

# Residential Direct Load Control Program Evaluation, Measurement, and Verification Report 2016

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Prepared for the FirstEnergy Ohio Companies:

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The Cleveland Electric Illuminating Company  
The Toledo Edison Company*

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# 1. Executive Summary

For 2016, the Ohio Operating Companies, The Cleveland Electric Illuminating Company (CE), Ohio Edison Company (OE), and The Toledo Edison Company (TE) (collectively “Companies”) offered the Residential Direct Load Control (DLC) program, also known as Easy Cool Rewards. Under contract with the Companies, ADM Associates, Inc. (ADM) performed evaluation, measurement and verification (EM&V) services to confirm the savings (kWh) and demand reduction (kW) realized through the energy efficiency programs that the Companies implemented in Ohio in 2016. This report presents and discusses results from an evaluation of the Companies’ 2016 DLC program.

This evaluation focuses on determining the achieved peak demand reduction and energy savings attributed to the DLC program in 2016. The evaluation included one-way UtilityPro Programmable Control Thermostats (PCTs). These thermostats restrict central air conditioner (CAC) runtime to a specified percentage of the runtime that would have occurred in the absence of the Load Control Event.

Program participation levels, Ex Ante, and Ex Post values are listed in the following table. Demand and energy savings calculations are detailed in Chapter 4. Demand savings represents average hourly kW reduction during Load Control Events, while energy savings represents the average hourly kWh over the duration (hours) of all Load Control Events.

*Table 1-1: Program Savings Summary*

Utility	Participating Residential Households with DLC Device <sup>1</sup>	Ex Ante Expected Savings		Ex Post Savings		kWh Realization Rate	kW Realization Rate
		kWh	kW	kWh	kW		
CE	6,844	36,771	4,596	27,162	4,595	74%	100%
OE	12,125	64,028	8,004	48,682	8,003	76%	100%
TE	1,627	8,515	1,064	6,564	1,064	77%	100%
Total Program	20,596	109,313	13,664	82,408	13,663	75%	100%

<sup>1</sup> Average of participation counts recorded for each event based on FE OH DLC tracking data

Ex Ante savings for energy savings and demand reductions were based on the average kW factors for each company for the previous year (i.e., for energy, the product of last year's kW results times the hours of the events). It is important to note that some of the events in 2015 and 2016 were run as program test events and not during particularly hot, late afternoon periods, as had been the case in prior years. Ex Ante energy savings are based on actual events. The difference in ex Ante and ex Post energy savings is due to different weather conditions. Ex Post demand reductions are based on results consistent with PJM deemed savings protocols for DLC programs<sup>2</sup> and substantially consistent with prior year results.

DLC program savings are assumed to have a measure life of one year.

Key findings from the process evaluation of the 2016 Direct Load Control program include:

**The established methods of communication between the Companies' staff and Honeywell staff continue to work well.** The Companies' and Honeywell both noted that there are no outstanding communication issues with respect to implementing the 2016 Easy Cool Rewards program. The communication processes remained consistent to prior years; Honeywell receives email communication from the Companies to confirm that the Companies want to call an air conditioner cycling event, and Honeywell responds with documentation that the event has been called. The two parties continue to maintain a standing biweekly call with program staff to address any issues that arise. While these check-ins are not always necessary, they do happen regularly and more often during cycling months.

**Direct mail and email campaigns proved to be effective in recruiting additional participants.** In 2016, there was an effort to increase program participation. This was successful through direct mail and email campaigns and enrollment increased by approximately 2,500 participants. The implementation contractor, Honeywell, reported that they achieved their installation goals in 2016 and this success allowed, marketing efforts to be put on hold in September and focus on customer service for existing participants.

**Program participants continue to express high levels of satisfaction with the Companies' Easy Cool Rewards program.** Participant satisfaction ratings with the overall program experience were high, with a mean score of 4.5 across all three companies (using a scale of 1 to 5, with 1 being "very dissatisfied" and 5 being "very satisfied").

**Customers' have the most difficulty understanding when and how they are notified when a cycling event occurs and how to reduce electricity use during cycling events.** Among all program aspects, survey respondents reported the lowest levels of

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<sup>2</sup> <http://www.pjm.com/~media/markets-ops/dsr/deemed-savings-report.ashx>

understanding for 1) how they are notified, 2) when notifications occur and 3) what else customers can do to reduce electricity use during an event.

**The thermostat is an effective incentive and encourages program participation.**

Forty percent of respondents also indicated the thermostat was the reason they participated in the program and both the Companies' and Honeywell program staff reported they receive positive feedback about the thermostat and that it is generally an upgrade from the thermostat currently in the customer's home.

## 2. Introduction and Purpose of the Study

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Under contract with the Companies, ADM performed evaluation, measurement and verification (EM&V) services to confirm the energy and demand savings realized by the energy efficiency programs implemented by the Companies in 2016.

The impact evaluation component of this report estimates annual gross energy savings and peak demand reduction through the following activities.

- Perform analysis of event data collected in 2016.
- Determine the program level kW and kWh Savings
- Determine the system wide kW savings at the EDC level

The goal of the process evaluation component was to determine how effective the program is in terms of customer satisfaction, customer awareness, and stakeholder interaction. The process evaluation included the following activities.

- Conduct Implementation Staff Interviews
- Perform Program Manager Interviews
- Conduct Participant and Drop- Out Surveys
- Perform Cross-sectional analysis between participants and non-participants.
- Identify potential behavioral differences between populations.
- Provide recommendations aimed at increasing program retention.

### 3. Description of Program

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The Companies have designed the DLC Program to reduce peak demand for electricity during the summer months. Customers who opt into the program will have a radio-controlled thermostat installed that will allow the Companies to reduce CAC compressor operation by a variable load control percentage (e.g., 50% cycling) during load control “events”. The load control events occurred in the summer of 2016 and were initiated to reduce electric energy consumption during peak hours. This program is strictly for residential customers, targeted at customers with CAC units who are willing to accept reduced cooling capacities during event hours.

Honeywell is contracted with the Companies to provide DLC program services. Load Control Events are enabled through special programmable thermostats that can receive radio frequency signals and cycle CAC unit compressor operation during load control events.

Thermostats are equipped with an adaptive algorithm that will reduce the runtime of the CAC compressor by 50% (or alternate percentage) of what it would have been otherwise, based on the normal operation of the unit. During a 70% cycling event for example, if a particular unit would have normally run 40 minutes during a given hour, the program will limit that unit to only 12 minutes of run time in that hour. Given that an event may last multiple hours, that same control limit will be applied to each hour of the event.

During the 2016 Cooling Season the Companies ran the following whole-system events, all at 50% cycling:

- (1) June 27th, 2 – 4 PM
- (2) July 12th, 2 – 4 PM
- (3) July 21st, 3 – 5 PM
- (4) July 22nd, 3 – 5 PM

From these event days, ADM calculated the average kW factor by EDC and number of enrolled participants. The device count is based on data provided to ADM from the Companies.

## 4. Evaluation Methodology

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This chapter discusses the EM&V approach for designing the sampling plan, calculating the kW impact per unit, program level kWh savings and program kW impacts.

