	3%
Tried it, didn't work as intended (please explain in the box below)	2	6%
Haven't gotten around to it	10	29%
Current one is still working	5	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	3%
Other (please specify in the box below)	13	37%
Don't know	3	9%

Q22. Insulator gaskets…

Response Option	Count	Percent (n=139)
Didn't know what that was	12	9%
Tried it, didn't fit	7	5%
Tried it, didn't work as intended (please explain in the box below)	4	3%
Haven't gotten around to it	48	35%
Current one is still working	19	14%
Takes too much time to install it / No time / Too busy	10	7%
Too difficult to install it, don't know how to do it	9	6%
Don't have the tools I need	3	2%
Don't have the items any longer (threw away, gave away)	2	1%
Other (please specify in the box below)	27	19%
Don't know	9	6%

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=326)

Yes, I would like another energy-efficient showerhead	79	24%
Yes, I would like another kitchen faucet aerator	45	14%
Yes, I would like more bathroom faucet aerators	47	14%
Yes, I would like more energy-efficient night lights	190	58%
Yes, I would like more energy-efficient light bulbs (LEDs)	254	78%
Yes, I would like more switch/outlet gasket insulators	49	15%
No, I am not interested in receiving any more of the items	32	10%
Don't know	79	24%

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

Response Option	Count	Percent (n=293)
Internet	218	74%
Telephone	35	12%
Pre-paid postcard	66	23%
Other, please specify	5	2%
Don't know	7	2%

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

Response Option	Count	Percent (n=251)
Yes	167	67%
No	83	33%
Don’t know	1	0%

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

Response Option	Count	Percent (n=167)
Yes	113	68%
No	50	30%
Don't know	4	2%

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=292)
All incandescent (old fashioned light bulb - likely purchased more than two years ago)	132	45%

All halogen (looks like an incandescent, but has a glass tube inside of the bulb)	8	3%
All CFL (spiral or twisty shaped bulb that fits into ordinary light fixtures)	123	42%
All LED (new bulb type that uses little electricity and lasts a long time)	12	4%
Some combination of bulb types (please specify which ones in the box below)	13	4%
Don't know	4	1%

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

Response Option	Count	Percent (n=292)
Living room	131	45%
Dining room	20	7%
Bedroom	104	36%
Kitchen	56	19%
Bathroom	59	20%
Den	8	3%
Garage	4	1%
Hallway	25	9%
Basement	4	1%
Outdoors	5	2%
Other area (please specify in the box below)	11	4%
Don't Know	6	2%

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=334)
Yes	57	17%
No	222	66%
Don't recall seeing the Hot Water Gauge Card	45	13%
Don't know	10	3%

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

Response Option	Count	Percent (n=57)
Yes	16	28%
No	41	72%

Q31a. Temperature setting...

Response Option	Count
120	2
128	1
130	3
140	4
155	1
160	1
Actually, it was not hot enough to read	1
The recommended for you	1
Very hot	1

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

Response Option	Count
72	1
100	1
105	1
110	1
118	1
120	8
130	2
140	1
180	1
Low	1

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

Response Option	Count	Percent (n=57)
Yes	51	90%
No	2	4%
Don't know	4	7%

Q34. Why did you change the water heater temperature a second time?

Response Option	Count
It was too cold for showers	1
Not hot enough	1

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

Response Option	Count	Percent (n=334)
Electricity	213	64%
Natural Gas	106	32%
Other (please specify in the box below)	3	1%
Don't know	12	4%

Q36. How old is your water heater?

Response Option	Count	Percent (n=334)
Less than five years old	111	33%
Five to nine years old	62	19%
Ten to fifteen years old	50	15%
More than fifteen years old	19	6%
Don't know	92	28%

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=309)
Yes	119	39%
No	105	34%
Don't know	85	28%

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

Response Option	Count	Percent (n=117)
Energy-Efficient Showerhead	24	21%
Kitchen faucet aerator	8	7%
Bathroom faucet aerator	7	6%
Energy-Efficient Night light	38	33%
Energy efficient lightbulbs (LEDs)	101	86%
Switch/Outlet Gasket Insulators	7	6%
No I would not have purchased any of the items	0	0%
Other	0	0%
Don't know	1	1%

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=83)
One	3	4%
Two	58	70%
Don't know	22	27%