### 4.1 Impact Evaluation Methodology

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The impact evaluation addressed the following items:

- Determine the kW peak demand reduction consistent with PJM protocols.
- Determine the kW reduction per event hour, for all program participants to support energy savings.

Demand reductions for each event hour and associated weighted temperature humidity index (WTHI) were based upon the predicted savings values listed in the “Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region” report dated April 3, 2007.

### 4.2 Data Collection and Conversion Procedures

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ADM received the following information on each program participant:

- Full Name
- Address
- Install Date
- Account Number
- System Size (Tons)
- System Age

The following table provides a comparison of participation tonnage values and unit age for the program.



Table 4-1 Participation and Average Tonnage Summary

Company	Program Pop. Size	Average Tonnage (Program Pop.)	Average Age (Program Pop.)
<b>CEI</b>	7,182	2.8	13.7
<b>OE</b>	12,506	2.7	13.0
<b>TE</b>	1,663	2.5	13.5
<b>Total</b>	<b>21,349</b>	<b>2.6</b>	<b>13.4</b>

### 4.3 Weather Data

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ADM compiled historical weather data from the National Oceanic and Atmospheric Administration for each EDC from May 15<sup>th</sup> – Sept 30<sup>th</sup> for the following cities:

- Akron (OE)
- Cleveland (CEI)
- Toledo (TE)

PJM design conditions of 80.7 WTHI were used for peak demand reductions.

### 4.4 kW Factors by EDC

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Using the PJM deemed savings protocols for DLC programs ADM calculated hourly kW (demand) factors for the following event days:

- (1) June 27th, 2 – 4 PM
- (2) July 12th, 2 – 4 PM
- (3) July 21st, 3 – 5 PM
- (4) July 22nd, 3 - 5 PM

### 4.5 Energy Savings

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Annual energy (kWh) savings for the 2016 DLC Program can be calculated as a function of kW reductions, Total Devices, and the number and length of curtailment events. Energy savings for an individual event is calculated as:

$$kWh\ Savings = \sum_j^M \sum_i^N kW_{i,j} \times Total\ Devices_{i,j}$$

Where:

$i$  = the event hour

$j$  = the Company

$kW_{i,j}$  = the kW factor for Company  $i$  during hour  $j$ .

And  $M, N$  denote the total number of device populations (i.e. three, one for each EDC) and DLC event hours, respectively. The quantity  $kW_{i,j}$  is calculated for every event hour and every Company based on the time of day and the weighted temperature humidity index and the associated lookup values in the Appendix F in the PJM Deemed Savings Estimates document.

#### 4.6 Process Evaluation Methodology

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The process evaluation for the DLC program assessed the following program components to determine initial and post program implementation effectiveness:

- Program awareness;
- Participating customer characteristics;
- Customer participation experience;
- Customer satisfaction.

## 5. Detailed Impact Evaluation Findings

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This chapter presents the findings of the impact evaluation of the 2016 DLC Program, including kW factors and kWh Savings.

Verified peak demand reductions are calculated based on PJM protocols. PJM guidelines specify design weather conditions (WTHI) of 80.7 degrees, and provide tables of approved kW per device. Resulting kW per device are 0.64 for the EDCs.

For kWh Savings, kW factors were calculated across all EDCs as detailed in Chapter 4. The kW factors are reported by event in the following tables. The averages are weighted by the number of participants in each EDC.

*Table 5-1 Average Event kW Factors by Hour*

<i>Date</i>	<i>Time</i>	<i>Average Event Hour Temp.</i>	<i>Average WTHI</i>	<i>Event Hour kW Factor</i>
6/27/16	2-3 PM	89.0	77.74	0.36
	3-4 PM	90.4	78.06	0.44
7/12/16	2-3 PM	90.0	78.72	0.42
	3-4 PM	90.0	78.96	0.50
7/21/16	3-4 PM	90.7	79.39	0.52
	4-5 PM	89.0	78.68	0.41
7/22/16	3-4 PM	91.0	81.54	0.65
	4-5 PM	91.3	81.53	0.57

### 5.1 kW Factors by EDC

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The kW factors were calculated independently by EDC as detailed in Chapter 4. Each set of kW factors are reported separately in the following three tables.

Table 5-2 OE Event kW Factors

Date	Time	Event Hour Temp.	WTHI	Event Hour kW Factor
6/27/16	2-3 PM	88.0	77.36	0.34
	3-4 PM	89.1	77.79	0.42
7/12/16	2-3 PM	91.0	79.10	0.44
	3-4 PM	91.0	79.40	0.52
7/21/16	3-4 PM	91.0	78.97	0.50
	4-5 PM	91.0	79.00	0.43
7/22/16	3-4 PM	91.0	81.36	0.64
	4-5 PM	93.0	82.04	0.60

Table 5-3 CEI Event kW Factors

Date	Time	Event Hour Temp.	WTHI	Event Hour kW Factor
6/27/16	2-3 PM	91.0	77.84	0.37
	3-4 PM	91.0	77.64	0.41
7/12/16	2-3 PM	91.0	78.36	0.40
	3-4 PM	90.0	78.23	0.45
7/21/16	3-4 PM	93.0	79.30	0.52
	4-5 PM	91.0	78.20	0.39
7/22/16	3-4 PM	93.0	82.24	0.69
	4-5 PM	91.0	81.28	0.56

Table 5-4 TE Event kW Factors

Date	Time	Event Hour Temp.	WTHI	Event Hour kW Factor
6/27/16	2-3 PM	88.0	78.02	0.38
	3-4 PM	91.0	78.76	0.48
7/12/16	2-3 PM	88.0	78.70	0.42
	3-4 PM	89.1	79.25	0.52
7/21/16	3-4 PM	88.0	79.90	0.55
	4-5 PM	84.9	78.85	0.42
7/22/16	3-4 PM	89.1	81.02	0.62
	4-5 PM	90.0	81.26	0.56

In order to capture the impact of the DLC program during event hours, the kW factors for each EDC were aggregated and scaled up by the total number of active DLC devices in

the field (average participation count of 21,349) measured in the summer of 2016. These results are captured in *Table 5-5*.

*Table 5-5 Hourly Load Impact All Companies in MW*

<i>Date</i>	<i>Time</i>	<i>Average Event Hour Temp.</i>	<i>Average WTHI</i>	<i>Event Hour MW Factor</i>
6/27/16	2-3 PM	89.0	77.74	7.78
	3-4 PM	90.4	78.06	9.31
7/12/16	2-3 PM	90.0	78.72	8.89
	3-4 PM	90.0	78.96	10.57
7/21/16	3-4 PM	90.7	79.39	11.17
	4-5 PM	89.0	78.68	8.84
7/22/16	3-4 PM	91.0	81.54	13.93
	4-5 PM	91.3	81.53	12.21

## 5.2 kWh Savings by EDC

kWh Savings are calculated as the sum of the kW factors for each EDC and event and hours multiplied by quantity of devices in the field. Total program savings for 2016 are 82.4 MWh. Results per event are listed in *Table 5-6* below.

*Table 5-6 kWh Savings by Event Hour*

<i>Date</i>	<i>Time</i>	<i>kWh CE</i>	<i>kWh OE</i>	<i>kWh TE</i>	<i>kWh All</i>
6/27/16	2-3 PM	2,656	4,248	632	7,536
	3-4 PM	2,928	5,187	802	8,917
7/12/16	2-3 PM	2,857	5,456	691	9,003
	3-4 PM	3,203	6,558	857	10,618
7/21/16	3-4 PM	3,722	6,244	922	10,887
	4-5 PM	2,804	5,391	703	8,898
7/22/16	3-4 PM	4,990	8,042	1,034	14,065
	4-5 PM	4,002	7,557	925	12,483
<b>Totals</b>		<b>27,162</b>	<b>48,682</b>	<b>6,564</b>	<b>82,408</b>

## 6. Detailed Process Evaluation Findings

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This chapter provides the findings of the process evaluation component of this report. The process evaluation was informed by participant telephone survey data and in-depth interviews with program staff at Honeywell and the Companies.

### 6.1 Program management, Implementation and Oversight

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In-depth interviews with program and implementation staff and survey results addressed the following researchable issues:

- Program administration and the working relationship between the Companies and implementation staff.
- Participation levels and barriers.
- Customer experience and motivation.
- Potential changes that could improve the program.

### 6.2 Key Findings

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**The established methods of communication between the Companies' staff and Honeywell staff continue to work well.** The Companies and Honeywell both noted that there are no outstanding communication issues with respect to implementing the 2016 Easy Cool Rewards program. The communication processes remained consistent to prior years; Honeywell receives email communication from the Companies to confirm that the Companies want to call an air conditioner cycling event, and Honeywell responds with documentation that the event has been called. The two parties continue to maintain a standing biweekly call with program staff to address any issues that arise. While these check-ins are not always necessary, they do happen regularly and more often during cycling months.

**Direct mail and email campaigns proved to be effective in recruiting additional participants.** In 2016 there was an effort to increase program participation. This was successful through direct mail and email campaigns and enrollment increased by about 2,500. The implementation contractor, Honeywell, reported that they achieved all their goals in 2016 for number of installations. Due to their success, marketing efforts were put on hold in September 2016 and the focus shifted to customer service for existing participants.

**Program participants continue to express high levels of satisfaction with the Companies' Easy Cool Rewards program.** Participant satisfaction ratings with the overall program experience was high across operating companies, with a mean score of 4.5 across all three territories (using a scale of 1 to 5, with 1 being "very dissatisfied" and 5 being "very satisfied").

**Customers’ have the most difficulty understanding when and how they are notified when a cycling event occurs and how to reduce electricity use during cycling events.** Among all program aspects, survey respondents reported the lowest levels of understanding for three items related to cycling events – how they are notified and when they are notified when an event is occurring and what customers can do to reduce electricity use during an event.

**The thermostat is an effective incentive and encourages program participation.** Forty percent of respondents indicated the thermostat was the reason they participated in the program and both the Companies’ and Honeywell program staff reported they receive positive feedback about the thermostat and that it is generally an upgrade from the thermostat currently in the customer’s home.

### 6.3 Methodology

Tetra Tech, working in conjunction with ADM, conducted in-depth interviews with staff from the Companies. The objective of these interviews was to gather feedback from both program and implementation staff, determine how the program is operating, and to collect suggestions for future program improvements.

In addition, VuPoint Research conducted a telephone survey of program participants. Tetra Tech received a file consisting of survey results from ADM from a telephone survey conducted between December 1 and 18. The file contained 280 valid surveys distributed across FirstEnergy’s Ohio electric utility operating companies, as detailed in Table 6-1.

*Table 6-1: Distribution of Survey Completes*

<i>Operating Company</i>	<i>n</i>	<i>Percentage</i>
CE	93	33%
OE	160	57%
TE	27	10%
<b>Total</b>	<b>280</b>	<b>100%</b>

### 6.4 Detailed Findings

#### **Program Administration**

The evaluation team conducted interviews with the Companies’ and Honeywell program staff in November and December 2016. These interviews focused on investigating program administration processes during the 2016 program year. Both the Companies’ and Honeywell staff described the communications and processes as functioning smoothly. There is a clear process in place for coordinating events and a clear chain of communication between the two companies.

The Easy Cool Rewards Program reached its expanded participation target in 2016 and did not have significant numbers of customers drop out. The Companies report the

dropout rate continues to be negligible compared to the total number of participants. Furthermore, it was noted that some customers forget they are participating in the program, which is a testament to how smoothly program operations are functioning.

The program continues to account for customers who move into a residence where the previous owner was a participant and had a thermostat installed. When it is recognized that a customer has moved into a house previously occupied by a program participant, the Companies update the system to reflect the new customer information, assuming the new customer will participate in the program. The Companies send a letter to the new customer, with program materials and a picture of the thermostat, so they are aware of the program. The new customers are also told they can call the Companies to cancel participation if they wish to. Customers who move into a home with a program thermostat are assumed to be participating unless they indicate to the Companies they wish to be removed. It has also been noted that very few customers opt out during this process.

The interview with Honeywell implementation staff indicated they rely on reports from customers to indicate when thermostats are not operating properly during cycling events. The current thermostats provided to participants do not support two-way communications. As a result, Honeywell uses the “Active Thermostat Report,” a list of the thermostats that have been installed and activated and those that have been removed, to determine the number of operating thermostats during any cycling event. If a participant’s thermostat is not operating properly, it is not known to program implementation staff unless the customer notifies them.

### **Marketing and Outreach Efforts**

Direct mail and email blasts were used in targeted geographies to increase participation in 2016, and they were very successful. Participation goals were met and active marketing and outreach efforts were put on hold in September.

For 2016 participants, over half of all survey respondents first learned about Easy Cool Rewards through a utility bill insert or direct mailing from their utility. Conversely, very few individuals learned about the program through media such as newspaper, radio advertising, and door hangers. Table 6-2 provides details on how respondents indicated they *first* heard about the program.



Table 6-2. How Participants First Heard of Program

<i>Response</i>	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
Utility bill insert	35%	34%	23%	33%
Utility direct mailing	38%	23%	18%	27%
Telephone call from EDC telemarketer	9%	17%	14%	14%
Word of mouth: Friend/ Relative/ Neighbor/ Co-worker	11%	8%	18%	10%
Other	3%	10%	14%	8%
Utility website	3%	3%	14%	4%
Newspaper advertisement*	0%	4%	0%	2%
Easy Cool Rewards email	0%	2%	0%	1%
Door hanger	0%	1%	0%	0%
Other event: Home and Garden show/ Earth day	0%	0%	0%	0%
<b>Total (n)</b>	<b>65</b>	<b>119</b>	<b>22</b>	<b>206</b>

\* Response added after data collection

When asked how they prefer to receive information about the program, responses were in-line with how they originally heard about the program with 62 percent saying they prefer to receive information through a direct mailing from the utility. Table 6-3 provides details about how respondents would like to hear about the program in the future.

Table 6-3. How Participants Prefer to Receive Information about Program

<i>Response</i>	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
Utility direct mailing such as a letter or postcard	66%	58%	74%	62%
Email from EDC	33%	39%	26%	36%
Telephone call from EDC	7%	8%	7%	8%
Other	6%	5%	0%	4%
Program website	0%	0%	0%	0%
<b>Total (n)</b>	<b>90</b>	<b>155</b>	<b>27</b>	<b>272</b>

## Participant Motivation

The Companies' customers identified receiving a new thermostat as the key motivation for participating in Easy Cool Rewards. Additionally, saving energy played a large role in

encouraging participation among customers. Table 6-4 below summarizes respondents' motivations for participating in the program.