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	3%	0%	1%	1%	1%	6%	4%	5%	8%	6%	64%	2%	191
The fact that the items were mailed to your house	1%	0%	1%	1%	0%	4%	1%	4%	7%	5%	76%	1%	191
The chance to win cash prizes for your household and school	8%	1%	3%	2%	2%	9%	3%	4%	5%	5%	57%	4%	191
Information in the kit about how the items would save energy	1%	0%	0%	2%	2%	7%	5%	6%	12%	13%	50%	3%	191
Information that your child brought home from school	1%	0%	2%	4%	2%	9%	3%	5%	13%	9%	48%	4%	191
Other information or advertisements from Duke Energy, including its website	8%	1%	1%	5%	2%	10%	6%	10%	11%	7%	37%	3%	191

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	3%	0%	1%	1%	1%	4%	1%	4%	7%	9%	70%	1%	292
The fact that the items were mailed to your house	2%	0%	0%	1%	0%	3%	2%	5%	6%	8%	73%	0%	292
The chance to win cash prizes for your household and school	10%	2%	1%	1%	3%	7%	3%	4%	7%	7%	52%	3%	292
Information in the kit about how the items would save energy	5%	0%	2%	2%	1%	8%	5%	11%	11%	11%	44%	1%	292
Information that your child brought home from school	7%	0%	2%	3%	2%	8%	4%	10%	12%	8%	42%	3%	292
Other information or advertisements from Duke Energy, including its website	12%	2%	2%	3%	2%	13%	5%	9%	11%	7%	30%	2%	292

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=187)
Yes	158	85%
No	22	12%
Don't know	7	4%

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

Response Option	Count	Percent (n=158)
Never	0	0%
Sometimes	37	23%
Always	121	77%
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	27
Purchased energy saving products for my home and received a Duke Energy rebate	6
Purchased energy saving products for my home but did not receive a Duke Energy rebate	28
Made energy saving modifications to my home (example: installed insulation or windows)	34
Adjusted how or when I use energy in my home	85
Looked for additional information on how to save energy	35
Other (please specify in the box below)	10
Don't know	5

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
Not applicable - no new behaviors	84
Turn off lights when not in a room	209
Turn off electronics when not using them	133
Take shorter showers	89
Other	21
Don’t know	11

Q45a. Other…

Response Option	Count
Addressing the television being left on.	1
He was very excited to get the kit and loved installing the new things.	1
I don't know how to answer this, because my child doesn't live with me.	1
I was always taught to be aware of cutting off lights etc. so I've always felt my children to do the same thing.	1
Keep the doors shut	1
No but they were already aware of energy savings	1
No child in family - wife is teacher at the school	1
Reminds others not to waste water when brushing teeth	1
She has increased awareness	1
She’s 6.	1
Turn off water when brushing teeth or washing hands	1
Turns water off while brushing teeth	7
Using less water	1
Using the night light	1
When she brushes her teeth, she turns the water off. She opens up the blinds to use sunlight instead of lights.	1

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

Response Option	Count	Percent (n=108)
Turning off lights when not in a room	81	75%
Turning off electronics when not using them	44	41%

Taking shorter showers	23	21%
Other	11	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	75
Turning off lights when not in a room	157
Turning off furnace when not home	42
Turning off air conditioning when not home	74
Changed thermostat settings to use less energy	151
Using fans instead of air conditioning	109
Turning off electronics when we are not using them	126
Taking shorter showers	80
Turning water heat thermostat down	40
Other (please specify in the box below)	29
Don't know	7

Q46a. Other…

Response Option	Count
Closing blinds during the day	1
Cut down on use of electronics as well as cut down on how much light we use per room	1
Do not let the water run when cooking	1
Doing laundry less frequently. Using solar lighting for exterior.	1
For the heater, put 1 down, instead of at 68, put at 67.	1
Girls will use natural lights instead of overhead electrical lights	1
I don't know of any, we are pretty efficient anyway.	1
I was already very conscious on saving energy to save money	1
I'm trying to get my trailer under bin to help save energy, especially during the winter to save on heating costs.	1
Installing energy-efficient equipment	1
More aware of electricity usage, bought more LED's	1
No running a half-full washer	1
Opening the blinds to use sunlight.	1

Response Option	Count
Purchasing and installing new energy efficient appliances including an a/c	1
Replacing all light bulbs for LEDs	1
Switched to energy-efficient lightbulbs	1
Trying to be more energy conscience and installed energy efficient windows	1
Turn off water when brushing teeth or cooking	1
Turning off the water when not using it.	1
Turning off water while brushing teeth	1
Turning water on for less time	1
Using electron appliances at night.	1
Using energy-efficient lighting	1
Using open windows instead of air conditioner. Using energy-efficient equipment	1
Using the toilet water gauges to consume less water	1
Watch how much water we use	1
Water conservation	1
We were already doing these things	1