*Table 6-4. Reasons for Participation in the Easy Cool Rewards Program*

<i>Reason</i>	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
To get a new thermostat	42%	37%	46%	40%
Concerned about saving energy in my home	29%	35%	38%	33%
The opportunity to participate in an energy savings program	13%	13%	27%	14%
To save money/reduce costs*	12%	16%	8%	14%
Other	5%	7%	4%	6%
It seemed like a good idea*	4%	5%	0%	4%
Help EDC avoid power shortages	5%	3%	0%	3%
Concerned about protecting the environment	0%	3%	4%	2%
The program was recommended to me by EDC	1%	0%	0%	0%
Reduce need for building new power plants	1%	0%	0%	0%
Not home when the AC is cycled	0%	0%	0%	0%
<b>Total (n)</b>	<b>84</b>	<b>147</b>	<b>26</b>	<b>257</b>

\* Response added after data collection

Across all three operating companies, only 12 percent of program participants expressed having concerns about participating in Easy Cool Rewards. Of the 34 respondents who had concerns, the major worry dealt with concerns about the utility being able to shut off their air conditioner (14 respondents). Some respondents were also concerned about being uncomfortable during load reduction events (5 respondents) and the load control device damaging their air conditioning equipment (4 respondents).

## **Program Enrollment**

There are only a couple constraints to participating in the program - customers need to have a central air conditioner along with a working thermostat. When asked to assess the information they received during the enrollment process, respondents indicated that information received on how to sign up to participate and how to schedule an appointment to install the thermostat were relatively easy to understand. Understanding information on when and how their operating company would notify them of a load reduction event was the aspect of the program deemed the most difficult to understand. Participants' scores for their understanding of how to reduce electricity during a cycling event were also lower

than other program aspects. Table 6-5 provides a summary of participants' rating of the ease or difficulty for each aspect of enrollment.

*Table 6-5. Mean Ratings for Ease or Difficulty of Program Aspects*

Selection	CE		OE		TE		Total	
	Avg.*	Std. Dev.	Avg.*	Std. Dev.	Avg.*	Std. Dev.	Avg.*	Std. Dev.
Schedule an appointment to have the Easy Cool Rewards device installed	9.2	1.7	9.1	1.5	9.2	0.9	9.1	1.5
Sign up to participate in the program	8.9	1.9	9.2	1.5	9.3	1.2	9.1	1.6
Interact with the EDC staff during enrollment	8.9	1.8	8.8	1.6	8.7	1.8	8.8	1.7
Understand the program requirements	8.8	1.6	8.6	1.8	8.5	2.1	8.7	1.7
Understand what you can do to reduce your electricity use when load reduction events are occurring	8.0	2.4	7.8	2.3	7.8	2.6	7.9	2.4
Understand when you will be notified of an load reduction event	7.2	3.2	7.3	2.8	6.8	3.1	7.2	2.9
Understand how you will be notified of a load reduction event	7.0	3.3	7.0	2.9	7.0	3.0	7.0	3.0

\*Using scale of 1 to 10, with 1 being "very difficult" and 10 being "very easy"

Participating in Easy Cool Rewards improved customers' satisfaction with their operating company for over half of respondents (54 percent) while 44 percent indicated no change in satisfaction. As a program satisfaction indicator, only 3 percent of respondents said their satisfaction with their operating company has decreased since enrolling in Easy Cool Rewards, as shown in Table 6-6.

*Table 6-6. Impact of Experience with Easy Cool Rewards on Satisfaction with Operating Company*

<i>Response</i>	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
Greatly improved satisfaction	17%	20%	11%	18%
Somewhat improved satisfaction	33%	35%	48%	36%
Made no difference in satisfaction	47%	43%	33%	44%
Somewhat decreased satisfaction	2%	2%	4%	2%
Greatly decreased satisfaction	0%	0%	4%	0%
<b>Total (n)</b>	<b>93</b>	<b>160</b>	<b>27</b>	<b>280</b>

Of the seven customers whose satisfaction decreased, the main reason for the decrease was having an issue with the performance of the thermostat (5 respondents). Other reasons include a lack of communication and the utility's control over the thermostat (1 respondent each).

### **Load Reduction Events Experience**

When a load reduction event is called, customers only receive notification of the event on their thermostat. The thermostat lights up and indicates "savings" on the screen. There are no other notifications, so it is likely that many participating customers do not know when an event is occurring. In 2016, four cycling events were conducted. Among the 2016 participant survey respondents, almost three-fourths (71 percent) could not recall the number of events called during summer, while 11 percent of participants believed no load reduction events occurred, as detailed in Table 6-7.

*Table 6-7. Number of Load Reduction Events Recalled by Participants for Summer 2016*

<i>Number of Events</i>	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
Don't know	70%	73%	58%	71%
0	14%	9%	12%	11%
1	0%	4%	4%	3%
2	2%	4%	4%	4%
3	4%	3%	15%	4%
4	0%	1%	0%	0%
5	4%	3%	4%	3%
6	2%	1%	0%	1%
8	2%	1%	0%	1%
10	0%	1%	4%	1%
15	1%	1%	0%	1%
30	0%	1%	0%	0%
<b>Total (n)</b>	<b>84</b>	<b>145</b>	<b>26</b>	<b>255</b>

Overall, a majority of program participants indicated their household maintained high levels of comfort during reduction events. Using a scale of 1 to 10, with 1 being “very uncomfortable” and 10 being “very comfortable,” almost three-fourths (73 percent) of participants who recalled experiencing at least one load reduction event rated their comfort level at eight or higher.

The Easy Cool Rewards program allows participants the option to override one event per cycling season. Based on the survey data and conversations with program staff, this does not happen very often. Only seven percent of respondents (17 respondents) indicated that they overrode an event in 2016. Almost all respondents who overrode an event gave the reason that it was too hot and they became uncomfortable. Customers who did override an event expressed high levels of satisfaction with the process to do so. Over three-fourths (82 percent) rated the ease of overriding an event as an eight or higher (using a scale of 1 to 10, with 1 being “very difficult” and 10 being “very easy”).

### **Program Satisfaction**

Program participants continue to express high levels of satisfaction with all aspects of the Easy Cool Rewards program. On a scale of 1 to 5, with 1 being “very dissatisfied” and 5 being “very satisfied,” respondents rated all aspects of program across all operating companies at 4.5 or greater, as shown in the table below.

Table 6-8. Mean Satisfaction with Specific Aspects of Easy Cool Rewards Program

Program Aspect	CE		OE		TE		Total	
	Avg.*	Std. Dev.	Avg.*	Std. Dev.	Avg.*	Std. Dev.	Avg.*	Std. Dev.
The receipt and installation of a new thermostat as compensation for your participation in the program	4.8	0.6	4.7	0.8	4.3	1.4	4.7	0.8
The service professional who installed the Easy Cool Rewards device	4.7	0.9	4.5	1.0	4.7	0.8	4.6	1.0
The availability of the program being offered	4.6	0.8	4.5	0.8	4.5	0.9	4.5	0.8
Your overall experience with the program	4.5	0.8	4.5	0.8	4.5	0.9	4.5	0.8
Your overall experience during load reduction events	4.5	0.9	4.5	0.8	4.3	0.9	4.5	0.9
The enrollment process	4.5	0.9	4.4	0.9	4.4	1.0	4.5	0.9

\* Using a scale of 1 to 5, with 1 being "very dissatisfied" and 5 being "very satisfied"

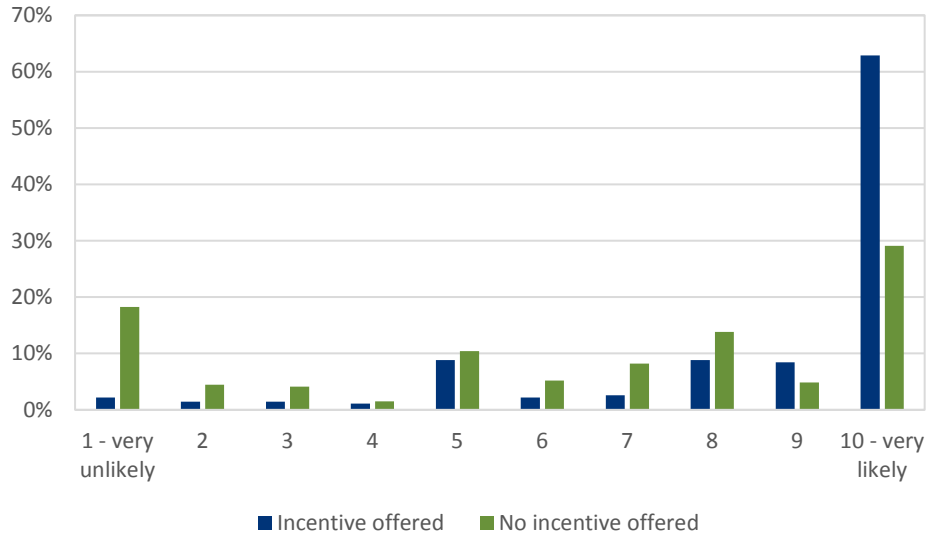
Another metric for estimating customer satisfaction is gauging the likelihood that participants will continue to participate in the program in subsequent years. Respondents were asked to rate the likelihood of participating in the program in future years if an incentive was offered, as well as the likelihood of participating if an incentive was not offered. Table 6-9 and Figure 1 provide survey results indicating that, overall, participants are satisfied with the program and will likely continue to participate in future years.

Table 6-9. Mean Likelihood\* of Participating in Easy Cool Rewards in Future Years

	CE	OE	TE	Total
Incentive offered	8.5	8.8	8.3	8.6
No incentive offered	6.2	6.5	5.4	6.3

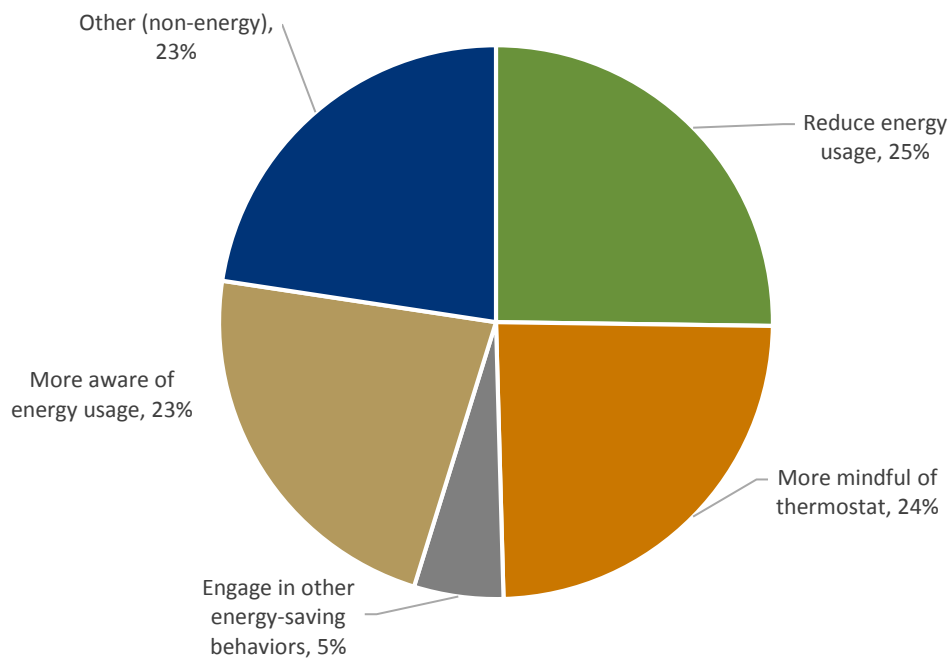
\*Using a scale of 1 to 10, with 1 being "very unlikely" and 10 being "very likely"

Figure 6-1: Overall Likelihood of Participating in Easy Cool Rewards in Future Years



Respondents were asked what effect the program has had on how they will use energy in the future. Over half of respondents (56 percent) said it had no effect. However, 29 respondents said they plan to reduce their energy usage in the future because of the program and 28 said the program has made them more aware of their energy use. Also mentioned was that the program has made them more mindful of how their thermostat is used and that it made them want to adopt other energy-saving behaviors. Figure 2 below shows the distribution of these responses for those who indicated that the program has had an effect.

Figure 6-2. Effect of Program on Future Energy Use



## Participant Demographics and Household Characteristics

Almost all Easy Cool Rewards respondents reported that they owned their home (98 percent) and living in a single-family home (87 percent). Table 6-10 below shows the distribution of home type by operating company.

*Table 6-10. Description of Home Type*

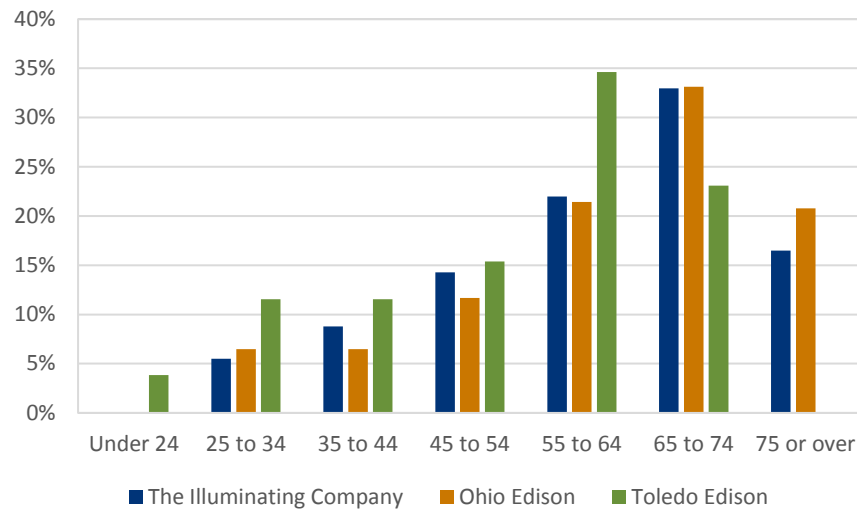
	<i>CE</i>	<i>OE</i>	<i>TE</i>	<i>Total</i>
Single-family home, detached construction	90%	85%	93%	87%
Condominium-traditional structure	3%	6%	4%	5%
Single family home, factory manufactured/modular	3%	5%	4%	4%
Other	1%	3%	0%	2%
Single family, mobile home	0%	2%	0%	1%
Apartment (4 + families)---traditional structure	1%	0%	0%	0%
Two or three family attached residence—traditional structure	1%	0%	0%	0%
Row house	0%	0%	0%	0%
<b>Total (n)</b>	<b>93</b>	<b>155</b>	<b>27</b>	<b>275</b>

The homes of respondents were older with almost half (44 percent) being built before 1970 and 41 percent of respondents reported having lived in their home for more than 20 years.