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

Response Option	Count	Percent (n=183)
Turning off lights when not in a room	121	66%
Turning off furnace when not home	25	14%
Turning off air conditioning when not home	33	18%
Changing thermostat settings so heating or cooling system uses less energy	75	41%
Using fans instead of air conditioning	60	33%
Turning off electronics when not using them	72	39%
Taking shorter showers	27	15%
Turning water heat thermostat down	13	7%
Other	11	6%

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=252)
0 – Not at all influential	5	2%

1	1	0%
2	0	0%
3	1	0%
4	3	1%
5	14	6%
6	22	9%
7	41	16%
8	49	19%
9	18	7%
10 - Extremely influential	97	38%
Don't know	1	0%

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=334)
Yes	195	58%
No	65	19%
Don't know	74	22%

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

Response Option	Count
Energy efficient appliances	76
Efficient heating or cooling equipment	54
Efficient windows	54
Adding insulation	54
Sealing air leaks	92
Sealing or insulating ducts	47
Efficient lighting (LEDs)	134
Energy efficient water heater	60
Internet connected “smart” thermostat	63
Other	18
Don't know	6

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=334)

Yes	92	28%
No	226	68%
Don't know	16	5%

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

Response Option	Count
Bought energy efficient appliances	26
Moved into an ENERGY STAR home	2
Bought efficient heating or cooling equipment	7
Bought efficient windows	4
Added insulation	10
Sealed air leaks	18
Sealed ducts	8
Bought LEDs	59
Bought CFLs	8
Installed an energy efficient water heater	12
None – no other actions taken	0
Other (please specify in the box below)	8
Don't know	0

Q49a. Other…

Response Option	Count
Added window tinting	1
I purchased more foam that goes behind the light switches.	1
Installed a storm door	1
one energy efficient a/c	1
programmable thermostat	1
Smart thermostat	1
Water leakage tape	1
Water Program.	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	0
Moved into an ENERGY STAR home	0
Bought efficient heating or cooling equipment	1

Response Option	Count
Bought efficient windows	0
Bought additional insulation	0
Sealed air leaks	1
Sealed ducts	0
Bought LEDs	4
Bought CFLs	1
Installed an energy efficient water heater	0
Other	0
I did not get any Duke Rebates	79
Don't know	7

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	Don’t Know	Total
Buy energy efficient appliances	8%	0%	0%	4%	8%	12%	0%	15%	15%	8%	31%	0%	26
Move into an ENERGY STAR home	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	2
Buy efficient heating or cooling equipment	29%	0%	0%	0%	0%	0%	0%	29%	0%	0%	29%	14%	7
Buy efficient windows	25%	0%	25%	0%	0%	25%	0%	0%	0%	0%	25%	0%	4
Add insulation	40%	10%	0%	10%	0%	10%	0%	0%	0%	10%	20%	0%	10
Seal air leaks	0%	6%	6%	0%	6%	22%	17%	6%	0%	6%	33%	0%	18
Seal ducts	0%	0%	13%	0%	0%	50%	0%	0%	0%	0%	38%	0%	8
Buy LEDs	10%	2%	0%	3%	0%	12%	14%	10%	10%	7%	29%	2%	59
Buy CFLs	0%	0%	0%	0%	0%	25%	25%	25%	0%	0%	25%	0%	8
Install an energy efficient water heater	8%	0%	8%	0%	0%	8%	8%	0%	0%	0%	50%	17%	12

Other	50%	13%	0%	0%	0%	0%	0%	13%	0%	0%	25%	0%	8

Q52. What kinds of appliance(s) did you buy?

Response Option	Count
Refrigerator	7
Stand-alone Freezer	5
Dishwasher	10
Clothes washer	12
Clothes dryer	9
Oven	8
Microwave	7
Other	1
Don't know	1

Q53. Was the [INSERT Q52 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=16)
Refrigerator	5	31%
Stand-alone Freezer	3	19%
Dishwasher	8	50%
Clothes washer	10	63%
Clothes dryer	8	50%
Oven	6	38%
Microwave	3	19%
Other	0	0%

Q54. Does the new clothes dryer use natural gas?

Response Option	Count
Yes- it uses natural gas	1
No – does not use natural gas	8
Don't know	0

Q55. What type of heating or cooling equipment did you buy?

Response Option	Count	Percent (n=5)
Central air conditioner	2	40%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	2	40%
Geothermal heat pump	0	0%
Boiler	0	0%

Response Option	Count	Percent (n=5)
Furnace	1	20%
Wifi-enabled thermostat	1	20%
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
Yes	1

Q57. Was the [INSERT Q55 RESPONSE] an ENERGY STAR or high-efficiency model?

Response Option	Count	Percent (n=4)
Central air conditioner	2	50%
Window/room air conditioner unit	0	0%
Wall air conditioner unit	0	0%
Air source heat pump	2	50%
Geothermal heat pump	0	0%
Boiler	0	0%
Furnace	1	25%
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
3	1
6	1
8	1

Q59. Did you add insulation to your attic, walls, or below the floor? [MULTIPLE RESPONSE]

Response Option	Count
Attic	3
Walls	2

Response Option	Count
Below the floor	3
Don’t know	0

Q60a. Approximately what proportion of the attic space did you add insulation?

Response Option	Count
Not applicable	0

Q60b. Approximately what proportion of the wall space did you add insulation?

Response Option	Count
Not applicable	0

Q60c. Approximately what proportion of the below the floor space did you add insulation?

Response Option	Count
Not applicable	0

Q61. Do you know how many of LEDs you installed at your property?

Response Option	Count
Yes	48
Don't know	5

Q61a. How many of LEDs did you install in your property?

Response Option	Count
2	2
3	1
4	1
5	6
6	2
7	1
8	5
9	1
10	3
12	4
15	4
17	2
18	1
20	7

Response Option	Count
25	2
30	1
36	1
38	1
40	2
50	1
Don't know	0

Q62. How many of CFLs did you install in your property?

Response Option	Count
Yes	6
Don't know	2

Q62. Number of CFLS installed…

Response Option	Count
4	2
5	1
8	1
15	1
36	1

Q63. Does the new water heater use natural gas?

Response Option	Count
Yes - it uses natural gas	4
No – does not use natural gas	7
Don't know	0

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	10
A tankless water heater that provides hot water on demand	0
A solar water heater	0
Other	0
Don't' know	0

Q65. Is the new water heater an ENERGY STAR model?

Response Option	Count
Yes	10
No	0
Don't know	1

Q66. Which of the following types of housing units would you say best describes your home? It is . . .?

Response Option	Count	Percent (n=334)
Single-family detached house	245	73%
Single-family attached home (such as a townhouse or condo)	11	3%
Duplex, triplex or four-plex	6	2%
Apartment or condominium in a building with 5 units or more	36	11%
Manufactured or mobile home	35	10%
Other	0	0%
Don't know	1	0%

Q66. Other…

Response Option	Count
Not applicable	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=334)
Less than 500 square feet	8	2%
500 to under 1,000 square feet	37	11%
1,000 to under 1,500 square feet	82	25%
1,500 to under 2,000 square feet	66	20%
2,000 to under 2,500 square feet	49	15%
2,500 to under 3,000 square feet	22	7%
Greater than 3,000 square feet	36	11%
Don't know	34	10%

Q68. Do you or members of your household own your home, or do you rent it?

Response Option	Count	Percent (n=333)

Own / buying	211	63%
Rent / lease	117	35%
Occupy rent-free	5	2%
Don't know	0	0%

Q69. Including yourself, how many people currently live in your home year-round?

Response Option	Count	Percent (n=334)
I live by myself	9	3%
Two people	39	12%
Three people	66	20%
Four people	117	35%
Five people	68	20%
Six people	25	7%
Seven people	7	2%
Eight or more people	2	1%
Don't know	1	0%

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

Response Option	Count	Percent (n=334)
Under $20,000	41	12%
$20,000 to under $30,000	39	12%
$30,000 to under $40,000	35	10%
$40,000 to under $50,000	31	9%
$50,000 to under $60,000	24	7%
$60,000 to under $75,000	21	6%
$75,000 to under $100,000	41	12%
$100,000 to under $150,000	28	8%
$150,000 to under $200,000	10	3%
$200,000 or more	7	2%
Don't know	7	2%
Prefer not to say	50	15%

Q71. What is the highest level of education achieved among those living in your household?

Response Option	Count	Percent (n=334)
Less than high school	7	2%
Some high school	6	2%

Response Option	Count	Percent (n=334)
High school graduate or equivalent (such as GED)	59	18%
Trade or technical school	18	5%
Some college (including Associate degree)	89	27%
College degree (Bachelor's degree)	67	20%
Some graduate school	5	1%
Graduate degree, professional degree	57	17%
Doctorate	11	3%
Don't know	0	0%
Prefer not to say	15	5%