Respondents also tended to be older with 85 percent being over the age of 45. Figure 3 below shows the age distribution of Easy Cool Rewards respondents by operating company.



Figure 6-3. Age Ranges of Easy Cool Rewards Respondents by Operating Company



## 6.5 Conclusion

The Companies continue to effectively deliver the Easy Cool Rewards program to participating consumers. Residential customers expressed high levels of satisfaction with the overall program and a large percentage of survey respondents indicated they plan to participate in the program in the future. Increased participation goals were met in. Implementation and Company staff continue to maintain effective lines of communication and report excellent working relationships.

## 7. Recommendations

Overall, the program appears to be continuing to function without major issues. Interviewees reported that channels of communication between the Companies and Honeywell remained open and that meetings and telephone calls were productive throughout the program year. However, we provide several recommendations for consideration.

### **Provide customers with a “refresher” on how to know when an event is occurring.**

Similar to prior years, customers’ understanding of how they will receive notification that an event is occurring is the single aspect of the program that participants found most difficult to understand. This could also be an opportunity to remind participants of additional actions they can take to reduce electricity use during an event.

**Monitor program satisfaction if the number of events increases.** In the past five years, few events have been called, averaging four. While the number of events does not seem to have a direct effect on satisfaction with the program, should weather change so more events are called, participant satisfaction will need to be assessed.

## 8. Appendix A: Required Savings Table

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DLC program savings have a measure life of one year.

*Table 7-1. Required Savings Table*

<i>Utility</i>	<i>Annual Ex Post Savings</i>		<i>Measure Life</i>	<i>Lifetime Ex Post Savings</i>	
	<i>kWh</i>	<i>kW</i>		<i>kWh</i>	<i>kW</i>
OE	27,162	4,595	1	27,162	4,595
CEI	48,682	8,004	1	48,682	8,004
TE	6,564	1,064	1	6,564	1,064
Total Program	82,408	13,663		82,408	13,663

## 9. Appendix B: Survey Instrument

### Ohio Edison, Cleveland Electric Illuminating, and Toledo Edison Companies' Residential Direct Load Control Survey

Q1. Hello, my name is [INTERVIEWER NAME], and I am calling on behalf of [EDC]. May I speak with [RESPONDENT NAME]?

1. Yes [CONTINUE]
2. No [SCHEDULE CALLBACK AND/ OR ATTEMPT TO CONVERT]

Q2. I'm with ADM, an independent research firm. We have been hired to assist [EDC] with review of their energy savings services by speaking with households that have signed up to participate in the Easy Cool Rewards (Thermostat) program. You will receive a \$10.00 gift card for completing this survey. I'm not selling anything; I'd just like to ask you some questions about your decision to sign up for the Easy Cool Rewards (Thermostat) program offered by [EDC]. I'd like to assure you that your responses will be kept confidential and your name will not be revealed to anyone other than the evaluation team members. For quality and training purposes this call will be recorded.

The Easy Cool Rewards (Thermostat) program helps [EDC] to save energy during peak demand periods. As a part of this program, your central air conditioning system is remotely controlled by [EDC] by increasing the temperature setting to reduce energy usage when [EDC] predicts that electricity demand will be high. Do you recall enrolling for this program?

1. Yes [SKIP TO Q5]
2. No

Q3. Is there someone else in the household who may be familiar with the program?

1. Yes [ASK TO SPEAK TO THEM AND RECYCLE TO Q1]
2. No [THANK AND TERMINATE]

[DISPLAY Q4 IF Q3 = 1]

Q4. May I speak to that person?

1. Yes [RECYCLE TO Q2]
2. No [THANK AND TERMINATE]

Q5. Are you an employee of [EDC] or FirstEnergy?

1. Yes [THANK AND TERMINATE]
2. No
98. Don't Know
99. Refused

1. How did you FIRST learn about Easy Cool Rewards (Thermostat) program offered by [EDC]? (Do not read list; Record response)
  1. Utility bill insert
  2. Utility direct mailing
  3. Telephone call from [EDC] telemarketer
  4. Utility website
  5. Door hanger
  6. Word of mouth: Friend/ Relative/ Neighbor/ Co-worker
  7. Other event: Home and Garden show/ Earth day
  8. Easy Cool Rewards email
  97. Other (Specify)
  98. Don't know
  99. Refused
  
2. How would you prefer to receive information from [EDC] about programs like this in the future? (Do not read; select all that apply)
  1. Utility direct mailing such as a letter or postcard
  2. Telephone call from [EDC]
  3. Program website
  4. Email from [EDC]
  97. Other (Specify)
  98. Don't know
  99. Refused
  
3. For what reason or reasons did you decide to participate in the Easy Cool Rewards (Thermostat) program? (Do not read; Select all that apply)
  1. Concerned about saving energy in my home
  2. The opportunity to participate in an energy savings program
  3. Concerned about protecting the environment
  4. The program was recommended to me by [EDC]
  5. Reduce need for building new power plants
  6. Help [EDC] avoid power shortages (or brownouts or buying power at high prices)
  7. To get a new thermostat
  8. Not home when the AC is cycled
  97. Other (Specify)
  98. Don't know
  99. Refused
  
- [DISPLAY Q5 IF > 1 SELECTED FOR Q4]
4. Of all the things that interested you about the program (Read list), what was the most compelling reason you decided to enroll in the program?
  1. Record verbatim response:
  98. Don't know
  99. Refused

5. Did you have concerns about participating in the Easy Cool Rewards (Thermostat) program?
1. Yes
  2. No
  98. Don't know
  99. Refused

[DISPLAY Q6 IF Q5 = 1]

6. What concerns did you have? (Do not read; Select all that apply)
1. Concerned about being uncomfortable during energy reduction events
  2. Concerned about the load control device damaging my air conditioning equipment
  3. Concerned about the utility being able to shut off my AC
  97. Other (Specify)
  98. Don't know
  99. Refused

[DISPLAY Q7-Q13 FOR DROPOUTS ONLY]

7. On a scale of 1 to 10, where 1 is very difficult and 10 is very easy, how easy or difficult did you find it to...(Read list; Record 1-10; 6 = Not applicable, 98 = Don't know, 99 = Refused)
- a. Understand the program requirements
  - b. Sign up to participate in the program
  - c. Schedule an appointment to have the Easy Cool Rewards device installed
  - d. Interact with the program staff
  - e. Understand how to operate the new thermostat

[DISPLAY Q8 IF Q7a-Q7e = 1, 2, 3, or 4]

8. What could the program have done differently to make it easier for you to [INSERT A-E WORDING]?
1. Record verbatim response:
  98. Don't know
  99. Refused

9. I understand that your household decided to participate and dropped out of the program. Can you tell me why that is? (Do not read; Prompt if needed)
1. The temperature increase was/ would be uncomfortable
  2. Didn't want [EDC] to control my energy use
  3. Didn't understand how the program worked
  4. Did not understand the energy reduction events
  5. Didn't understand what the program was trying to accomplish
  6. Afraid it might damage my central air conditioner
  7. Didn't like the time periods when the energy reduction events would happen
  8. Didn't like the number of days a year when energy reduction events would occur
  9. Health reasons
  10. Problems with Easy Cool Rewards device installation (Specify)
  11. Did not receive enough notification
  97. Other (Specify)
  98. Don't know
  99. Refused
10. What could the program have done differently to encourage you to remain in the program? (Do not read; Prompt if needed)
1. Nothing they could have done
  2. Better explained the program
  3. Offer an incentive/payment for participating (Specify Amount)
  4. Shorter event days
  5. Reduced the amount by which the temperature was increased
  6. Provide more advance notice
  7. Provide more information on the energy saving effect of the program
  97. Other (Specify)
  98. Don't know
  99. Refused

[DISPLAY Q11 IF Q9> 1 RESPONSE]

11. Of all the reasons you mentioned for deciding not to participate in the program, which reason was the most important?
1. Record verbatim response:
  98. Don't know
  99. Refused

12. Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with [EDC] as your utility.

Did it...(Read list)

1. Greatly improve your satisfaction
2. Somewhat improve your satisfaction
3. Make no difference in your satisfaction
4. Somewhat decrease your satisfaction
5. Greatly decrease your satisfaction

13. Will you please tell me why you responded [RESPONSE FROM Q12]?

1. Record verbatim response
98. Don't know
99. Refused

[DISPLAY Q14-Q22 FOR ENROLLED PARTICIPANTS ONLY]

14. Next, I would like to ask you some questions about your enrollment in the program. Thinking about the information you have received about participating in the program, on a scale of 1 to 10, where 1 is very difficult and 10 is very easy, how difficult or easy did you find it to...(Read list; Record 1-10; 6 = Not applicable, 98 = Don't know, 99 = Refused)

- a. Understand the program requirements
- b. Sign up to participate in the program
- c. Schedule an appointment to have the Easy Cool Rewards device installed
- d. Understand when and how you will be notified of an energy reduction event
- e. Understand what you can do to reduce your electricity use when energy reduction events are occurring
- f. Interact with the [EDC] staff during enrollment

[DISPLAY Q15 IF Q14a-14f = 1, 2, 3, or 4]

15. What could the program have done differently to make it easier for you to [INSERT A-F WORDING]?

1. Record verbatim response:
98. Don't know
99. Refused

16. Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about enrollment?

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

[DISPLAY Q17 IF Q16 = 1]

17. Were your questions sufficiently answered?

1. Yes
2. No (Record verbatim response: What was not answered?)
98. Don't know
99. Refused

[DISPLAY Q18 IF Q16 = 2, 98, or 99]

18. Were you aware that there is a toll free number you can call with questions about the program?

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

19. Did you have any initial questions about the participating in the program?

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

[DISPLAY Q20 IF Q19 = 1]

20. What questions or concerns did you have? (Do not read; Prompt if needed)

1. Didn't know how to reduce my energy consumption during energy reduction events
2. Didn't understand how the program worked
3. Didn't like the potential time periods when the energy reduction events would happen
4. Problems with installation of Easy Cool Rewards device (Specify)
97. Other (Specify)
98. Don't know
99. Refused

21. Can you tell me in your own words your understanding of what occurs during an energy reduction event? (Record verbatim response)



22. What information did you find helpful? (Do not read; Select all that apply)
1. Information about savings periods/events
  2. Information about rebate
  3. Information about how to save and/or reduce energy usage during savings periods
  4. Information about how savings period/event notifications will be sent
  5. Information about what to do when notification is received
  6. Information about penalties
  7. Information about how savings are calculated
  8. Information about how savings will be communicated
  9. Information about what number to call if there are questions
  10. Information about how to opt out of events
  97. Other (Specify)
  98. Don't know
  99. Refused

Next I would like to ask you some questions about your experience during the energy reduction events that occurred during the summer.

23. How many reduction events do you think [EDC] issued this past summer?
1. Number of days
  2. Never
  98. Don't know
  99. Refused

24. Were you at home during any of the energy reduction events?
1. Yes
  2. No
  98. Don't know
  99. Refused

[DISPLAY Q25 IF Q24 = 1]

25. How could you tell that [EDC] AC was cycling during an event? (Select all that apply)
1. The house got uncomfortably warm
  2. I didn't hear the air conditioner run as often
  3. I looked at the thermostat and saw that the temperature had been increased
  4. I called the program customer service line to see if they had adjusted the temperature
  5. I received a notification via my thermostat
  97. Other (Specify)
  98. Don't know
  99. Refused

26. Thinking about the events that occurred when you were home, on a scale of 1 to 10, where 1 is very uncomfortable and 10 is very comfortable, how uncomfortable or comfortable was it for you?

1. Record 1-10:
98. Don't know
99. Refused

27. Were you aware that energy reduction events had occurred when you were not at home?

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

[DISPLAY Q28 IF Q27 = 1]

28. How did you know that energy reduction events had occurred when you were not home during the event? (Select all that apply)

1. The house was uncomfortably warm when I returned home
2. The air conditioning ran more than usual
3. I called the program customer service line to see if they had adjusted the temperature
4. I received a notification via my thermostat
97. Other (Specify)
98. Don't know
99. Refused

29. Have you called the Easy Cool Rewards (Thermostat) toll free number with any questions about energy reduction events?

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

[DISPLAY Q30 IF Q29 = 1]

30. Were your questions sufficiently answered?

1. Yes
2. No (Record verbatim response: What was not answered?)
98. Don't know
99. Refused

[DISPLAY Q31 IF Q28 = 3]

31. You mentioned in a previous question that you had called the program customer service line to ask if an energy reduction event had occurred. Were your questions answered?
1. Yes
  2. No
  98. Don't know
  99. Refused
32. On a scale of 1-5 where, Very dissatisfied = 1, Somewhat dissatisfied = 2, Neither satisfied nor dissatisfied = 3, Somewhat satisfied = 4, Very satisfied = 5, Don't know = 98, and Refused = 99, how unsatisfied or satisfied are you with...
- a. The enrollment process?
  - b. The program provided?
  - c. The service professional who installed the Easy Cool Rewards device?
  - d. The receipt and installation of a new thermostat as compensation for your participation in the program?
  - e. Your overall experience during energy reduction events?
  - f. Your overall experience with the program?

[DISPLAY Q33 IF Q32a-Q32f = 1, 2, 3, or 4]

33. What can the program do differently to make you more satisfied with [INSERT A-F WORDING]? (Record verbatim response)

34. On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely are you to participate in an Easy Cool Rewards (Thermostat) program in the future?
1. Record 1-10:
  98. Don't know
  99. Refused

[DISPLAY Q35 IF Q34 = 1, 2, 3, or 4]

35. What can the program do differently to make you more likely to participate in the future?
1. Record verbatim response:
  98. Don't know
  99. Refused

36. On a scale of 1 to 10, where 1 is not at all likely and 10 is very likely, how likely are you to participate in an Easy Cool Rewards (Thermostat) program in the future if [EDC] did not offer an incentive (i.e. a free thermostat) to participate?
1. Record 1-10:

98. Don't know

99. Refused

37. What effect, if any, has the program had on how you will use energy in the future?

1. Record verbatim response:

98. Don't know

99. Refused

38. Now I would like to understand how your experience with Easy Cool Rewards (Thermostat) program has affected your satisfaction with [EDC] as your utility.

Did it... (Read list)

1. Greatly improve your satisfaction with [EDC]

2. Somewhat improve your satisfaction with [EDC]

3. Make no difference in your satisfaction with [EDC]

4. Somewhat decrease your satisfaction with [EDC]

5. Greatly decrease your satisfaction with [EDC]

39. Will you please tell me why you responded [RESPONSE FROM Q38]

1. Record verbatim response:

98. Don't know

99. Refused

I would now like to ask you some questions about how you would like to receive information about your electricity use and updates about the program from [EDC].

40. Do you have internet access?

1. Yes

2. No

98. Don't know

99. Refused

[DISPLAY Q41 IF Q40 = 1]

41. Have you ever visited [EDC] or FirstEnergy's website?

1. Yes

2. No

98. Don't know

99. Refused

[DISPLAY Q42 IF Q41 = 1]

42. Have you ever used the [EDC] or FirstEnergy Home Energy Analyzer to assess your home energy usage?

1. Yes

2. No

98. Don't know

99. Refused

43. Other than the FirstEnergy website or the Home Energy Analyzer, are there other methods that [EDC] should consider using to provide feedback information about your performance during energy reduction events? (Do not read; Select all that apply)

1. Text message
2. Email
3. Cell phone call
4. Home phone call
5. Mail
6. In home display
97. Other (Specify)
98. Don't know
99. Refused

44. Have you been to the [EDC] website to review the energy savings tips they provide online?

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

[DISPLAY Q45 IF Q44 = 1]

45. Please rate the usefulness of the energy efficiency tips provided on the website using a scale of 1 to 10, where 1 is "not at all useful" and 10 is "very useful".

1. Record 1-10:
98. Don't know
99. Refused

46. What types of additional information would you like on the website?

Next, I want to better understand the types of energy using equipment you have in your home.

47. How many plasma TV's do you have?

1. Record response:
98. Don't know
99. Refused

48. How many LCD/LED TV's do you have?

1. Record response:
98. Don't know
99. Refused

49. How many conventional (tube-based) TV's do you have?

1. Record response:

98. Don't know

99. Refused

50. How many projection TV's do you have?

1. Record response:

98. Don't know

99. Refused

51. How many other TV's do you have?

1. Record response:

98. Don't know

99. Refused

52. What type of stove do you have?

1. Natural Gas

2. Electric

3. Propane

97. Other (Specify)

98. Don't know

99. Refused

53. What type of water heater do you have?

1. Natural Gas

2. Electric

3. Propane

97. Other (Specify)

98. Don't know

99. Refused

54. What type of clothes dryer do you have?

1. Natural Gas

2. Electric

3. Propane

97. Other (Specify)

98. Don't know

99. Refused

55. Which of the following best describes your home/residence?

1. Single-family home, detached construction (Not a duplex, townhome, or apartment; attached garage is ok)

2. Single family home, factory manufactured/modular

3. Single family, mobile home

4. Row House

5. Two or Three family attached residence—traditional structure
6. Apartment (4 + families)---traditional structure
7. Condominium---traditional structure
97. Other (Specify)
98. Don't know
99. Refused

56. Do you own or rent this residence?

1. Own
2. Rent
98. Don't know
99. Refused

57. Approximately when was your home constructed? (Do not read list)

1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006 or later
98. Don't know
99. Refused

58. How many square feet is the above-ground living space (If necessary, this excludes walk-out basements)?

1. Numerical open end (Range 0-99,999)\_\_\_\_\_
98. Don't know
99. Refused

[DISPLAY Q59 IF Q58 = 98 or 99]

59. Would you estimate the above-ground living space is about:

1. Less than 1,000 sqft
2. 1,001-2,000 sqft
3. 2,001-3,000 sqft
4. 3,001-4,000 sqft
5. 4,001-5,000 sqft
6. Greater than 5,000 sqft
98. Don't know
99. Refused

60. How many square feet of conditioned living space is below- ground (If necessary, this excludes walk-out basements)?

1. Numerical open end (Range 0-99,999)\_\_\_\_\_
98. Don't know
99. Refused

[DISPLAY Q61 IF Q60 = 98 or 99]

61. Would you estimate the below-ground living space is about:?

1. Less than 1,000 sqft
2. 1,001-2,000 sqft
3. 2,001-3,000 sqft

4. 3,001-4,000 sqft
5. 4,001-5,000 sqft
6. Greater than 5,000 sqft
98. Don't know
99. Refused

62. What kind of air conditioning does your home have? (Select all that apply)

1. Central Air Conditioning
2. Heat Pump
3. Window A/C (Number)
4. None
98. Don't know
99. Refused

63. How many window A/C units does your home have?

1. Record response:
98. Don't know
99. Refused

Finally, I would like to ask you a few questions to better understand your household.

64. How many years have you lived at your current address? (Do not read list)

1. 1 year or less
2. 2 to 5 years
3. 6 to 9 years
4. 10 to 20 years
5. More than 20 years
98. Don't know
99. Refused

65. I'm going to read several age groups. Please stop me when I come to the group in which your age belongs. (Read list)

1. Under 24
2. 25 to 34
3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 to 74
7. 75 or over
98. Don't know
99. Refused

66. How many people were living in your home during the summer of 2016?

1. Number of people:
98. Don't know
99. Refused



[DISPLAY Q67IF Q66 > 0]

67. On average, how many of these people were home during week during the hours of [Savings period] during the summer?

1. Number of people:

98. Don't know

99. Refused

END: Thank you, those are all the questions I have for you today.

## 10. Appendix C: Temperature Humidity Index

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For the cooling season (June, July, August, and September), Temperature-Humidity Index (THI) is used as the weather variable:

$$\text{If } DB \geq 58, \text{ THI} = DB - 0.55 * (1 - \text{HUM}) * (DB - 58)$$

$$\text{If } DB < 58, \text{ THI} = DB$$

Where: THI = Temperature humidity index;

DB = Dry bulb temperature (°F),

HUM = Relative Humidity (where 100% = 1).

For shoulder months (March, April, May, October and November), the average daily dry bulb temperature serves as the weather variable.

The weighted temperature-humidity index (WTHI) is constructed by incorporating “lag terms” in the THI. The WTHI as calculated as:

$$\text{WTHI} = 1/14 \times (10 \times \text{THI}_n + 3 \times \text{THI}_{(n-24)} + \text{THI}_{(n-48)})$$

Where:  $\text{THI}_n$  = Temperature humidity index for hour  $n$ .

$\text{THI}_{(n-24)}$  = THI for hour  $n-24$  (same hour from the previous day)

$\text{THI}_{(n-48)}$  = THI for hour  $n-48$  (same hour from the previous previous day)